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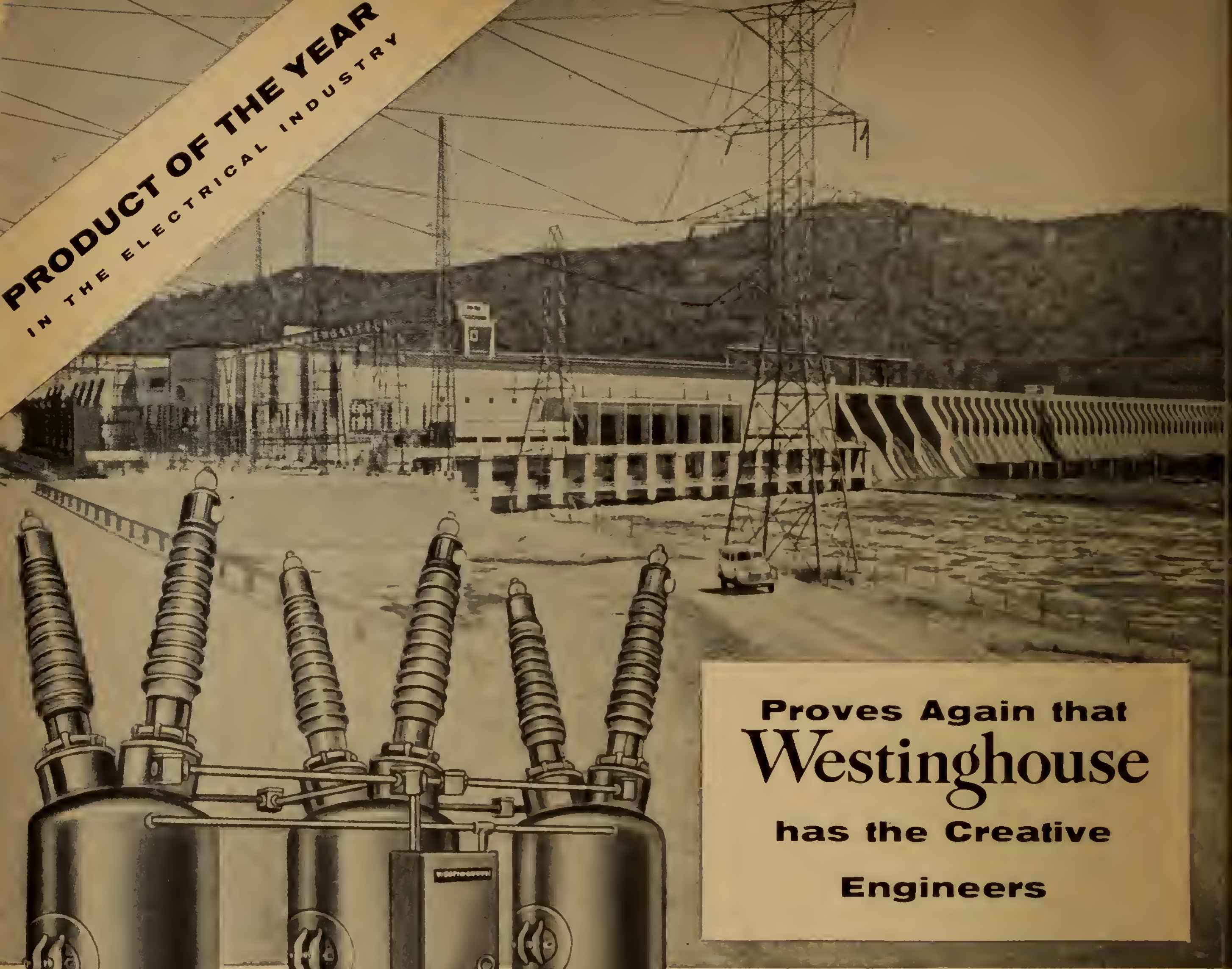

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Harvey McKeough

Carl Smith

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The Selection of

Boilers and their Auxiliaries

for Heating and Industrial Use

A. M. Bain, M.E.I.C.
Dominion Bridge Company Limited,
Montreal, Que.

This paper describes the principal considerations governing the choice of boilers and their auxiliaries. It is directed at the layman rather than the expert and may be of assistance to a prospective purchaser in his selection of the complex equipment of his boiler plant. The paper has been recommended by the Canadian Boiler Society (of which the author's company is a member) as being an unbiased treatment of the subject.

It has been found necessary in the preparation of this paper to limit its scope in order to keep it to a manageable length. For this reason, boilers in the following categories are touched on briefly, if at all.

(1) *Electric Power Plant Boilers.*—Because of their usually large capacity, high pressure, etc., they could be the subject of a separate paper, even as general as this one.

(2) *Waste Heat Boilers.*—Utilizing hot waste gases from many different industrial processes, as well as from internal combustion engines.

(3) *Oil Refinery Boilers.*—Burning excess combustible products from the refining process.

(4) *Boilers* burning other waste products, such as bark, wood shavings, sawdust, sugar cane (bagasse).

(5) *Recovery Boilers.*—Utilized widely in the wood pulp industry, to reclaim process chemicals by burning waste from liquors and, at the same time, generating large quantities of steam.

(6) *Incinerator Boilers.* — A highly specialized type burning garbage and other refuse.

(7) *Forced Circulation Boilers.* —Formerly used principally where space was at a premium and for waste-heat applications, but now extending also into the electric power plant field.

(8) *Electric Boilers.* — Used where surplus electric power exists, or where other fuels are not economically available.

We are left, therefore, with the subject of industrial boilers and heating boilers of the more or less standard varieties, fired by liquid, gaseous or solid fuels.

Definitions

Before discussing the factors affecting the selection of boilers and their auxiliaries, it seems advisable to establish the definitions of a few of the terms commonly used in the boiler trade.

Boiler.—To most people, a boiler is a device in or under which one lights a fire using some kind of fuel to produce steam under pressure in some kind of container. This definition is over-simplified, since many boilers used for heating purposes do not deliver steam but produce hot water for direct distribution to radiators. On the other hand, the waste-heat boiler has no fire in or under it. It is one of the inconsistencies of our language that a steam-producing boiler, in which boiling takes place, is now generally called a steam generator, while the hot water boiler, where boiling is not supposed to occur, is still called a boiler.

Working Pressure. — The pressure at which the boiler delivers steam or water to a header or line; measured in Canada in lb. per sq. inch gauge (p.s.i.g.).

Design Pressure.—The pressure for which the boiler is designed. This is usually a few pounds above the working pressure so that safety valves can also be set above it. Some users provide a substantial margin of design over working pressure to provide for the "rating down" which may some day be necessary due to wear or old age.

Heating Surface.—The surface area (usually expressed in square feet) of the hot gas side of tubes, headers, etc., exposed to the hot gases. An inconsistency arises here which causes considerable confusion in the minds of those unfamiliar with trade practice. In the fire-tube boiler field, manufacturers for many years have been selling boilers whose catalogue description is based on the surface area of tubes on the water side—that is, the outside. This means that one set of areas is used in catalogues, etc., while another set, about 5 per cent smaller, is used by the designer for heat-transfer calculations and the determination of safety valve sizes to meet the safety codes. Everyone agrees that this practice is confusing, but it is so firmly established that to change it uniformly throughout the trade is next to impossible.

Horse Power.—The term horse power, when applied to the sale and purchase of boilers, has two current meanings. The first and true meaning is the usual mechanical energy equivalent of the heat output of the boiler. This is known as the developed horse power. The second is a throw-back from the customs of the trade and is defined as 10 sq. ft. of heating surface equalling one nominal horse power. The first, depending on the boiler type and its firing equipment, may be anywhere from 125 to 300 per cent of the latter, or higher in special cases. This percentage is called the "boiler rating". The terms horse power and boiler rating are now becoming obsolete in connection with water-tube boilers, and the sooner we get rid of them from our fire-tube boiler terminology, the better. It should be emphasized here that the capacity of a boiler should not be judged by its heating surface, unless the disposition of that heating surface is also considered. Surfaces exposed to gas or flame radiation will absorb a great deal more heat than those gaining their heat by gas convection only. Also, gas velocity and gas direction relative to the tubes play a large part in the efficiency of heat pick-up.

Furnace Heat Release. — The amount of heat released by the burning of a fuel in a furnace, measured in B.t.u. per cubic foot per hour. This is a meaningless term by itself, but it does give the designer a rough and ready means of checking his furnace volume provided he has sufficient data on similarly-shaped furnaces burning the same fuel at hand.

Grate Heat Release.—This is defined as the amount of heat released by the burning of a fuel on a grate, measured in B.t.u. per square foot of effective grate area per hour. Here again the figure is of use to the designer, provided he has sufficient similar data and experience to fall back on.

Efficiency.—Efficiency may be defined as the ratio (per cent) of the heat which has been added to the steam or water in the boiler, divided by the heat content of the fuel burned. The difference between these two quantities is, of course, the various losses which inevitably occur. By far the largest of these is the heat which goes up the stack.

Watertube v. Firetube Selection

There are two main classes of boiler: fire tube and water tube; the difference between them is simple. In a fire tube boiler, the hot gases travel inside the tubes and the water is on the outside. In a water tube boiler, the gases are outside the tubes with the water on the inside. Figures 1 to 4 indicate the three most common types of f.t. boiler and one type of w.t. boiler.

Boilers are again divided into the two sub-classes: low-pressure heating boilers, and power boilers. These subclasses are dictated by the low pressure and power boiler safety codes, which require different design considerations and manufacturing procedures for each. Of these codes, the A.S.M.E. boiler codes are the governing ones on the North American continent. They are supplemented and clarified for use in Canada by the C.S.A. boiler and pressure vessels code. These codes are administered in the various provinces by the boiler and pressure vessels inspection branches of the appropriate provincial departments and under the boilers and pressure vessels Act of each province. The low pressure boiler code covers steam boilers up to 15 p.s.i.g. working pressure, and hot water boilers up to 160 p.s.i.g. working pressure, or 240° F. water temperature. The power boiler code covers boilers operating at higher pressure or temperature.

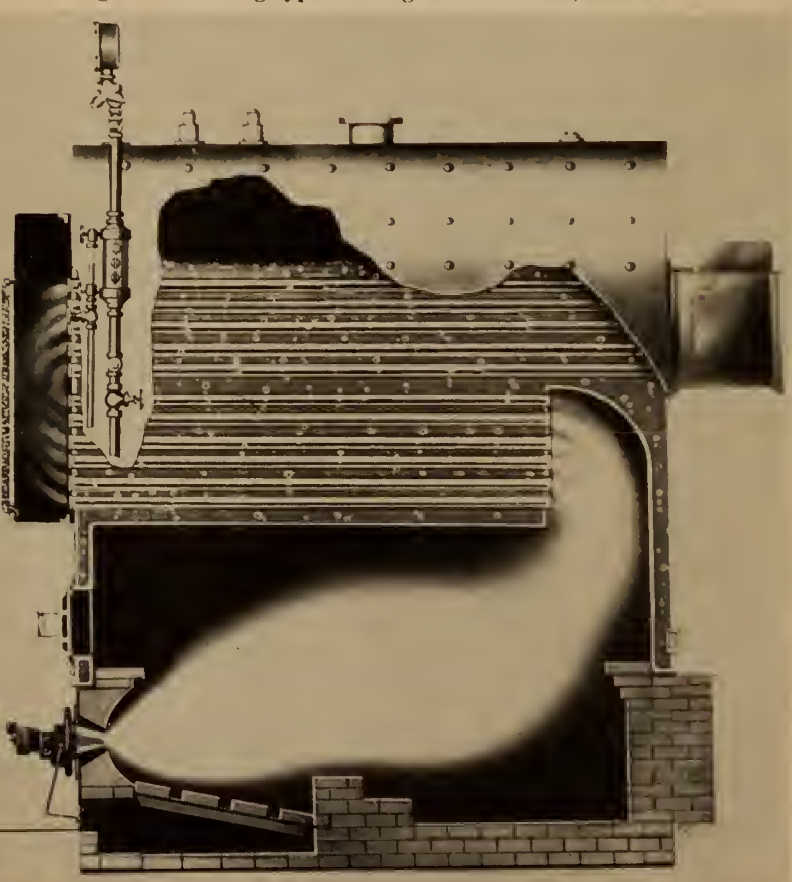
There are two principal considerations which govern the choice of fire tube versus water tube boilers: The most important of these is capacity, and the second, design pressure.

A fire tube boiler will become unmanageably large for capacities exceeding 12,000 to 15,000 pounds of steam per hour (p.p.h.), while a water tube boiler will become non-competitive in price if the capacity per unit is much under 10,000 p.p.h.

For the second consideration, design pressure, it has been found that for pressures exceeding about 250 p.s.i., the fire tube boiler shells and heads become too thick for good heat transfer, and the staying of flat surfaces becomes difficult and expensive. On the other hand, the water tube boiler, because of its higher first cost, becomes uneconomical in the low-pressure heating field.

It can be seen, then, that once the operating pressure is settled, there is only a narrow band of capacities between about 8,000 p.p.h. of steam and 15,000 p.p.h.,

Fig. 1. Waterleg type heating on brick base, oil fired.



where the choice between fire tube and water tube boilers is not clear-cut.

Within this band there are several secondary factors which singly or together will govern the final choice.

Of these factors, the size and shape of the unit is probably the most important since floor space and ceiling height are often restricted. In Fig. 5 and 6, the comparative sizes of the principal classes and types of boiler are illustrated and drawn to scale. Each one shown has a capacity of 10,000 p.p.h.

Fuel is another secondary factor affecting choice of class and type. For any one fuel or combination of fuels, furnace design requirements must be considered, and this will affect the boiler choice.

A third factor is that of demand. If the demand on the boiler is going to be continuous, or if a brief weekly shut-down for cleaning would be embarrassing, the water tube boiler should be chosen. It can, with proper operation, remain on the line for months at a time without shut-down.

The fourth factor, and the last one to be discussed here, is the problem of water treatment. The w.t. boiler, with its high steaming rate and small water content, is sensitive to scale-forming. It consequently requires more accurate and meticulous feedwater treatment than the f.t. boiler. This in turn demands a higher degree of skill in the operator than does the f.t. boiler with its larger water content and slower steaming rate.

Fire Tube Boiler Selection

(A) Suppose that our analysis of one job has led to the selection of a fire tube boiler of the low pressure heating type. In this field, the waterleg and the scotch type boilers predominate. The question of dimensions comes first and can soon be disposed of. It can be said that the waterleg type is always much higher, somewhat shorter, and about the same width as the scotch type. The first cost will be about the same. The scotch boiler, because of its furnace arrangement, is not normally used to burn coal, although this has been done successfully. The waterleg type can burn either oil, gas or coal, and can be readily converted from one to the other. It is, however, more difficult to keep clean in the water spaces, and when set on a brick base for oil firing, may require more brick maintenance. With these factors in mind, the choice between these two types should be easy.

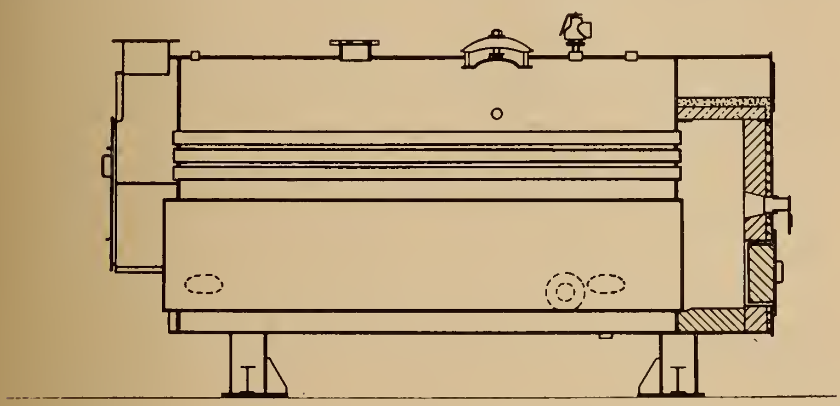


Fig. 2. Scotch dryback boiler, heating or power, oil fired.

Both types are suitable for either steam or water heating systems. The hot water boiler is much simpler to install and operate than the steam boiler. It is, however, at a disadvantage where the distribution system to the radiators is complicated, where the radiators must be kept small, and where steam in any quantity is needed for cooking or other reasons. It should be borne in mind when making a choice between steam and hot water boilers that one can always get hot water from a steam boiler through a heat exchanger but, with a water boiler, the temperature of the water is so limited that steam production from it is not practical. As a word of warning here, domestic hot water should not be taken from a closed hot water heating system on account of the make-up water endangering the boiler through scale formation or oxygen corrosion.

High-temperature high-pressure hot water for heating is being used more extensively now than heretofore and has much to recommend it for large central heating plants. The principle is simple in that there is a steam space maintained either in the boiler or in a collector drum. The water in the boiler is therefore kept at the steam saturation temperature corresponding to the pressure used (usually about 125 p.s.i.). Circulation through heat exchangers supplying hot water or steam to the radiators is effected by means of circulating pumps. The advantages over low-pressure hot water are that the main distribution lines are smaller and that high-pressure steam can be made available for laundries and the like, either through heat exchangers or directly from the collector drum. The principal disadvantage is its first cost since the boiler must be made to the power boiler code, heat exchangers supplied, and the pipelines made to withstand the higher pressures involved. The class of operator is required by law to be higher and adds to the operating cost.

(B) Suppose, alternatively, that the analysis of the job had indicated the need for a fire tube steam boiler operating at a pressure in excess of 15 p.s.i.g. This automatically puts it in the higher-priced power boiler field. Two typical cases would be that of a small institution requiring 100 to 125 p.s.i.g. for its laundry dryer rolls, and that of a food processing plant where the higher temperature of high-pressure steam speeds up the cooking process greatly. In both cases, the building heating requirements can be taken care of by low-pressure hot water or steam procured through heat exchangers or reducing valves respectively.

Although some types of waterleg boiler can be designed to meet the safety requirements of the power boiler code, the difficulty of doing adequate inspection and cleaning has decreased their popularity in this field. This leaves the scotch boiler competing with the H.R.T. type. The latter, because of its furnace arrangement, will usually be used if coal is to be burned. If oil or gas is to be the fuel, the scotch boiler has the advantage of compactness, lower brickwork maintenance, and lower first cost. It has therefore almost completely displaced the once-popular H.R.T. for this application.

Water Tube Boiler Selection

We will now proceed to the analysis of a job where one or more water tube boilers are to be used. So far, there has been no mention made of the important effect of load conditions on the size and number of boiler units and their desired efficiency. These factors will now be discussed in connection with a water tube boiler installation of the power type. Most of these remarks, however, apply with equal force to a fire tube boiler installation, but have been included here to avoid repetition.

As indicated in Figures 7 to 11, there are two principal "standard" types of w.t. boilers in common use today: the cross-drum type and the longitudinal drum type. Space and shape considerations will usually decide which is most suitable for the job. In general, the cross-drum, for the same capacity and efficiency, is higher, shorter, and about the same width as the longitudinal drum.

We can assume, of course, that the maximum continuous, as well as peak and minimum plant loads are established, together with the daily and seasonal load demand curve. From these data can be determined the load level at which most of the fuel will be burned. This is the level at which the boiler efficiency should be a maximum. It is obvious that for peak loads of short duration, it would not be economical to install a boiler with its highest efficiency at maximum load. This is particularly true if very low loads are to be handled at other times with the inevitable "low fire" difficulties of a too-large boiler.

There are two main factors to be considered when selecting the number and capacity of the boilers needed. These are: *(a)* standby requirements, and *(b)* load variation.

Standby requirements alter with the kind of service. For example, hospitals, and public buildings involving tenant occupancy, cannot take a chance on even a partial failure of their heating plant during the winter months. Consequently, they must have at all times idle capacity of some percentage of their maximum demand. W.t. boilers have reached a state of reliability where one idle boiler out of three is considered adequate standby. In small plants, this ratio, for reasons of economy, may be one idle out of two installed. Many process plants, such as distilleries and sugar refineries, where a partial failure of steam supply would be expensive to the process, use the same standby ratios as hospitals and institutions. Others, where partial failure would be merely an inconvenience or, at worst, a temporary reduction in production which could be made up later, do not provide for any *idle* capacity at maximum load. Instead, they provide *surplus* capacity. In a two-boiler installation, for instance, each boiler would have a capacity of about 65 to 75 per cent of the maximum load demand. If one of these boilers had to be shut down at a time of maximum demand, some non-essential services could be discontinued or reduced.

Seasonal load variation is often the deciding factor in choosing the number of units in a plant. It is difficult and uneconomical to operate a boiler at too small a fraction of its normal capacity. The efficiency drops drastically, and the flue gases tend to condense on and corrode breechings. In institutions and the like, where standby capacity is installed, the seasonal load variation is automatically provided for only if more than two units are installed, so that some of the two or more boilers which carry the maximum load in the winter can be shut down in the summer. It is not uncommon to see one out of three, or one out of four, such units carrying the entire summer's load at less than half capacity. It is worth considering, in such cases, the addition of a small fire tube boiler for summer use.

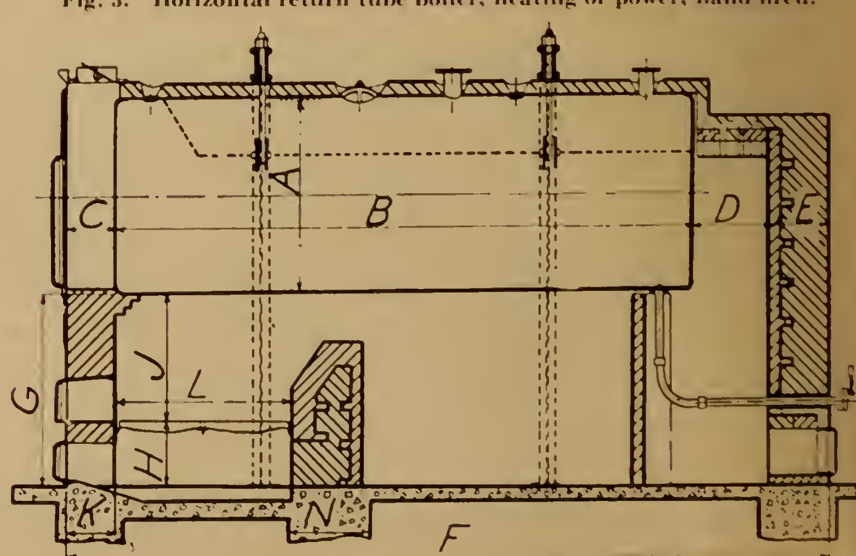
It should be noted also that the fewer the units used, the lower will be the first cost. Two boilers of a given capacity will cost about 50 per cent more than a single boiler of the same total capacity and their maintenance costs will be in about the same proportion. A good rule to follow is to use as few units as possible, taking into consideration standby and load variation requirements.

Before leaving the subject of w.t. boilers, it is worth mentioning efficiency. It was stated before that a boiler's maximum efficiency should be reached at the rating at which most of the fuel is to be burned, and that the boiler's heating surface should be decided on that basis. How high we should aim for efficiency is not always clearly understood. Higher efficiency can usually be obtained by increasing the heating surface, installing heat recovery equipment, or arranging the heating surface so more of it is exposed to direct flame radiation. All of these methods cost money and, unless the additional cost can be recovered in a reasonable time—say, 10 or 12 years (with interest)—it is not worth doing. Here is where the load variation comes in again. There may be two plants to be installed with identical maximum loads, one of which may have 50 to 100 per cent higher yearly load factor than the other and burns that much more fuel. Obviously, a high efficiency is economically more justified in one than in the other. More will be said about this later when economizers and air heaters are discussed.

Laws Affecting Operators

We will now discuss the effect

Fig. 3. Horizontal return tube boiler, heating or power, hand fired.



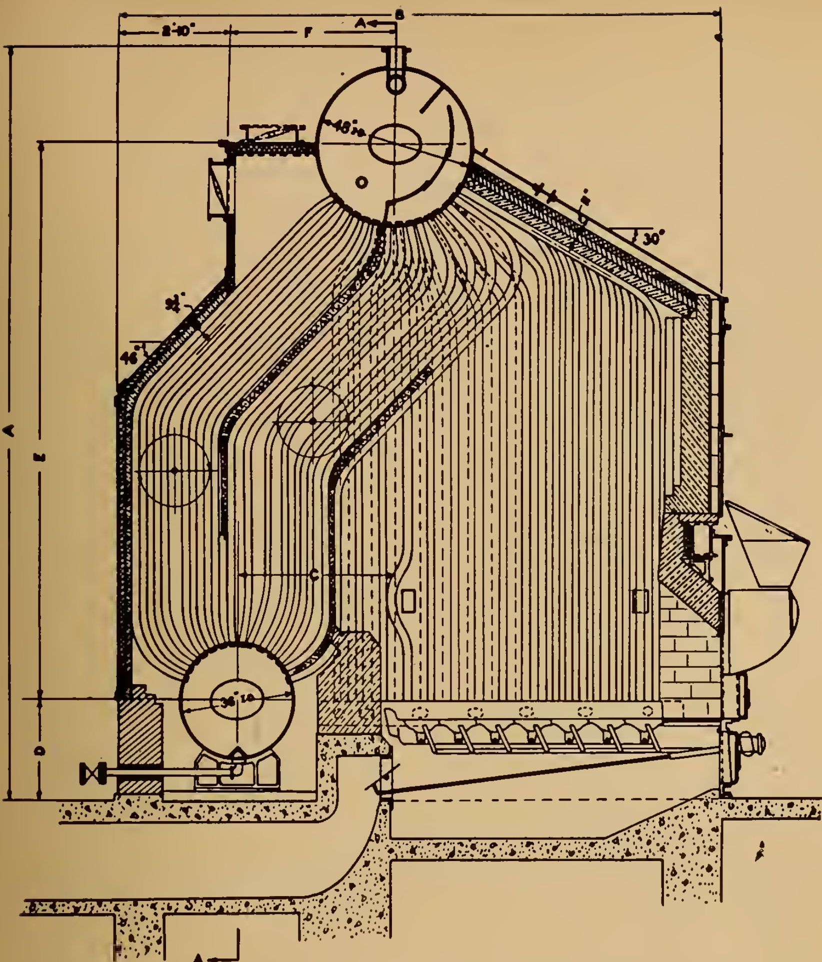


Fig. 4. Water tube boiler, cross drum type, spreader stoker.

of our Provincial laws on the selection of boilers, particularly as they affect the grade of operator required. This, of course, has a striking effect on operating cost. Each province has an Act and regulations stipulating the maximum total installed heating surface permitted for unattended boilers. The Provincial Acts give these limits in horse power rather than in heating surface. The Acts are somewhat confusing in that different classes and types of boiler have different defined values of horsepower. In Quebec and Ontario, for example, the following quantities are the maximum permissible heating surfaces for mechanically-fired, unattended boilers, in the low-pressure field:

H.R.T. boilers:	
Quebec:	900 sq. ft.
Ontario:	1125 sq. ft.
S.D.B. and Waterleg boilers:	
Quebec:	825 sq. ft.
Ontario:	900 sq. ft.
W.t. boilers:	
Quebec:	640 sq. ft.
Ontario:	750 sq. ft.

The corresponding limits for high pressure boilers are: Quebec, one fifth of the low pressure ones; Ontario, one third.

There are also limits established in the Provincial Acts for the maximum installed horsepower which each class of operating engineer is permitted to handle. In Quebec, for example, an operating engineer with second class papers can have charge of a high pressure water tube boiler plant, mechanically fired, with a total installed heating surface not exceeding 5100 sq. ft. In Ontario this figure is 6000, and in Alberta 5000.

It is apparent from the above that the plant designer should, after making his boiler choice, re-examine the sizes chosen from the point of view of legal requirements. Often, a slight increase in boiler rating, a small reduction in standby capacity, or a reduction in the provision for future load growth, will put the plant in another operator's class.

Package Boilers

Before passing on to the discussion of firing equipment, we will take a look at the modern trend toward "package" boiler units. A boiler, either fire tube or water tube, can be called a package unit if it is assembled in the manufacturer's shop complete with all necessary components such as brickwork and insulation, firing equipment, draught fan, combustion and water controls, fuel heaters and dumps, standard boiler trim and, frequently, feed water pumps and soot blowers. This package is so designed and arranged that it can be shipped to site as a unit without too much danger of damage in transit to its installed brickwork and the more fragile of its components. In theory, all that remains to be done once the boiler is in place is to connect up the water, steam, fuel and electric lines, push a button and you're away. In practice, this is almost true, since the equipment has already been shop tested, with the possible exception of the combustion controls. The test procedure of some manufacturers, for reasons of overall economy, do not include this. So far as the writer knows, most packages sold today are either oil or gas fired, or both, and cannot be converted to the use of coal.

The scotch dry-back type of boiler forms the basis for all fire tube packages. This type is enjoying a wide popularity in both the United States and in Canada at present and constitutes the vast majority of all packages sold. Water tube boiler packages are a recent innovation and are gaining in popularity, particularly in the United States, where the large market makes quantity-production methods practical and economical. Due to shipping weights and clearances, the water tube package is limited to the small and medium capacity field, the output varying between 7500 p.p.h. and 35,000 p.p.h. It is interesting to note here that a 30,000-p.p.h. package has a shipping weight of 40 tons. This presents no mean handling problem and points up the moral that no one should specify a water tube package without first checking on the handling facilities at the site and getting an approximate idea of what it is going to cost to move it from car or truck into place in the boiler room. It is certain that in many cases it would be cheaper to install a field-assembled unit instead of a package if all such fringe costs are included.

Fuel Selection

We will now proceed to the important question of fuel selection. A few years ago, most heating boilers and shell-type fire tube boilers were coal fired by hand on shaking grates, much the same as most of us did in our domestic furnaces. Today, oil and gas have cut sharply into the coal-burning field for the small and medium sized boiler, and mechanical stokers have almost completely replaced hand firing. We will, therefore, discuss fuel for mechanical firing equipment only and outline a few of the principal factors governing its selection.

There are four main possibilities: to burn coal or coke, oil or gas, and the choice is usually made on a basis of cost and convenience. Of these, cost is by far the more important. Many boilers burn, annually, fuel costing between half to twice the initial value of the installation. It is obvious then, that a careful study of the cost of alternative fuels is more than warranted.

There are many things, some of them not too apparent, that affect the over-all cost of a fuel. Let us take coal and coke first and enumerate them:

(1) Initial investment for firing equipment including special furnace requirements.
(2) Initial investment for combustion controls.
(3) Initial investment for coal handling equipment.
(4) Initial investment for ash handling equipment.
(5) Initial investment for fly-ash collection equipment (if used).
(6) Initial investment for coal storage facilities.
(7) Cost of fuel per M.B.t.u., f.o.b. site.
(8) Cost of unloading.
(9) Cost of handling fuel from storage to boiler.
(10) Cost of handling ash from boiler to dump.
(11) Cost of boiler room staff wages.
(12) Cost of maintenance (all equipment).
(13) Boiler efficiency.

This is a formidable list of costs but, if approached systematically in the planning stage, they are not as difficult to determine as one might think. Some of them, however, deserve special mention:

The initial cost of the coal and ash handling equipment may, in a small heating plant, cost only a few dollars and consist merely of a couple of shovels and a wheelbarrow. In a larger plant they may amount to many thousands of dollars and consist of such items as track hopper, bucket elevators, storage bins, conveyors, pneumatic ash handling systems, etc. Whether such labour-saving devices are warranted or not depends largely on the amount of coal to be handled daily.

Consider the fly-ash collection equipment. In general, this is not needed by the owner for his own purposes, but is a requirement demanded by the smoke-abatement laws of most large urban centres when certain types of coal firing equipment are used.

The last item listed, boiler efficiency, enters into the balance sheet when comparing coal costs with those of oil or gas. This is due to the fact that it is virtually impossible to burn out a coal completely. There are, therefore, what we call "unburned" losses in our heat balance figures which do not apply when burning oil or gas and help weigh the efficiency figures against coal.

A corresponding list of cost factors for oil or gas firing would be as follows:

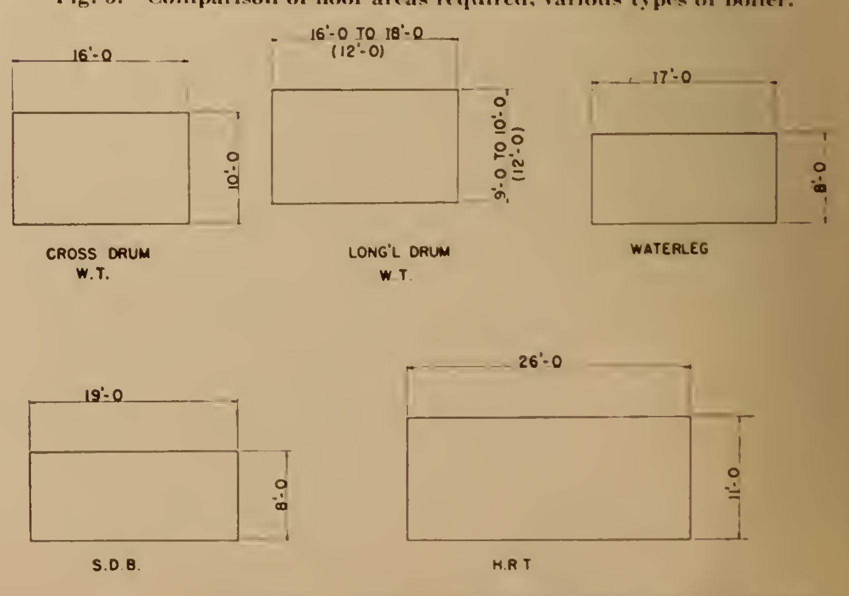
(1) Initial cost of burners.
(2) Initial cost of combustion controls.
(3) Initial cost of safety devices.
(4) Initial cost of oil heating and pumping equipment.
(5) Initial cost of oil or gas piping, valves, etc.
(6) Initial cost of oil storage facilities.
(7) Initial cost of oil unloading facilities.
(8) Cost of power for heating and pumping oil.
(9) Cost of fuel per M.B.t.u., f.o.b. site.
(10) Cost of unloading (other than power).
(11) Cost of boiler room staff wages.
(12) Cost of maintenance (all equipment).
(13) Boiler efficiency.

Certain of the above items will stand elaboration:

Item (3), safety devices—add perhaps 10 per cent to the initial cost of an oil or gas burner installation. They are, however, considered to be a "must" for burners in small automatically controlled self starting jobs. You will find them on your own oil burning domestic furnace. On larger jobs, with modulating controls—but not self starting—they are being used more and more, largely as a protection against human errors in operation and not so much to protect against mechanical failure. More and more the insurance companies are insisting on such devices before they will agree to insure.

Item (4) to (8) inclusive, having to do with the storage, heating, and transfer of oil are a common source of under-estimate. The storage and transfer facilities are

Fig. 5. Comparison of floor areas required, various types of boiler.



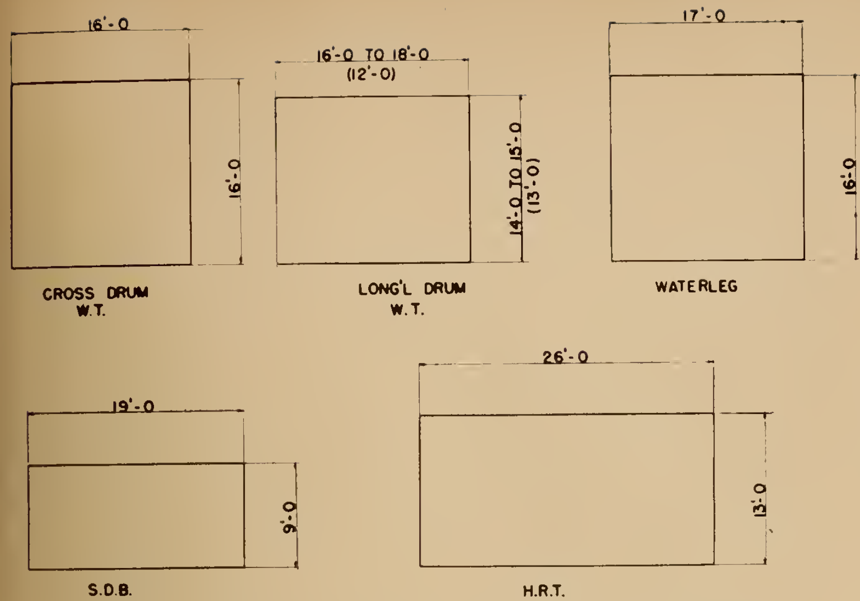


Fig. 6. Comparison of heights required, various types of boiler.

strictly controlled by the fire underwriters and, in these days of high plumbing and material costs, may form a surprisingly large percentage of the total cost—even exceeding the cost of corresponding equipment for coal.

Item (11), boiler room wages, usually shows a substantial saving over a coal-burning job, even if the latter is fully mechanized.

Item (12), maintenance costs, will usually be considerably less with oil or gas as a fuel than with coal. Stoker grates have a tough job to perform, but any stoker manufacturer can predict fairly accurately what the maintenance cost per ton of coal burned per year will be. The same goes for pulverizers. On the other hand, the burner tips and gas rings of oil or gas burners are exposed to severe conditions also, but are comparatively inexpensive to replace. Other components of the system such as pumps, heaters, valves, etc., operate under good conditions, and their mechanical deterioration can be kept very low by preventive maintenance.

This has been a brief summary of the main cost factors affecting the choice of fuels. We will now proceed to what we call the "convenience" factor.

It is apparent that this convenience factor is all in favour of oil or gas and against the use of coal. Many jobs have been installed with liquid or gaseous fuels, even when the economics were strongly in favour of solid fuel.

In the first place, it may not be convenient to allocate the space for coal storage when underground oil tanks offer so little obstruction. Secondly, some types of industry tend to make show places out of their boiler rooms, and this can more easily be done and maintained in the relatively dust-free atmosphere of an oil or gas fired job. Thirdly, it is not difficult to obtain operators who can operate an oil fired plant efficiently, but good stoker or pulverizer operators are more difficult to find. Fourth, there are numerous plants where cleanliness is essential to preserve the quality of the product.

These cannot tolerate coal dust, ash, or fly ash blowing about and will use oil or gas if it is at all feasible. Lastly, there is the very numerous group of small heating plants with unattended boilers operating entirely automatically except for cleaning and routine maintenance. For these, oil firing is not only a convenience, but may become a necessity if it is desired to keep operator attendance to a minimum.

Firing Equipment Selection

If the decision is made to burn coal (or coke) the type of stoker or pulverizer best suited for the job must be selected. The type chosen will depend principally on three factors as follows: (1) Is the coal caking or free-burning? (A caking coal is one which tends to fuse together and become impervious to air passage when heated.) (2) Capacity desired. (3) Rate and magnitude of load variations.

There are several types of stoker available, and each has its advantages and disadvantages.

The Single Retort Underfeed Stoker, as its name implies, introduces the coal under the fuel bed by means of a single screw or ram. The screw type, because it can deliver coal to one exit point only, has a limited capacity and is used mainly for small heating boiler jobs. The ram type employs a piston to force coal into a central trough, and auxiliary pushers to distribute it over the length of the trough. Capacities up to 40,000 p.p.h. can be obtained with the largest sizes available. Because of the constant motion of its fuel bed, the underfeed stoker can burn caking coals successfully. Any cakes that form are broken up immediately into fine enough particles to permit efficient air penetration. This type of stoker cannot be used where it is necessary to follow rapidly fluctuating load demands. It is, however, very simple to operate and is generally regarded as the "old reliable" of the small, steady load field.

The Multiple Retort Stoker was once extensively used in medium and high capacity plants. It has been largely supplanted now by the spreader and travelling grate stokers in the medium range, and by pulverizers in the high capacity range. Coal feed is effected by a parallel battery of rams feeding on to a stepped and rearward sloping grate. Secondary feeders nudge the coal down the slope toward the rear where the ash is either dumped or disposed of by mechanical means.

The Spreader Stoker (in its modern form) is a comparative newcomer in the stoker field but has already attained a large measure of popularity within its capacity range. Its principle is simple. Coal is fed by two or more variable speed feeders in parallel on to rotors which throw it backward onto a grate. The coarse particles are thrown furthest, the finer particles less far, and the very fine particles and dust burn in suspension. By proper proportioning of the small and large particles, a thin, even, fuel bed can be maintained. Almost any kind of coal can be burned so long as sizing is right. Rapid load fluctuations can be followed without difficulty. Since there is a practical limit to the distance the coal particles can be thrown evenly (12 to

13 ft.), the higher capacities must be attained by widening the boiler and increasing the number of feeder and rotor units proportionately.

There are two methods of cleaning the fire. The first is by means of longitudinally zoned dumping grates, each zone corresponding to one feeder and rotor unit. One unit is dumped at a time and, during that time, both capacity and efficiency suffer. For this reason, a minimum of three zones is often specified for small boilers in order to reduce the percentage of outage during the cleaning period. When the boiler capacity gets up around the 40 or 50 thousand p.p.h. mark, the chore of dumping the multiple zones in sequence becomes too onerous, and recourse is had to the continuous discharge travelling grate. Unlike the conventional travelling grate, this one travels from rear to front. This principle gives the larger particles, which were thrown furthest back, time to burn out before being carried over into the ash pit. Spreader stokers of this type are being used regularly up to 125,000 p.p.h. and, in a few cases, even higher. In this respect they now overlap what used to be considered the exclusive range of pulverizer firing.

There are four important features, however, of spreader stoker firing about which we should warn the prospective user. First, it is essential that the furnace be designed to give plenty of length of travel for the particles in suspension to burn out before they encounter the first pass of boiler tubes. Secondly, it is necessary to keep the furnace temperature down to prevent softening of the fly ash with resultant fouling of the first pass tubes. These two requirements add to the boiler dimensions as compared with one designed for underfeed stoker firing and this, of course, is reflected in the cost. The third warning is that the spreader does not function well at low loads. About 25 per cent of full capacity is generally agreed to be the practical minimum. This limitation will often rule out the spreader unless the boiler units are made small enough to permit one of them carrying the minimum plant load without the fuel bed becoming too thin and spotty. The fourth warning is that the spreader stoker is one of the worst offenders when it comes to emitting objectionable fly-ash and cinders. As a result, dust collectors are required by law in conjunction with spreaders in most urban centres. Even where by-laws do not demand dust collectors at present, there will likely be such a requirement some day, and the wise purchaser will leave space somewhere between his boiler and stack for one to be installed in the future.

It is worthy of note here that most boilers have some place in their gas passes where the larger particles are trapped. A fair percentage of these particles will be found to be unburned carbon. Consequently, for reasons of efficiency, it is standard practice with spreader installations to return these cinders to the furnace via an auxiliary air operated cinder return system.

The Travelling Grate Stoker has a wide range of capacity extending from about 15,000 p.p.h. of steam up to 250,000 p.p.h. There are two limitations to the use of this type of stoker other than its economic capacity range. It cannot follow rapidly fluctuating loads with best efficiency, and it cannot efficiently burn caking or semi-caking coals.

In principle, the grate is an endless belt conveyor whose top surface travels from the front toward the rear of the boiler. Coal is fed on to the grate through a guillotine-type gate from a hopper at the front of the boiler. The amount of opening of the gate regulates the fuel bed depth, and the burning rate is regulated by the rate of travel of the grate. Air is fed under the grate through transverse zoning chambers which permit the burning rate to be varied from front to rear. To obtain best results and minimize the likelihood

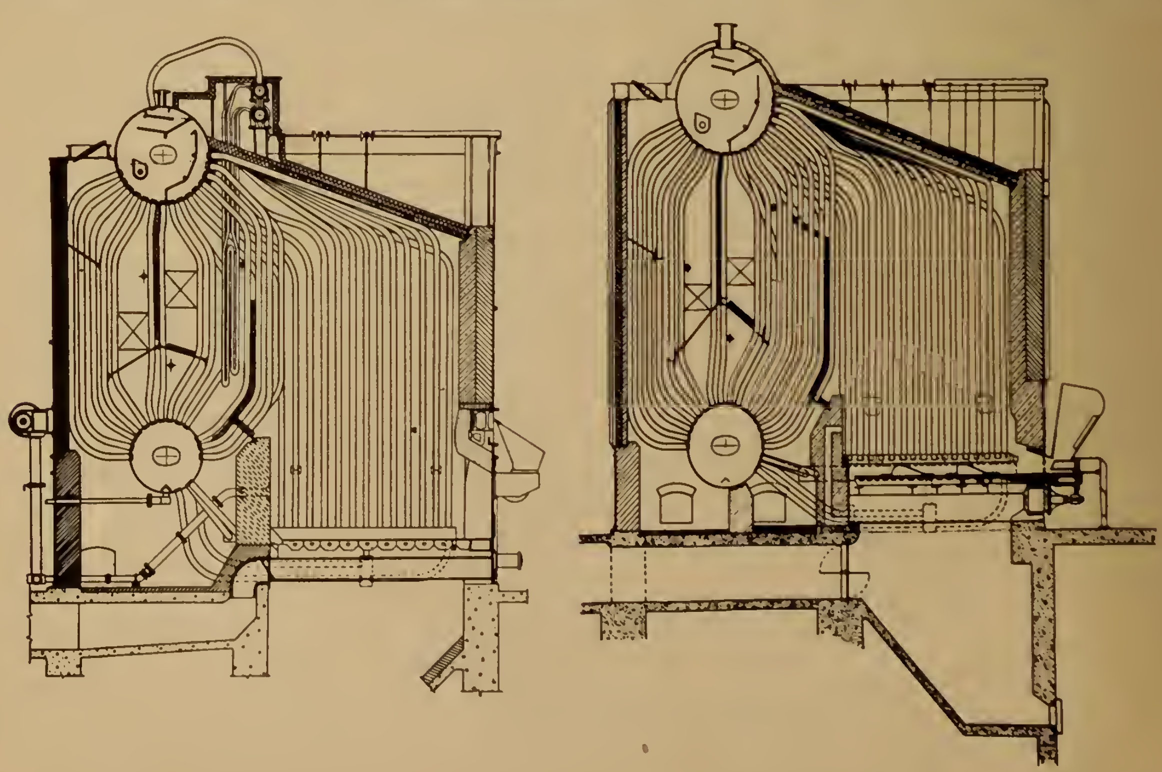


Fig. 7. Water tube boilers, cross drum type, dumping grate spreader and underfeed stokers.

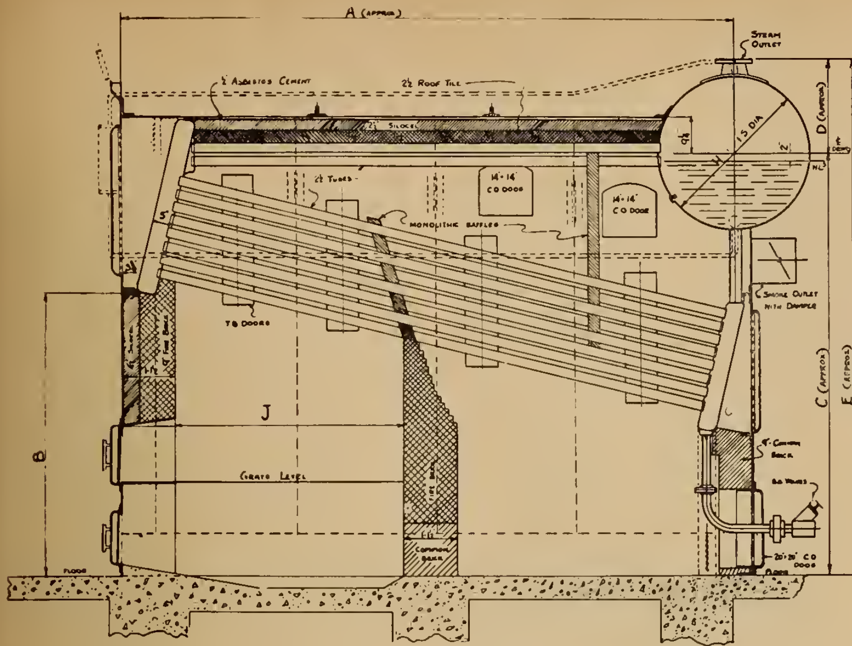


Fig. 8. Water tube boiler, cross drum straight tube, hand fired.

of the fire going out, it is customary to do as much burning as possible in the zones nearest the gate. This gets the raw coal ignited as rapidly as possible and gives it time to be burned out in an even, orderly fashion before it is dumped as ash at the rear of the furnace. It has been found that an overhanging arch over the first zone greatly assists in getting the raw coal ignited. With some fuels, notably coke breeze, a long rear arch is desirable to ensure relatively complete combustion. These arches, and the general design of the furnace for this type of stoker, make for a more expensive boiler than would be required for the same capacity were a spreader or underfeed to be used. In spite of this added cost, where the capacity desired exceeds the upper limit of the underfeed, and other considerations rule out the spreader or pulverizer, the travelling grate is frequently the only solution.

For the guidance of a prospective purchaser, it is worthy of note that there are two sub-types of travelling grate. The less expensive type is known in the trade as the chain grate. With this sub-type, the grate surface is made up of the chain links which are threaded on to long pins extending the width of the stoker. Special links at each side engage the drive sprockets. The principal disadvantage of this sub-type is that to replace a grate element, the stoker chain pins must be pulled and then reinstalled after the links are replaced — a time-consuming operation.

The other sub-type is known as the travelling grate—somewhat to the confusion of the uninitiate. A more accurate designation would be the "bar and key" grate. This grate differs from the chain grate in that the grate elements (keys) do not form part of the chain proper and hence can be renewed readily and with little loss of time. Since the chain elements are not at the firing surface, a much higher degree of mechanical perfection can be attained in their design, and this is reflected in lower maintenance costs and less outage time. Furthermore, by varying the width of the grate elements and the proportions of the air slots between them, finely divided fuels can be burned without excessive sifting of fuel or ash through the grate. This characteristic can be attained on the chain grate also, when new, but as the chain wears, the spacing between links increases and the advantage is eventually lost.

We can sum up the relative usefulness of the two sub-types of grate by saying that the travelling grate has a higher first cost than the chain grate, but is usually chosen in preference to the latter where the load demand requires a minimum of outage time and fine sifting fuel is to be used.

Pulverizers

Let us now touch briefly on the burning of pulverized coal. To be very elementary, we can say that pulverized coal firing consists of reducing the coal particle size to a point where, if blown by air carrier into a furnace, it will burn in suspension.

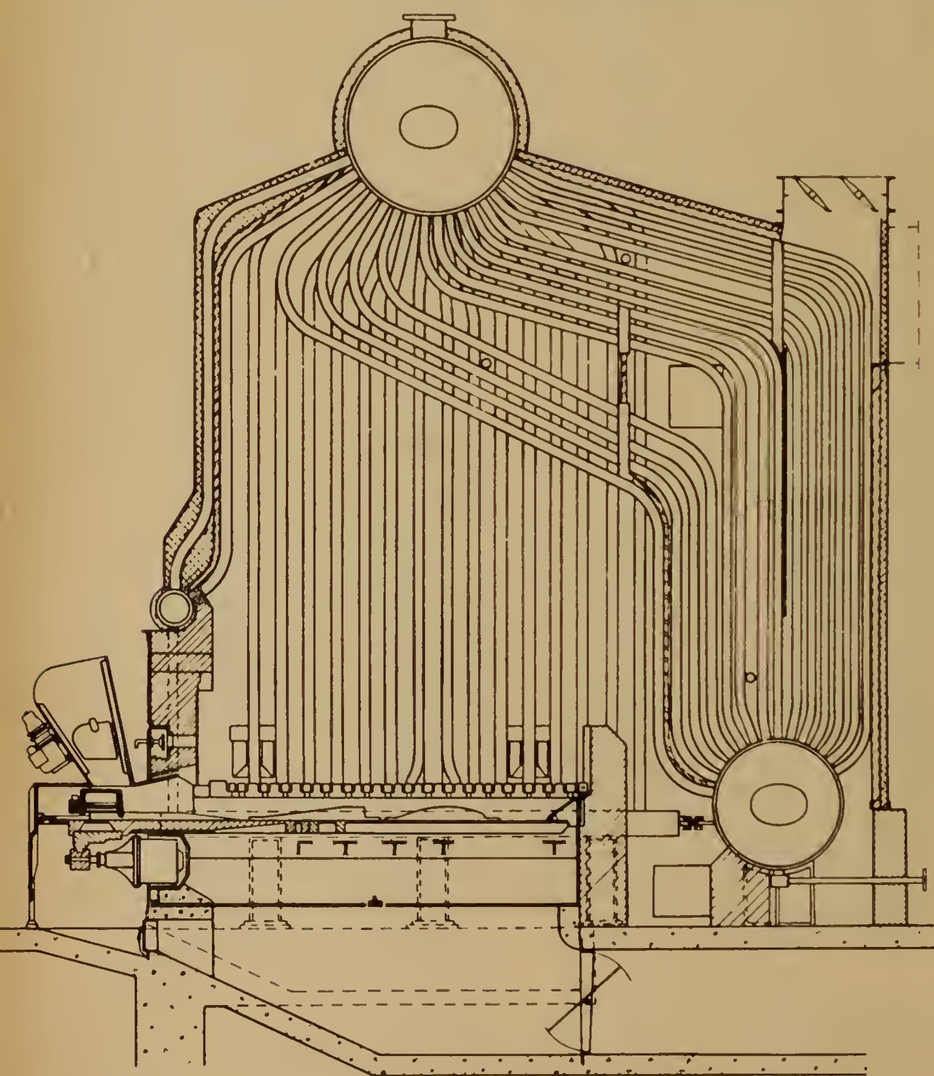
The two principal components of any pulverized fuel firing system are the pulverizer and the burner. There are many varieties of burner in use, and it is not proposed to go into their relative merits here. It should be noted, however, that pulverized coal firing is the only method of burning coal which permits easy conversion of the boiler furnace to oil or gas. In fact, there are many installations where combination coal-oil burners are installed and both fuels are used as the economics of fuel cost changes.

As for the major element of the system, the pulverizer, there are three main types: the ball mill, the impact-attrition mill, and the roll-race or ball-race mill. The ball mill consists of a rotating drum containing a number of hardened balls. Coal is introduced into the drum and is pulverized by the tumbling action of the balls and the coal itself. The impact-attrition mill consists of a series of hammers or lugs attached to a rapidly rotating rotor in a closed housing. The hammers break up the larger particles and, by windage and attrition, these produce the finer particles. The roll-race and ball-race mills consist of rollers or balls confined in a race with the coal, which is crushed and pulverized as the ring or race rotates. In all these types, the finer particles are carried away from the grinding elements by an air stream, passed through a classifier which rejects the coarser of these and allows the real fines to proceed to the burner and hence to the furnace.

All of these types have their advantages and disadvantages, and all will do a good job if the conditions are right for their type. For example, the ball mill and the impact-attrition mills have a large power to production ratio if operated at fractional capacity, while the roll-race and ball-race types are unduly expensive in first cost for small capacity installations. There are other factors which must be considered in choosing the most suitable type of pulverizers, such as moisture content of coal, and length and frequency of shut-down time for replacement of grinding elements.

The designer of a pulverizer fired unit should, for satisfactory operation, satisfy himself that five basic conditions are going to be fulfilled. First, the minimum load must be such that the pulverizer can handle it without losing ignition. The use of a pilot oil flame to stabilize ignition at low loads is frequently used to avoid such difficulties. The use of two or more pulverizers per boiler would have the same effect. For this reason and to provide part load capacity in the event of temporary pulverizer failure, it has become standard practice to install two or more units per boiler in the load range of 60 or 75 thousand p.p.h. steam and up. Second, the boiler furnace must be so designed as to have a maximum temperature below the ash-softening temperature of the coal. If this is not done and if the flame travel is not adequate, slagging will be sure to occur. The common method of minimizing slagging in a furnace, other than making it of adequate size and shape, is to have the furnace wall tubes practically touching, thus presenting completely water-cooled surfaces. Some boiler manufacturers use a wider wall tube spacing with fins attached to the tubes to fill in the gaps. With these arrangements, the wall refractory maintenance is practically nil. Furthermore, the water-wall contour is such that any slag formed cannot get keyed on and will usually drop off when it gets heavy enough, or when the boiler cools off during a shut-down. Third, the coal available should have a reasonably good grindability and not too low an ash fusion temperature. It should also be properly sized for the type of pulverizer to be used. The pulverizer manufacturer will always specify the coal sizing limits for his product and it is frequently found economical in large installations to buy over-sized coal and install crushing equipment to reduce it to the required size. Fourth, the fly-ash emission from a pulverized coal fired boiler is very high and, as with the spreader stoker, most urban centres require dust collection equipment to be installed. Fifth, the intelligence and ability of the operating staff probably needs to be higher to fire pulverized coal than for any other type of firing. For this reason, the small plant which may not by law require a class one operator and can least afford to pay extra money for a first class man, frequently encounters more operational difficulties than the large one.

Fig. 9. Water tube boiler, cross drum, type E underfeed stoker.



Oil and Gas Burning Equipment, in common with coal burning devices, is available in several types. For burning gas, there are the gas ring burner and the inspirating burner. Which to use will depend on the gas pressure available, the noise level tolerated, and the individual preference of the purchaser.

For oil burning, there are four principal types: *(a)* the spinning cup, which introduces a fine spray of oil via the centrifugal action of a highly-polished spinning cone. These burners have medium to low capacity and are used principally with heating boilers; *(b)* steam atomizing burners, which use medium pressure steam for atomizing through a gun-type burner element, and have a wide range of capacity. These cannot be used for water or low-pressure steam boilers unless medium-pressure steam is available from some other source for atomizing; *(c)* mechanical atomizing burners, which atomize the oil by pumping it at high pressure through a gun-type burner element; *(d)* the steam-assisted mechanical atomizing burner which uses steam for atomizing at partial capacity and a combination of steam and mechanical atomizing at higher loads. By this means, the low turn-down ratio of steam atomizing is combined advantageously with the economy and efficiency of mechanical atomizing at high loads. How the oil is heated and pumped, and how the combustion air is handled for each type, is too long a story to be told here.

Heat Recovery Equipment

Heat recovery equipment will now be discussed briefly. When used in conjunction with boilers, heat recovery can be defined as the extraction of heat from the flue gases after they leave the boiler. The purpose, of course, is to reduce the heat loss up the stack and hence improve the overall efficiency of the unit. There are two methods of doing this. One is by transferring heat from the flue gas to the feedwater in an *economizer,* and the other is to transfer heat from the flue gas to the combustion air in an *air heater* or *air preheater* as it is sometimes called. Both these devices are simply a special form of heat exchanger. These methods of heat recovery are seldom used together, except in the high pressure power plant field and in conjunction with some types of marine boiler, both of which are beyond the scope of this paper. There are several types of economizer and air heater in common use, but space will not permit their description here. The discussion will therefore be limited to the factors deciding whether heat recovery will be used and, if so, which type, economizer or air heater, is best suited for the job.

Whether or not to use heat recovery equipment is usually strictly a matter of economics. It is common to improve efficiency 4 to 5 per cent with an air heater, and $4\frac{1}{2}$ to $6\frac{1}{2}$ per cent with an economizer, the limitations usually being: the minimum flue gas temperature that can be attained without gas condensation and resultant corrosion or fouling up of the unit; or maximum water temperature that can be attained in the economizer without danger of steaming; or maximum preheated air temperature permissible for reasons of grate maintenance and coal slagging on the grate.

If the annual fuel bill is known, it is a simple matter to calculate the gross savings that can be reasonably expected when heat recovery equipment is used. Against these savings must be balanced the amortized cost of the heat recovery equipment, its maintenance, the additional cost of draught fan and power needed to overcome the draft losses through the equipment and the cost of the additional space needed. Even if the economics of the case do not warrant it, air heaters will usually be installed in conjunction with pulverizers, to improve the combustion and dry the coal.

If it is decided to install heat recovery equipment, the next step is to choose between an economizer and an air heater. In general, for steam pressures up to 200 or 250 p.s.i., the air heater is a better investment than the economizer while, above that, the conomizer begins to show the best returns. The reason for this lies basically in the fact that the higher the operating pressure, the higher will be the temperature of the saturated steam in the boiler, and the higher will be the gas outlet temperature. This means that more heat can be extracted from the gas before its dewpoint is reached. This larger amount of available heat may exceed that needed by the air heater to bring the combustion air temperature up to the permissible limit, particularly for stoker operation. Consequently, with an air heater the flue gas temperature cannot, in a high pressure boiler, be lowered to the optimum point, and the best efficiency cannot be reached. On the other hand, as the boiler pressure increases, the temperature of the feed-water can also be increased and, as a result, the economizer, in heating the feedwater, can make use of the optimum amount of heat from the flue gases and hence produce the optimum efficiency.

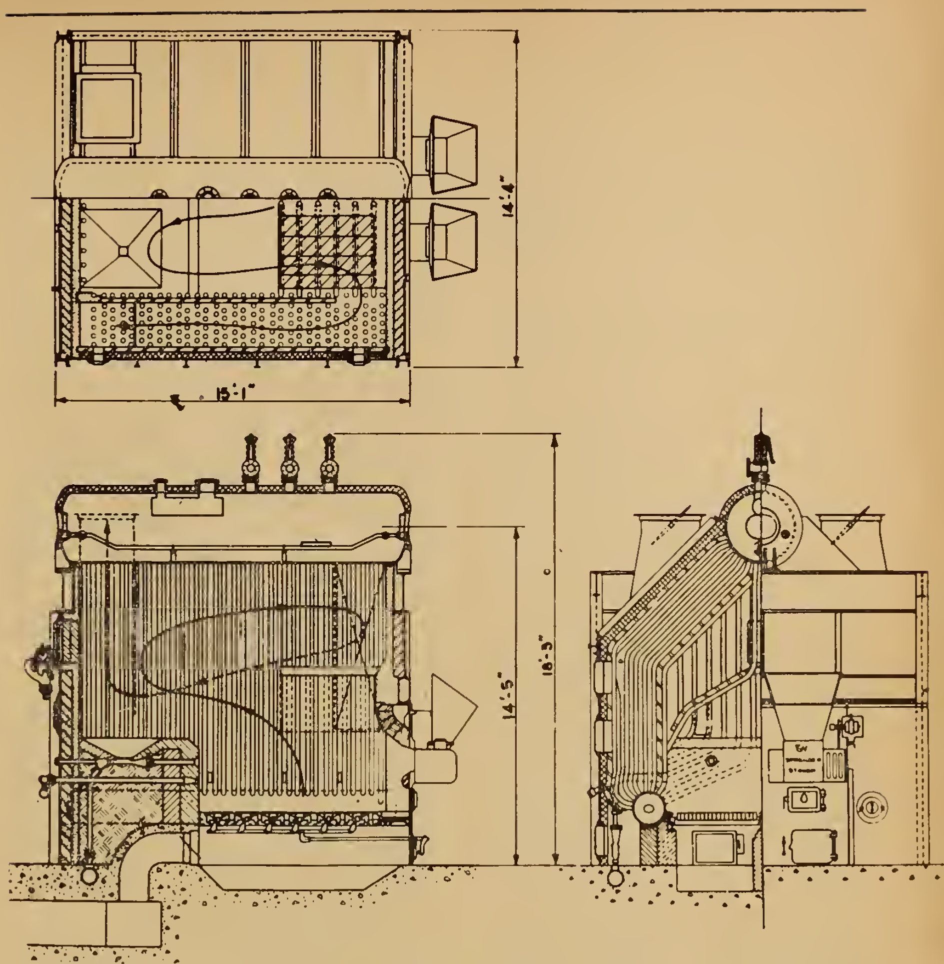


Fig. 10. Water tube boiler, longitudinal drums, dumping grate spreader.

In practice, the fields of application of the economizer and air heater are not so simply defined. For example, it will be found that an economizer will cost more than an air heater for the same pick-up. Against this is the fact that an air heater is likely to have cold spots, particularly at partial load, where condensation is likely to occur. It is therefore considered unwise to reduce the average gas temperature as low with an air heater as with an economizer. This is particularly true with oil firing where sulphur compounds are found in varying amounts in the flue gas. These compounds tend to condense and form hard insoluble deposits at temperatures around 300° F. and may require strong-arm methods for removal. To overcome these operating difficulties, air recirculation, air by-pass, or steam heater at the air entrance can be used to advantage. The critical gas temperature for various loads can then soon be determined and avoided by an operating procedure which will give best efficiency without danger of slagging.

Soot Blowers

The question of fouling heating surfaces leads naturally to the subject to soot blowers. Soot blowers may use either air or steam as the blowing medium and be installed in air heaters, economizers, and boilers of all types. When air is used, the blowing cycle is usually continuous and the operation completely automatic. This type is units as the cost is too high for normally used only on large boiler cconomic use in small boilers. Steam blowers, on the other hand, are relatively inexpensive. They are usually arranged for hand or semi-automatic operation once per shift or when rising flue gas temperatures indicate the need for blowing.

Whether or not to install soot blowers depends largely on the construction of the boiler and the load characteristics. Even a small fire-tube boiler, if it cannot be shut down for brush cleaning without interrupting important plant functions, should have soot blowers installed. Practically all water-tube boilers need to be on the line for long periods at a time and in addition have relatively inaccessible heating surfaces. Consequently, they normally require soot blowers. An exception is often made to this rule in the case of gas-fired boilers and occasionally where spreader stokers are installed. In the latter case, the scouring action of the cinders is said by some to keep the heating surfaces clean, but this has not been generally substantiated.

Fans and Chimneys

This paper would not be complete without the subject of draught fans and chimneys being dealt with. Draught fans for boilers fall into two categories.

Forced draught fans (or forced air fans) supply the combustion air under pressure to the burners or under the stoker grate. They are, in general, required when conditions are as follows: (*a*) when an air heater is used with the resultant relatively high air pressure loss; (*b*) when a stoker is used with its high fuel bed resistance; (*c*) with gas or oil burners of medium to high capacity where the fan pressure can create better air-fuel mixture by increasing turbulence and hence increase combustion rate and shorten the flame; (*d*) in "package" boilers where only a rudimentary chimney is supplied. These boilers usually operate under pressure from the forced draught fan and hence require to be gas-tight so that the products of combustion can be forced through the boiler (without leakage into the boiler room) and thence up the chimney.

Induced draught fans, on the other hand, are placed after the boiler and serve to draw off the products of combustion and send them up the chimney. They are essential under the following conditions: (*a*) where air heaters or economizers are installed; (*b*) where there is no adequate chimney and the boiler is not pressure fired; (*c*) where there is no adequate chimney and there is no forced draught fan.

The question of what constitutes an adequate chimney is not always clearly understood. As is well known, the "chimney effect" of hot gases in a smokestack creates a small reduction in pressure at the base of the stack which is continued through the breeching to the boiler. This reduction in pressure, or draught, is required to carry off the products of combustion and in doing so to overcome the draught losses through the boiler. In addition, with a natural draught oil burner, it may have the job of drawing in sufficient combustion air to operate the burner without smoke. The combined requirements may easily be more than the existing or projected stack height can handle and only trouble can ensue if either the stack height or diameter is inadequate.

It should be borne in mind by the prospective purchaser that just because someone of his acquaintance is "getting by" with a 50 or 60 foot stack does not mean that he also can do so. The draught loss through any given combination of burner, boiler, breeching and stack will vary as the square of the boiler rating. His friend may be operating his boiler at 100 per cent rating, whereas he may need to operate at 150 per cent, thereby requiring a stack two and a quarter times as high.

Other Auxiliaries

It should be noted that there are several other important auxiliaries which the designer must include in his thinking, even if he may not include them all in the specified equipment. A brief list of the more important of these would be:

(*a*) *Feedwater Supply*—required by Code to be in duplicate. If two pumps are used, at least one of them must be steam driven.

(*b*) *Feedwater Treatment*—Consult the experts.

(*c*) *Automatic Combustion Controls*—Highly desirable with rapidly fluctuating loads and essential for unattended boilers.

(*d*) *Indicating and Recording Instruments*, such as steam and airflow recorders, temperature gauges, draught gauges, aid the operator in attaining best efficiency, but may not be economically justified unless substantial quantities of fuel are to be burned yearly.

(*e*) *Automatic Feedwater Regulators*—Essential for unattended boilers and highly desirable for use when loads fluctuate rapidly or boiler water content is relatively small, as in watertube boilers.

(*f*) *Safety Devices* — including flame failure warning and shut-off, air-flow and gas-flow failure fuel cut-off switches. Essential in some form with unattended boilers, and usually specified in conjunction with oil and gas firing in all sizes of boilers.

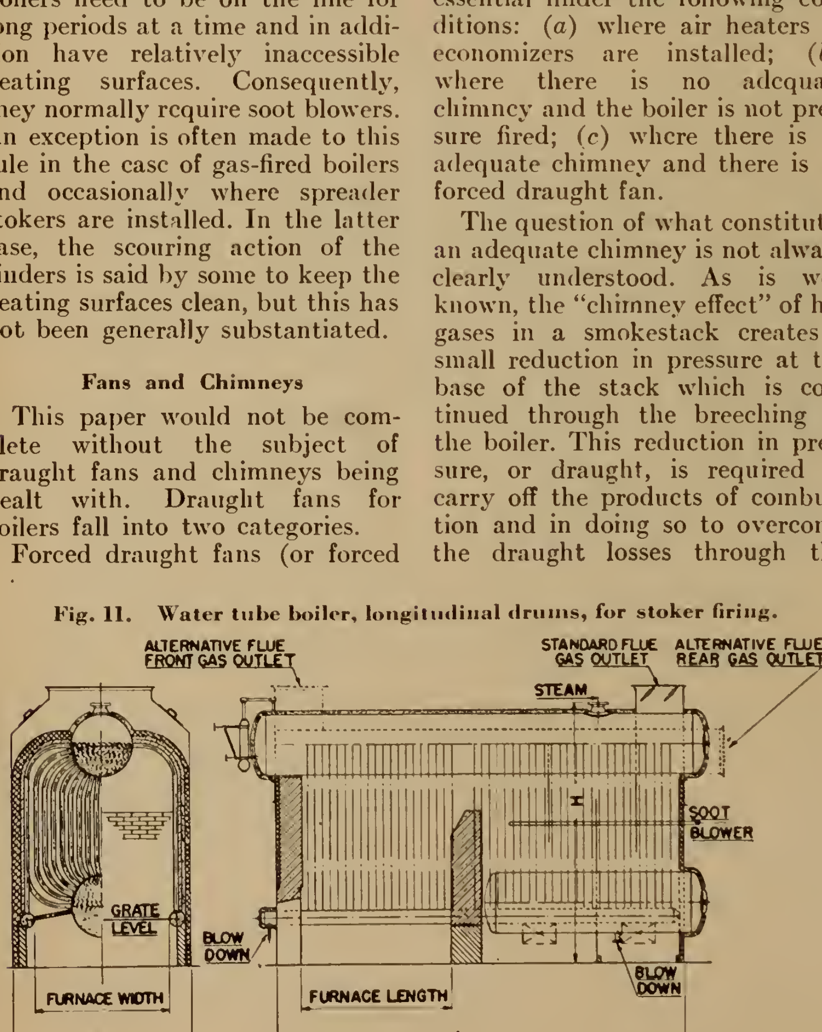


Fig. 11. Water tube boiler, longitudinal drums, for stoker firing.

PHOTOELASTICITY

. . . for Design Improvement

I. W. Smith,

Associate Professor of Mechanical Engineering,
University of Toronto.

Engineering design involves the calculation of stresses by means of recognized formulae. Occasionally a simple formula such as P/A or M/S does not give the correct value of stress, and in other cases the conditions may be complicated to the extent that no formula is available for stress computation. In situations such as these photoelastic stress analysis may provide the answer, and it is the purpose of this paper to outline something of its scope and application. Figure 1 is the fringe pattern for a short column, loaded in compression, and having a transverse hole 25.2 per cent of the width. Whereas the average stress from P/A is 830 p.s.i. on the reduced section, the 4.7th order fringe at the edge of the hole shows the maximum stress at this section to be 1950 p.s.i. or 2.35 times the average. The photoelastic method has been invaluable in the determination of stress concentration factors.

The photoelastic method for stress analysis is not new. In 1853 a gelatin model was used to investigate torsional shear[1]. A polariscope using glass plates to obtain a wider field was described in 1912 by Coker and Thompson[3]. Photoelastic tests in the plastic range were made in 1923 by Filon and Jessop[4]. A series of papers by Z. Tuzi was published in Japan in the late twenties, reporting work on three-dimensional stress problems, the stress freezing technique, and dynamic stress studies[5,6]. Credit should be given to these men, and others of their times, for the progress that was made in spite of relatively insensitive model materials, polariscopes of restricted size, and a limited background of proven techniques.

The introduction of Polaroid, making possible polariscopes with larger fields, and the development of improved model materials, have greatly expanded the use of photoelasticity since 1930. Many excellent books on the subject are now available [7,8,9,10,11,12] and there have been numerous technical papers. References 13 to 34 indicate the wide field of application for the photoelastic method and are typical of many more problems that have been successfully solved but never published. Figures 2 and 3 are fringe patterns for spur gear teeth showing stresses for one and two pairs of teeth in contact. References 35 to 37 indicate that photoelasticity has been used for twenty years in the study of gear tooth stresses.

Although most of the development of the photoelasticity method has been done in universities many private companies now own and operate polariscopes and are using the technique to analyze stresses for design improvement. A brief summary of the basic principles, together with the latest advances in technique and the difficulties encountered, will serve to show where the photoelastic approach may be used to advantage.

Photoelastic stress analysis may provide an answer to stress calculations where these cannot readily be solved by mathematical formulae. The paper outlines the scope and application of photoelastic techniques.

Plane Stress Analysis

To analyze the stresses in a proposed structure an accurately scaled model made of suitable transparent material is used. The model is placed in a beam of polarized light and loaded, in a manner similar to that of the prototype, in a plane perpendicular to the path of light. Strain, induced in the model by the applied load produces temporary birefringence. The entering ray of light, represented as a vector oriented by the plane of polarization, is resolved into components in the directions of the two principal stresses, p and q, at that point. The components travel through the model at different velocities and when recombining on emergence may be in phase, to give a resultant having the original orientation, or antiphased to produce a resultant that represents a 90 degree rotation, or may have a resultant at some intermediate angle. A second polarizer, known as the analyzer, is placed in the light beam beyond the model, either with its axis in line with the first polarizer (forming a "parallel" or "light field" polariscope) or 90 degrees to it ("crossed" or "dark field" polariscope).

The amount by which the emerging vector has been rotated depends on model thickness, material sensitivity, the wavelength of the light, and the algebraic difference of p and q. Rotation of the resultant is indicated by the intensity of light passing through the analyzer. In the crossed polariscope no light is passed in the unstressed regions (hence the term dark field) but as the resultant becomes rotated toward the axis of the analyzer, with increasing load, the light intensity increases at the viewing station. A further increase of load rotates the vector beyond the 90 degree position, until it is again perpendicular to the analyzer axis and the field is again dark. This cycle is known as one retardation and the effect will continue into higher orders as more load is applied. If n is the number of retardations, d the model thickness, and C a constant

Read at the 69th Annual General and Professional Meeting of The Engineering Institute of Canada, Toronto, May 1955.

Fig. 1. Fringe pattern for short column, loaded in compression, with transverse hole

for the material sensitivity and the wavelength used, then

$$p - q = n.C/d$$

The value of C is obtained by calibration, using a sample of model material and a known load. The relation between load and retardation number is usually linear up to 10 to 15 retardations.

The variation of $p - q$ throughout the model appears as a pattern of dark and light bands known as fringes and the retardation order is designated by the fringe number. In the light field polariscope the fringes are bright, Fig. 1: in the crossed polariscope the fringes are dark, Fig. 2 and 3. The fringe number at a particular point may be determined when the model is in the polariscope by counting retardations as the load is applied, or on a photograph by counting lines from a point where the fringe order is known, such as the zero fringe at the upper left or right corners of Fig. 1.

When the plane of polarization is in the direction of a principal stress the component perpendicular to it has zero magnitude and hence there can be no retardation effect regardless of how much load is applied. In a model, the points having principal stresses in a given direction will connect into lines known as isoclinics. By rotating the polarizer and analyser, the isoclinics for various stress directions are obtained and these may be used to draw stress trajectories or "flow lines". To make the isoclinics clearly visible, white light is used so that the isoclinic stands out as a black line (in the crossed polariscope) against a coloured fringe pattern.

The coloured fringe pattern results because white light contains all visible wavelengths and the retardation number is affected by wavelength. Above the third order, the coloured bands merge and become indistinct so that monochromatic light, usually from a sodium or mercury vapour lamp, must be used for higher orders. To remove the confusion of superimposed isoclinics, quarter-wave plates are placed between the polarizer and analyzer to produce (and then eliminate) circularly polarized light. Since the directions of principal stresses are not recognized by this light, no isoclinics appear. Figure 4 shows a complete polariscope using a "point" source of light and collimator to provide parallel light through the model. To circumvent the problems of obtaining parallel light over a large area the newer installations utilize a diffused light source, which may be a set of fluorescent tubes closely spaced. The polarizer, analyzer, quarter wave plate and diffused light mat-

Fig. 2. Fringe pattern for spur gear teeth: one pair of teeth in contact.

Fig. 3. Fringe pattern for spur gear teeth: two pairs of teeth in contact.

erials, for a 12 inch working area, may be purchased for about $100. To obtain sharp definition throughout the thickness of the model photographs of the fringe pattern are made with a long focal length camera, in some cases a distance of 15 feet between the model and the film, for a 1:1 magnification.

The maximum shear stress at any point is given by $\frac{1}{2}(p-q)$, so that the fringe number can be used to find this stress throughout the model. Components of shear can also be found from $\frac{1}{2}(p-q)\sin 2\theta$ when θ is obtained from the isoclinic. Since failure in a ductile material, under steady load, may start as a shear failure, the photoelastic method gives a direct indication of likely trouble spots.

Maximum tension and compression stresses are not indicated directly by the fringe pattern except at free boundaries, where one of the principal stresses (normal to the boundary) is zero. Since the stress causing failure is likely to be at the surface, no information beyond that given by the fringe pattern is usually required. In fact, where the peak stress can be expressed as a ratio relative to a known stress at some other point, it is not even necessary to calibrate the model material or measure the load that produced the fringe pattern. For example, in the crane hook of Fig. 5 the fringe pattern shows the maximum stress at the inside edge to be four times the stress in the shank and this would be true for any stress intensity within the elastic limit and for any prototype material. It can be shown that the *distribution* of stress within the model is identical with that in the prototype if the shape and load patterns are similar and if the elastic limit is not exceeded. It is also desirable that the optical limit of the model material, i.e. the fringe number for which linearity with stress ceases, be not exceeded. Local excesses of yield or optical limit, say where concentrated loads are applied, may be tolerated without disturbing the general pattern of stress (St. Venant's principle). However, when excessive distortion of the model, due to the low modulus of elasticity possessed by most of the model materials, results in a changed load pattern the stress distributions are no longer comparable with those of the prototype.

When stresses inside the boundary are desired there are several solution methods. although none of these is entirely convenient. If a pattern for $p+q$ could be obtained easily, this, with the fringe pattern for $p-q$ would enable the p and q stresses to be readily determined. Vol. 2 of reference 9 shows how isopachic diagrams for $p+q$ may be obtained experimentally. The Southwell relaxation method[38] is a mathematical means, usually requiring much computation time, in which $p+q$ may be obtained from boundary values found by the photoelastic method. Measurement of the change in model thickness as the load is applied will give $p+q$ but it is a delicate measurement requiring extreme accuracy, and usually can be done for only one point at a time. It is possible under certain special conditions to obtain p and q from photoelastic data, using methods given in Vol. 1 of reference 9. A newer method, developed by Dr. Shelson[39] combines the fringe pattern of the conventional polariscope with those obtained by the scattered light technique, but it is usually confined to the frozen stress models to be described later.

Edge Stress

Accurate determination of the fringe number at a free boundary involves difficulties. In the first place stresses may exist in the model before any load is applied. The materials supplied for photoelastic model-making are usually free of initial stress but if initial stresses do exist they may be determined and suitable compensation made in the assessment of the final fringe pattern. Some materi-

Fig. 4. Complete polariscope using point source and collimator to provide parallel light.

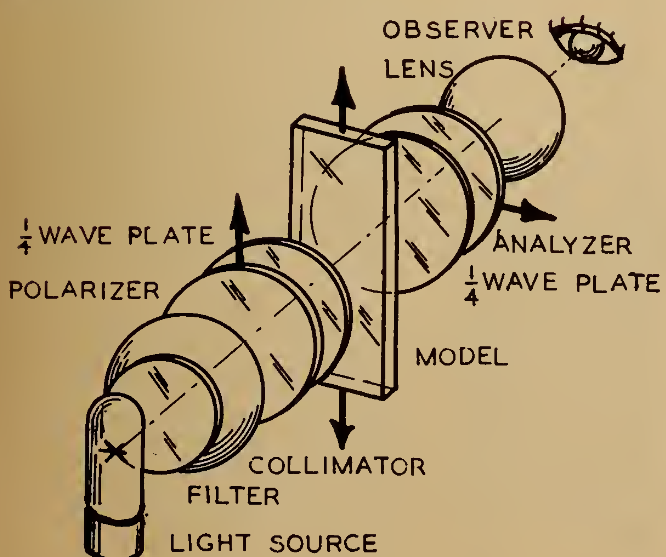
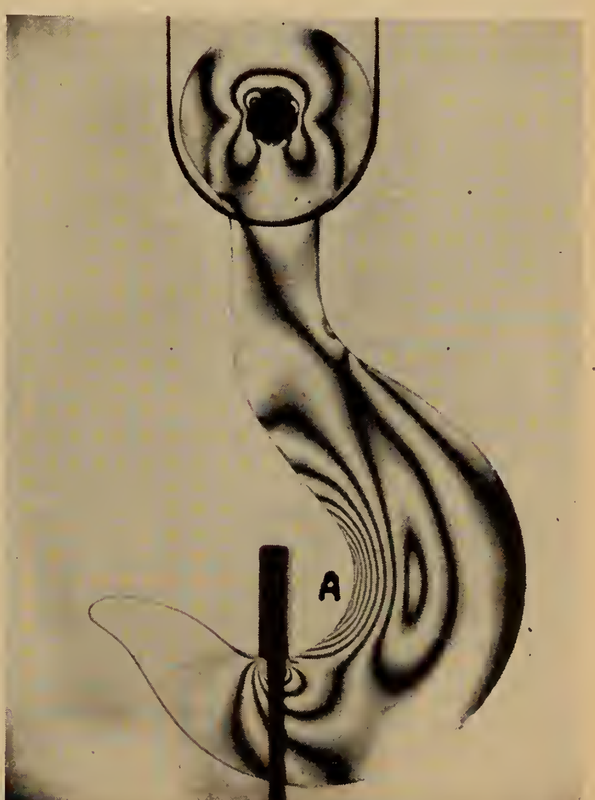


Fig. 5. Fringe pattern in crane hook.



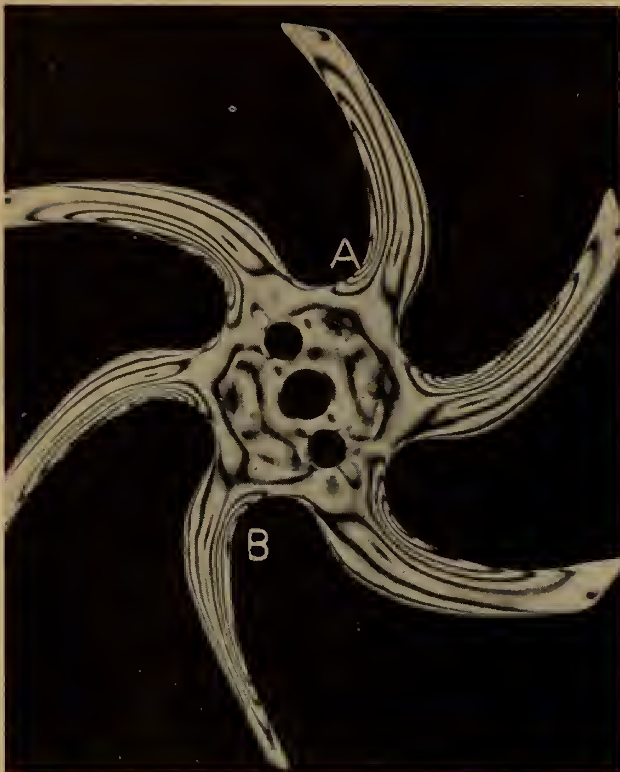


Fig. 6. Fringe pattern for pump impeller.

als permit removal of initial stresses by thermal annealing, although complete removal is somewhat difficult.

Edge stresses may be introduced during machining, particularly if heat is generated because of a dull tool, inadequate cutting clearance, or excessive depth of cut. Models for plane stress problems are usually cut from plastic sheets 3/16 or ¼ inch thick. A modern aid for this work is the Chapman profiler[48]. A high speed tungsten carbide multi-tooth cutter is guided by a follower pin in contact with a ⅛-inch thick metal template, of the correct shape and size, attached by adhesive tape to the plastic being cut. The model can be rough-cut to within 1/16 inch of the template, using a high speed jig saw, leaving only light cuts for the profiler. The presence of edge stress due to machining is evidenced by a disturbance of the fringe pattern. At point A in Fig. 5 the waviness of the fringes close to the edge shows that an uneven machining stress exists. Figure 2 shows the compression fringes in the A region and the tension fringes at B altered at the boundary to indicate the superposition of a tension edge stress. When small holes are required in a model it is usually necessary to have an accurate determination of stress at the edge of the hole, as in Fig. 1. Sharp drills with clean cutting edges will produce stress-free holes, particularly if the drill is submerged in a coolant while cutting.

The second cause of edge stress is an expansion or shrinkage of the machined edges of the model due to absorption or evaporation. This effect is usually uniform throughout the boundary and progresses with time. By using the model soon after it is made the extent of the error is limited. Figure 6 shows a compression edge stress at A and B, superimposed on the tension due to bending and tending to lower the fringe number at the surface.

Creep

Most of the plastics used in photoelastic work exhibit creep at room temperature. At any given point in the model the full strain is not developed the instant that load is applied so that the optical sensitivity appears to increase with time under a steady load. To obtain accurate stress values in a material that creeps, time calibration curves, as in Fig. 7, must be determined and applied to model work by noting the time lapse between initial load application and recording of the fringe pattern. Creep does not affect isoclinic values since these remain the same for all loads.

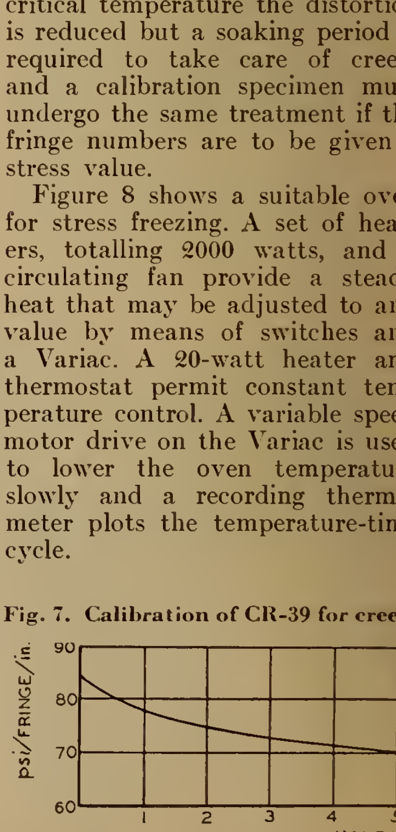
Stress Freezing

Some photoelastic materials will permit a thermal treatment that locks in the stresses, and hence the fringe pattern, after the loads have been removed. The model is heated to 80 to 90 per cent of its critical temperature during a two-hour period, the loads are applied and after about a half hour of "soaking" at constant temperature the model is slowly cooled to room temperature in about twelve hours. The di-phase materials used for this purpose may be visualized as having a fine elastic grid-work or lattice filled with a wax-like plastic that softens with increased temperature and becomes liquid at the critical temperature. The behaviour is fully elastic at the critical temperature but the modulus of elasticity is greatly lowered and hence the optical sensitivity is increased. As the material is cooled, under load, the plastic part stiffens and holds the grid work in the strained position, even when the model is cut into pieces.

If the model is heated to the critical temperature no soaking time is required because there is no longer any creep. However, the distortion is so great that unless the loads are very light the shape of the model may no longer represent that of the prototype. By using 80 to 90 per cent of the critical temperature the distortion is reduced but a soaking period is required to take care of creep, and a calibration specimen must undergo the same treatment if the fringe numbers are to be given a stress value.

Figure 8 shows a suitable oven for stress freezing. A set of heaters, totalling 2000 watts, and a circulating fan provide a steady heat that may be adjusted to any value by means of switches and a Variac. A 20-watt heater and thermostat permit constant temperature control. A variable speed motor drive on the Variac is used to lower the oven temperature slowly and a recording thermometer plots the temperature-time cycle.

Fig. 7. Calibration of CR-39 for creep.



The fringe pattern for the pump impeller shown in Fig. 6 was obtained by rotating the model at 3200 r.p.m. while the temperature was brought up to 210° F., held for half an hour, and then lowered over a 15-hour period. The photograph of the fringes was made in a conventional polariscope, and shows the largest stress to be tension at the inside fillet. Several blade shapes were included in the one model and it is interesting to note that the thinner blade at B shows one less fringe than the thick blade at A.

When dynamic stresses have "fixed" values, as in the rotating impeller, the stress freezing technique is suitable for stress evaluation but it is of no use for fluctuating stresses. In one of the impeller models that was tested the blades vibrated during rotation and the areas in which there were fluctuating stresses showed no distinct pattern. For problems of this kind and for stresses due to impact, a very strong light source of short duration is required. Figure 9 shows the Model 1534-A Polariscope[64] in which the Strobolume is used as a light source. With this equipment fringe patterns of a beam vibrating at 30 c.p.s. may be obtained, as described in references 40 and 41.

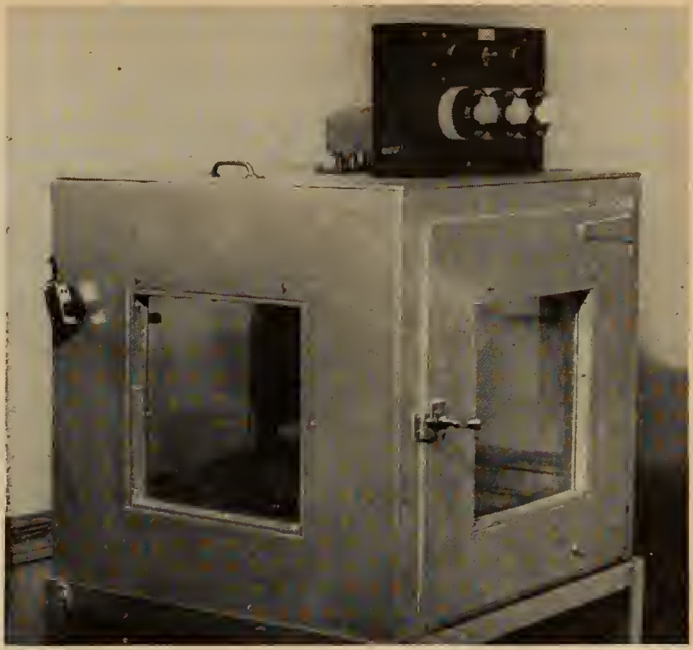


Fig. 8. Oven suitable for stress freezing. Constant temperature control is incorporated.

Materials

For plane stress models, CR-39 plastic[65] is most convenient. It is supplied in sheets of various thicknesses, 3/16 and ¼ inch being most useful, with optically polished surfaces. Although it cannot be annealed, it is usually free of stress when supplied and if machined carefully a stress-free model is obtained. Account must be taken of creep and time edge stress.

Celluloid, Lucite, and Plexiglas, although readily available and low in cost, are too insensitive optically for use as photoelastic models. This is illustrated in Fig. 5, where the model is made of CR-39 but the loading link at the top is Lucite of thickness equal to that of the model. No fringes appear in the loading link but those in the eye of the hook are readily visible.

BT-61-893 was the designation[66] of a material developed by another company for photoelastic work but it is now known as Catalin 61-893. It is supplied in sheets up to 1⅛ inch thick and is readily machined. The faces of a sheet are rough-sawn and it is necessary either to polish a model to optical clarity or coat it with an oil, of the same refractive index, while viewing the fringes. Catalin 61-893 can be annealed and is suitable for stress freezing, with a critical temperature of 230° F., but it develops severe time edge stress as can be seen in Fig. 6.

Other materials, such as Catalin 800, Marblette, Marco Resin, and Castolite may be used. For problems in which the body force (weight) is large relative to any externally applied load, such as in the study of earth dams and underground tunnels, gelatin is used. References 43 to 47 discuss materials.

Polariscopes

There are a number of commercial polariscopes available, ranging in price from $600 to $5000. References 41 and 48 to 51 list some sources of supply for polariscopes and one deluxe "home made" model.

The optics for a polariscope are usually purchased although the means for rotating the polaroids by remote control might be constructed by the user. The loading frame should be arranged for controlled application of load by a remote means so that the fringe build-up can be watched. There should also be an arrangement for bringing any point on a loaded model to the optical axis of the polariscope, preferably by controls at the viewing station.

The loading frame for the polariscope used in the Department of Mechanical Engineering at the University of Toronto has a screw thread arrangement giving coarse adjustment for tension, compression, and bending loads, a short stroke hydraulic piston for actual (remote) load application, and a strain gauge dynamometer system that measures only the load applied to the model. It permits a total force of 750 lb. with scale divisions of ½ lb. The loading frame (and model) can be moved horizontally and vertically, by handwheels located at the viewing station, for positioning of the model in the field.

Three Dimensional Stress Analysis

When the loads applied to a flat model are in the plane of the model the significant stresses will also be in that plane, although perpendicular stresses will exist. If the model is thin relative to its general dimensions the principal stresses will remain constant along the path of the light and the fringe pattern will be a true representation of the state of stress. However, if the model has excessive thickness, or if the loads do not lie in one plane, the value of $p-q$ may change along the light path and only an average value is indicated in the fringe pattern. Furthermore, with three dimensional loading the directions of the principal stress planes will vary throughout the body.

On a plane of symmetry in a body the principal stresses must lie in the plane and perpendicular to it. Hence, if this plane is isol-

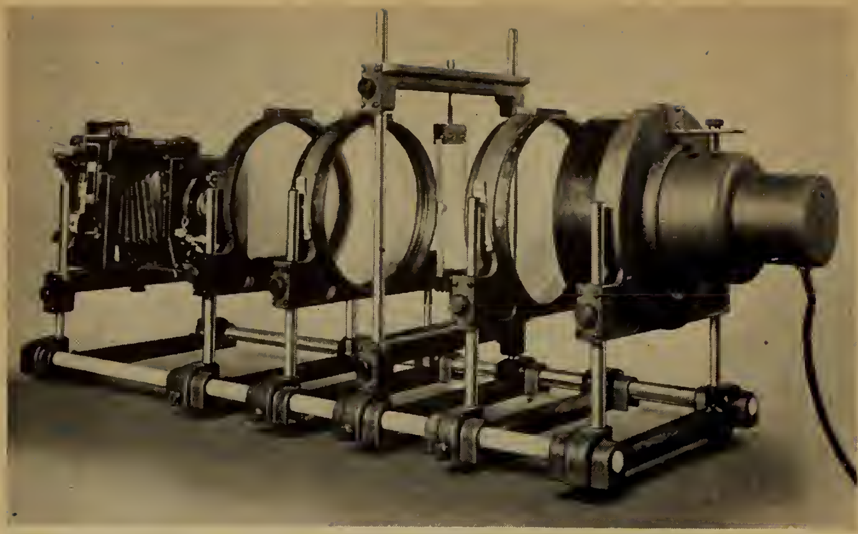


Fig. 9. Polariscope using the Strobolume as light source. Fringe patterns of a beam vibrating at 30 c.p.s. may be obtained. *(Photo.: General Radio Co.)*

ated, it can be examined in a conventional polariscope with the assurance that the observed fringes represent the differences of true principal stresses — those in the plane of symmetry. The principal stresses normal to the plane will not affect the fringe formation and some other approach is required to determine them.

At the surface of a body where no external load is applied one of the principal stresses is zero and the other two are in the surface plane. Again, if this plane could be isolated and examined in the conventional way, the principal stresses would be obtained.

One technique for examining the stresses in a plane using the conventional polariscope is to "freeze" the stresses as described previously and then saw the plane, as a slice, from the model. If the usual machining care is taken to prevent the introduction of machining stress, the frozen stresses will be unchanged by the slicing. A compromise must be made on the thickness of slice taken, since the fringe orders are reduced when the slice is made thinner, so as more nearly to approach uniform conditions in the perpendicular direction. If reduced forces are used to control distortion during stress freezing the highest fringe order in the slice may be only one or two.

A superior material[67] for the stress freezing technique is known as Fosterite. It has a high optical sensitivity, a lack of time edge stress, and is available in cylinders up to 6 inches diameter. The critical temperature is 194° F. so that a minimum freezing temperature of 160° F. is suitable. The University of Toronto oven, which measures 2 x 2 x 2 feet, requires about 200 watts for this temperature. The properties of Fosterite are outlined in references 51 and 52 and summarized in Table I.

Figure 10 shows a Fosterite model in the oven after stress freezing. The model consists of a hub and a flange, joined by a conical web section. With the flange securely bolted, a couple was applied to the hub in the form of horizontal forces acting through wires attached to the hub, passing over ball bearing pulleys and to which weights were attached. Because of the high coefficient of expansion for Fosterite (200×10^{-6} in./in./°C.) the flange was bolted to a Fosterite ring that was supported on thin steel rods to permit free radial movement of the ring. A Fosterite disc bolted to the jig and given the stress freezing cycle showed no stress induced by thermal effects.

The load applied to this model was too high and excessive distortion resulted. A slice from the plane of symmetry, Fig. 11*a*, shows a fringe order of 19 at the outside web fillet. In subsequent tests the load was reduced to keep the maximum fringe number below 10. Figure 11*b* is the same slice photographed 16 months later, showing the lack of time edge stress and no change in the fringe orders.

The slices were carefully sawed from the model and then faced in a lathe, using light cuts with the slice attached to the face plate by double adhesive. No polishing was done, but the slice was placed in a plate glass tank filled with oil of the same refractive index for viewing. In subsequent tests in this project the conical web was pierced with small holes and special techniques were used to obtain the stresses adjacent to

Fig. 10. Fosterite model (hub and flange joined by a conical web section) in the oven after stress freezing.

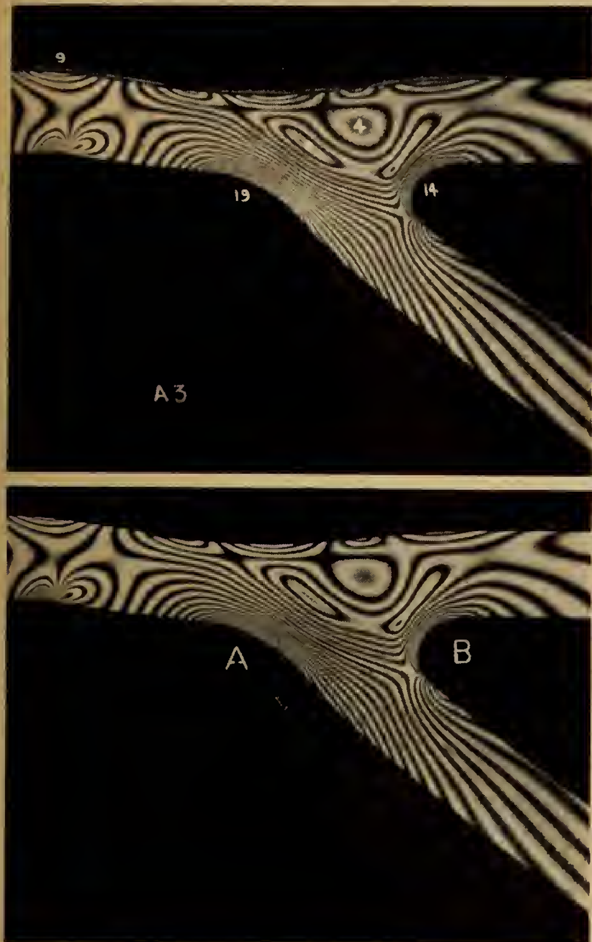


Fig. 11 (left). Slice from the plane of symmetry of the model shown in Fig. 10 showing excessive distortion; (*a*) above, original photograph; (*b*) same slice photographed 16 months later.

Fig. 12 (below). Two Fosterite models used in an analysis of stresses in thick-walled tubes.

path of light and a series of fringes may be observed indicating stress intensity not by fringe order but by fringe spacing. For each retardation the stress intensity is obtained from the fringe spacing d and material constant C as follows:

$$p-q = C/d$$

As the value of $p-q$ increases, the fringe spacing d decreases.

To prevent reflection and refraction at the model boundary it is submerged in a mixture of Halowax and Bayol, compounded to give the same index of refraction as the model material. A high intensity monochromatic light source is used with a polarizer, and a 0.010-inch slit provides the sheet of light. As the intensity of the scattered light is very low a completely darkened room must be used and a photographic exposure

them, but the maximum stress occurred at the hub fillet.

Scattered Light Technique

The problem of examining stresses on a plane can in some cases be handled by the scattered light technique in which a sheet of light is passed through the model instead of actually slicing it[54,55,56]. The light excites the particles of the plastic model so that they become secondary sources of light, of greatly reduced intensity, and may be viewed in a direction perpendicular to the beam. The effect is strongest where the light enters the model and diminishes along its path, particularly after passing through a region of high stress. Using a sheet of plane polarized light, preferably set at 45 degrees from the planes of principal stress, interference due to birefringence takes place along the

of 10 minutes is required with Super Pancro-Press Type B film. Measurement of fringe spacing must be accurately done and for this purpose the University of Toronto Photoelastic Laboratory has a microphotometer that measures light intensity on a spot 0.003-inch diameter. As the photographic film of the fringe pattern is moved with micrometer precision past the eye of the photometer a meter shows the exact centre of the dark fringe. The phototube is so sensitive that it must not be exposed to the bright part of the fringe pattern.

Figure 12 shows two of the Fosterite models used in an analysis of stresses in thick-walled tubes, subjected to axial load and internal pressure, with and without transverse holes. The study was made in connection with the gas

Table I. Properties of Materials Used for Models.

Material	Temp. °F.	Sensitivity p.s.i. per fringe	E p.s.i.	Poisson's Ratio	Creep	Time edge stress
CR-39	Room	75–90	295,000	0.41	medium	small
Catalin 800	Room	45–50	187,000	0.40		medium
	176	1.6	1,500			
BT-61-893	Room	84	630,000	0.36		large
	230	3.2	1,150	0.50		large
Fosterite	Room	unsuitable			high	none
	185	3.6	2,300	0.48	none	

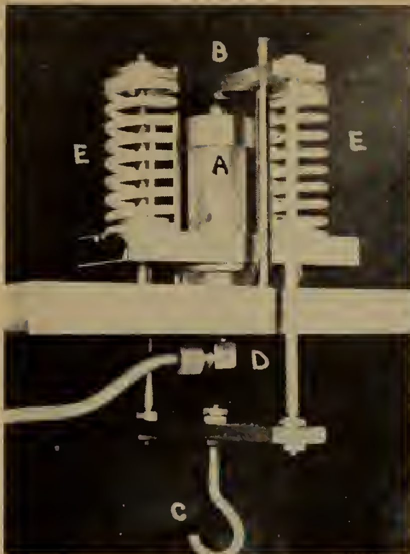


Fig. 13. Model (A) in loading frame ready for stress freezing: (B) frame for applying axial load; (C) hook for weights; (D) connector for internal pressure; (E) springs holding flange of model against bottom plate.

tube of an automatic shell ejector[57]. Figure 13 shows the model (A) in the loading frame ready for stress freezing; B is the frame for applying axial load through hook C and attached weight, D is the connection for internal pressure, and E the springs that hold the flange of the model against the bottom plate. A rubber membrane arrangement prevented loss of the hydraulic oil through the perforations, while offering no appreciable restraint on the internal pressure. Figure 14 shows the model in the scattered light polariscope. The letters indicate the high intensity mercury vapour lamp at A, a filter at B, collimating lens at C, polarizer at D, plate glass tank (before filling with Halowax mixture) at E, metal slit at F, and the model in its special holder at G. Fringe patterns were photographed from approximately the same point used to take Fig. 14.

Figure 15a is a scattered light fringe pattern for a transverse plane cutting through the unperforated tube shown at the left in Fig. 12. The tube has not been cut apart in any way, but it does not show in Fig. 15a because it is illuminated only on the transverse plane, the light entering from the left. The pattern frozen in the model resulted from internal pressure and axial load. The fringe *spacing* along the horizontal diameter represents the difference between the axial stress and the tangential stress. An increase in

Fig. 14. Model in scattered light polariscope. A, mercury vapour lamp; B, filter; C, collimator; D, polarizer; E, plate glass tank; F, metal slit; G, model in special holder.

stress intensity toward the inside of the tube is plainly visible. By using other optical sections the three stresses, axial, radial, and tangential, may be found. Figure 15b is a transverse section that was taken tangent to one side of the perforations. Although the holes are not visible in the photograph their effect on the fringe pattern may be clearly seen.

Oblique Incidence

When examining a slice, or a plane stress model, in the transmission polariscope care is usually taken to have all rays in the beam of light perpendicular to the face of the slice. However, for determination of stresses at a given point it is possible to rotate the slice about one of the principal stresses at that point and obtain a new fringe value[58,59]. The method is more difficult and in some cases not applicable for slices that are not from a plane of symmetry, but may be used for boundary stresses, particularly when the directions of principal stresses are known before slicing[60].

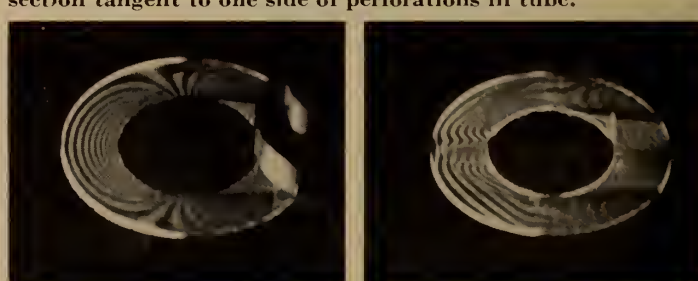
Conclusion

A number of photoelastic techniques have been described briefly and it may be necessary in a complicated stress problem to use a combination of these together with information from the applications of stress coat or strain gauges to a metal model. With careful work and straightforward techniques an accuracy within 5 per cent may be obtained but under questionable conditions the error might be 30 per cent[61]. However, in the latter case it frequently happens that there might be no alternative approach to the stress problem and the photoelastic method is infinitely better than none.

In plane stress work there is no effect on the similarity of stress distribution between model and prototype arising from differences in Poisson's ratio. In three dimensional work, however, these differences have a definite, although usually unknown, effect. In the stress freezing technique the plastics attain a ratio of 0.5 which is significantly different from that of metals, so that attempts have been made to develop three-dimensional room - temperature procedures[62]. However, in the discussion by V. M. Hickson of reference 61, it is pointed out that errors caused by differences in Poisson's ratio are not as significant in the maximum principal stress as in the lesser ones, and that some interpolation might be done between models made of materials having different values of the ratio if the effect became important.

Fortunately many problems can be treated with sufficient accuracy using CR-39 plastic in a transmission polariscope and the speed of this method makes it attractive. In the problem of the gas tube for the automatic ejector it was desirable to have the maximum amount of perforation, for gas discharge, without increasing stress concentration unduly. For this study the tube was considered as a flat plate,

Fig. 15. (a) Left, scattered light fringe pattern for transverse plane through unperforated tube. (b) Pattern for transverse section tangent to one side of perforations in tube.



loaded in compression, with various arrangements of holes in-line and staggered[63]. Figure 16 shows a plate carrying a vertical compression load while Fig. 17 and 18 are enlargements of the in-line and staggered arrangements.

The results of this investigation showed the stress concentration factor for the in-line arrangement remained at about 1.65 as the ratio of hole area to net area increased (closer hole spacing) while the factor for the staggered arrangement rapidly increased with increase of area ratio beyond 0.30.

In the measurement of loads, dynamometer rings are frequently used, with strain gauges cemented on the inside and outside of a metal ring. Since the strain gauge measures the average strain over the area to which it is applied, it is of interest to know the stress gradient along the external and internal surfaces of the ring and if the stress changes sign. The inside and outside gauges are usually connected into opposite arms of a Wheatstone bridge, so that the ratio of average stresses should be known. When the dynamometer ring is small, say two inches outside diameter, it is necessary to know whether a more expensive short gauge should be used or the conventional A-11. Accurate calculation of these stresses is quite tedious but the polariscope provides a very convenient method.

Sometimes stresses exist that are unsuspected until failures begin to appear. For example, there is a surface tension stress adjacent to a large compression contact stress. This stress was the cause of fatigue failures in railroad axles where the car wheels were shrunk to the shaft, until a combination of redesign and artificially induced surface compression stress eliminated the trouble. The tension stress was demonstrated photoelastically by a frozen stress model in reference 39, but it is also shown in Fig. 19, using a plane compression load on CR-39. The 1.8 order fringe at A represents a tension stress of 790 p.s.i. developed by the (average) 2140 p.s.i. compression stress at the contacting surface.

Many stress problems remain that cannot be solved by the photoelastic method; some of these may never attain solution, others await the ingenuity of the photoelastician to devise new or improved techniques. From the examples included in this paper and those given in the bibliography it is evident that in many instances photoelasticity can be of great assistance to the design engineer and that the day is not far off when the polariscope will be a necessary tool, not a luxury.

(*DISCUSSION—see page 34*)

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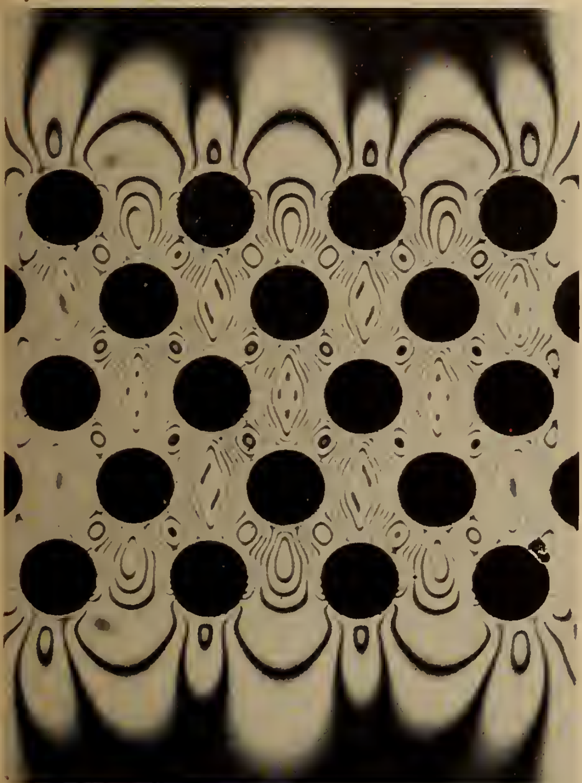

Fig. 16 (left). Plate carrying a vertical compression load.

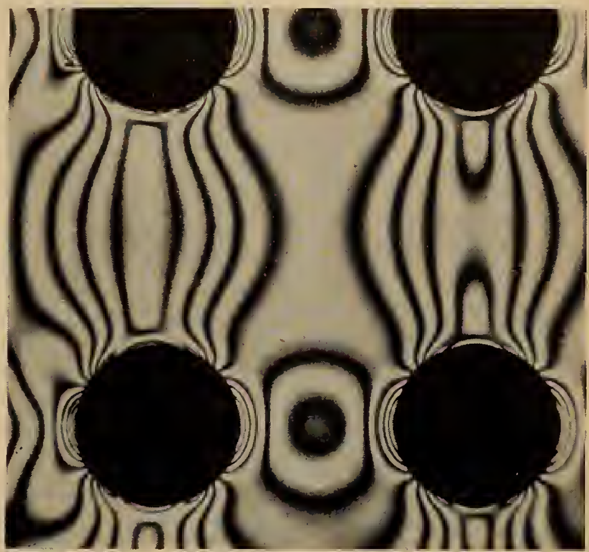

Fig. 17 (top, right). Enlargement of in-line arrangements from plate carrying vertical compression load.

Fig. 18. Enlargement of staggered arrangements from Fig. 16.

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Fig. 19. Tension stress existing adjacent to large compressing contact stress.

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A Complete Sanitation Program for Metropolitan Toronto

L. B. Allan, M.E.I.C.
Commissioner of Works,
Municipality of Metropolitan Toronto.

Following the establishment of a metropolitan form of government in the Greater Toronto area a master plan was developed to provide adequate water and drainage facilities throughout this area of rapid growth.

In recent years industrial and residential expansion in the metropolitan Toronto area has been spectacular, perhaps as rapid as any city in North America. Since the war, the population of Toronto and its twelve surrounding municipalities has shown an intense growth — from 900,000 to over 1,250,000. Of this increase, very little has occurred within the city proper, but the population of some of the suburban municipalities has more than doubled. For instance, the population of the township of North York increased from 38,000 in 1948 to over 130,000 in March, 1955. The growth in population of the suburban municipalities shows no sign of abating.

Coincident with the rapid expansion of the Toronto area has come a tremendous demand for services of all types, which was one of the compelling reasons necessitating the establishment of a metropolitan form of government in the Greater Toronto area. Paramount in the service requirements was a demand for sewage disposal facilities which it had been demonstrated could not be provided by the individual efforts of the separate municipalities or by reliance upon the process of mutual assistance and cooperation.

The city of Toronto, for example, supplied sewage treatment facilities for the village of Forest Hill and the town of Leaside, and accepted some sanitary drainage from the townships of North York, York and East York, all of whom paid trunk sewer and outlet charges for the accommodation provided. The township of Etobicoke had agreements with the town of Weston, the village of Long Branch, and the Union Sewerage Commission (Mimico and New Toronto) for treatment of sanitary drainage. With the tremendous increase in population in the townships of Etobicoke, Scarborough and North York, shortage of water and sewerage accommodation in these municipalities was particularly severe. At this time the city and the municipalities through agreements endeavoured to give sewer and water accommodation within their ability to cope with the situation.

The problems presented by the above-mentioned conditions, among others, finally became acute and required an immediate remedy. Realizing the problem the city made application to the Ontario Municipal Board for amalgamation of the twelve adjoining suburban municipalities and itself. After a complete and exhaustive investigation of existing conditions the Ontario Municipal Board, in a report signed by its chairman, Lorne Cumming, and its vice-chairman, W. J. Moore, placed its findings and recommendations before the Government of Ontario. These recommendations were used by the Provincial Government as the basis of "Bill 80", which, after receiving Royal assent on April 2, 1953, became "The Municipality of Metropolitan Toronto Act."

The local municipalities which together constitute the new municipality of metropolitan Toronto are shown in Fig. 1 and listed in Table I.

The Municipality of Metropolitan Toronto Act provided that on and after January 1, 1954, responsibility for all sewage treatment within the metropolitan area rested with the new metropolitan corporation, and no member municipality would be permitted after that date to operate, plan, or own any sewage treatment works.

To enable the new corporation to meet its obligations under the act, it additionally provided that, on the date mentioned, all rights and titles to sewage treatment works, sewage pumping stations, and trunk sewers owned by area municipalities or boards thereof, and designated by by-law of the metropolitan council, were to be transferred to the municipality of metropolitan Toronto, which, along with the physical structures, assumed all outstanding debt, and all rights or obligations imparted by existing agreements, easements, etc.

One of the first steps taken by the new administration was the engagement of a firm of consulting engineers to present recommendations for a master plan to provide the much needed water and drainage facilities throughout the metropolitan area, in as orderly a fashion as possible, and in a manner that would keep the works program within the financial ability of the metropolitan corporation. On January 30, 1954, the firm of Gore and Storrie presented its report to the metropolitan works committee, which forwarded it to the metropolitan council, embodying a priority list for the works as recommended by the commissioner of works.

Existing System

Most of the existing sewers in the metropolitan area are of the

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Read at the 69th Annual General and Professional Meeting of The Engineering Institute of Canada, Toronto, May 1955.

combined type, in which the sanitary and industrial wastes and surface water are collected and carried away together in the same sewers. The construction of sewers of sufficient capacity to carry the combined storm and sanitary flow to a single point of disposal is not economically feasible and, consequently, the usual practice is to convey an amount equal to 2½ times the normal dry weather flow to the sewage treatment plant, and to discharge the remainder of the flow to nearby watercourses or lakes.

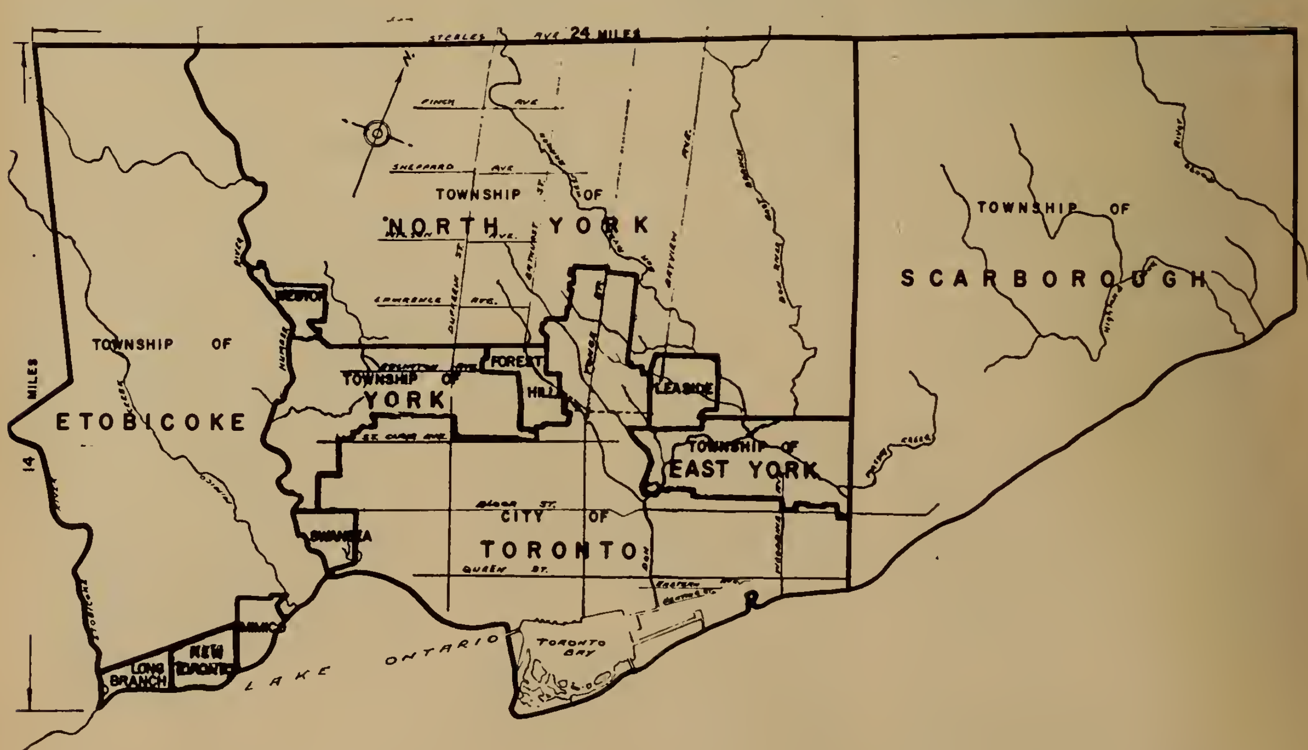
In metropolitan Toronto there are many watercourses into which storm flow may be discharged without nuisance, but many of them are so small that the overflow from a combined sewer system would be objectionable because of pollution carried into the streams during such overflow periods. Accordingly, metropolitan Toronto has adopted the policy that in the future all sewers in the area will be separate, i.e., sanitary sewage is carried in one set of sewers and storm water runoff in another. Coupled with the resulting improvement in stream conditions will be the saving in the size of sewage treatment plant facilities, with the elimination of the extra 150 per cent load delivered to the plants by combined sewers designed to intercept 2½-times dry weather flow.

Table I. Municipalities Constituting Metropolitan Toronto

Municipality	Area Acres	Area Sq. Miles	Population March, 1955
City of Toronto	22,287	34.82	682,415
Township of York	5,050	7.89	106,695
Township of East York	3,747	5.85	68,812
Township of North York	44,588	69.65	130,766
Township of Scarborough	45,012	70.33	95,706
Township of Etobicoke	27,312	42.67	83,169
Town of New Toronto	659	1.02	11,207
Town of Mimico	500	.78	12,383
Town of Leaside	1,126	1.75	16,873
Town of Weston	622	.97	8,569
Village of Forest Hill	739	1.15	18,664
Village of Swansea	682	1.06	8,718
Village of Long Branch	750	1.17	9,263
Totals	153,074	239.11	1,251,840

Prior to formation of the metropolitan corporation, proper engineering design of sewer systems was, in many cases, not possible because of artificial municipal boundaries. Where joint services were required, neighbouring municipalities often could not find a basis for determination of responsibility; down-stream communities, whose treatment facilities already were inadequate or overloaded, were obliged to refuse sanitary drainage from their up-stream neighbours and sewers in areas which provided natural outlets for storm drainage from up-stream communities were inadequate to serve the neighbour, so that some up-stream areas bordering heavily developed sections down-stream became virtually impossible to drain from an economic standpoint. In short, no long-range view was possible and the end result is the existence of a non-integrated system; sewers in one municipality draining large areas toward another municipality, and into which they logically should continue to flow, instead are intercepted by pumping stations, or a series of pumping stations, which pump the flow back, often by long and complicated systems, to a sewage treatment plant upstream. In many cases the plant effluent then flows back in an open stream often through the municipality which originally refused to accept the sewage. This condition cannot be corrected immediately but will gradually be improved with the construction of a metropolitan sys-

Fig. 1. Municipal boundaries of Metropolitan Toronto.



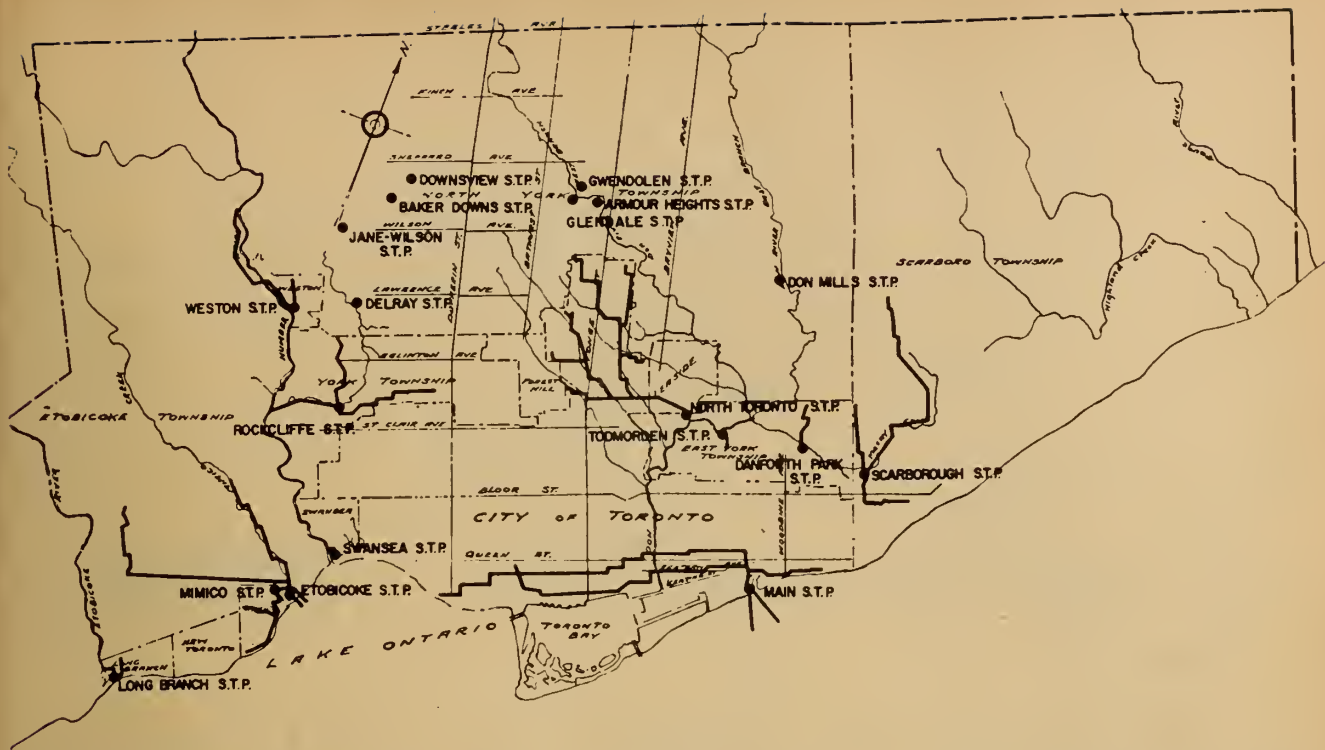


Fig. 2. Existing trunk sewers and sewage treatment plants.

tem designed to serve all areas with equal and adequate facilities.

Existing Sewage Treatment Plants

There are nineteen sewage treatment plants within the borders of metropolitan Toronto, as indicated in Fig. 2. A list of these plants is given in Table II.

The foregoing plants, with the exception of the R.C.A.F. plant at Downsview, and the Don Mills plant, were assumed by Metropolitan Toronto By-Law No. 36 on January 1, 1954, as authorized by the Municipality of Metropolitan Toronto Act. The other two plants were not assumed as they were not owned by an area municipality at the time the by-law was passed.

All of the above-mentioned treatment plants, with the exception of Weston, are of the activated-sludge type, the latter being a bio-filtration installation. The main plant, at the moment, provides primary sewage treatment only, with the second stage, i.e., installation of aeration tanks, secondary settling tanks, etc., at present under design.

Sewage may be broadly defined as "water-carried wastes", and its character depends upon the relative amount of water and the composition of wastes. Wastes from residential and commercial areas do not vary a great deal in composition or in quantity per capita. Wastes from industrial establishments, however, may vary a great deal.

Sewage treatment consists essentially of the removal of the wastes from the sewage so that its water content, which is used as the carrier of the wastes, can be safely discharged into the receiving waters. There are numerous processes involved in the treatment of sewage, and the degree of treatment to be accomplished depends upon the processes or the combination of processes utilized. Primary treatment consists of the removal of the heavier solids from the sewage, usually by means of screening, settling of grit, and sedimentation. Secondary treatment consists of the removal of the finer solids and colloidal matter and is generally accomplished by means of a bacteriological process involving oxidation and sedimentation. Treatment plants of the primary type remove 50 to 55 per cent of the suspended solids and about 35 per cent of the biochemical oxygen demand. Secondary treatment plants can accomplish reductions of 90 per cent or more.

In addition to the treatment of the sewage to provide a good effluent for discharge into the lake or stream, provision must be made for the disposal of the wastes as they are removed from the sewage. The first step is usually anaerobic digestion in heated tanks which reduces the solids by 45 to

Table II. Sewage Treatment Plants in Metropolitan Toronto

Name of Plant	Capacity (M.g.d.)	Constructed by	Location
Main (Ashbridge's Bay)	84. (D.W.F.) 210. (Storm)	City of Toronto	Ashbridge's Bay
North Toronto	7.5	City of Toronto	Don River
Glendale	3.0	North York Twp.	West Don River
Armour Heights	0.24	North York Twp.	West Don River
Gwendolyn	0.15	North York Twp.	West Don River
Don Mills	1.4	North York Twp.	East Don River
Jane-Wilson	0.15	North York Twp.	Black Creek
Baker Downs	0.42	North York Twp.	Black Creek
Delray	0.75	North York Twp.	Black Creek
Downsview	0.75	R.C.A.F.	Black Creek
Weston	2.7	Weston	Humber River
Rockcliffe	2.5	York Twp.	Black Creek
Swansea	0.5	Swansea	Humber River
Etobicoke	3.0	Etobicoke Twp.	Mimico Creek
Mimico	2.4	Mimico	Mimico Creek
Long Branch	0.75	Long Branch	Etobicoke Creek
Todmorden	1.5	East York Twp.	Massey Creek
Danforth Park	1.0	East York Twp.	Massey Creek
Pharmacy Avenue	2.25	Scarborough Twp.	Massey Creek

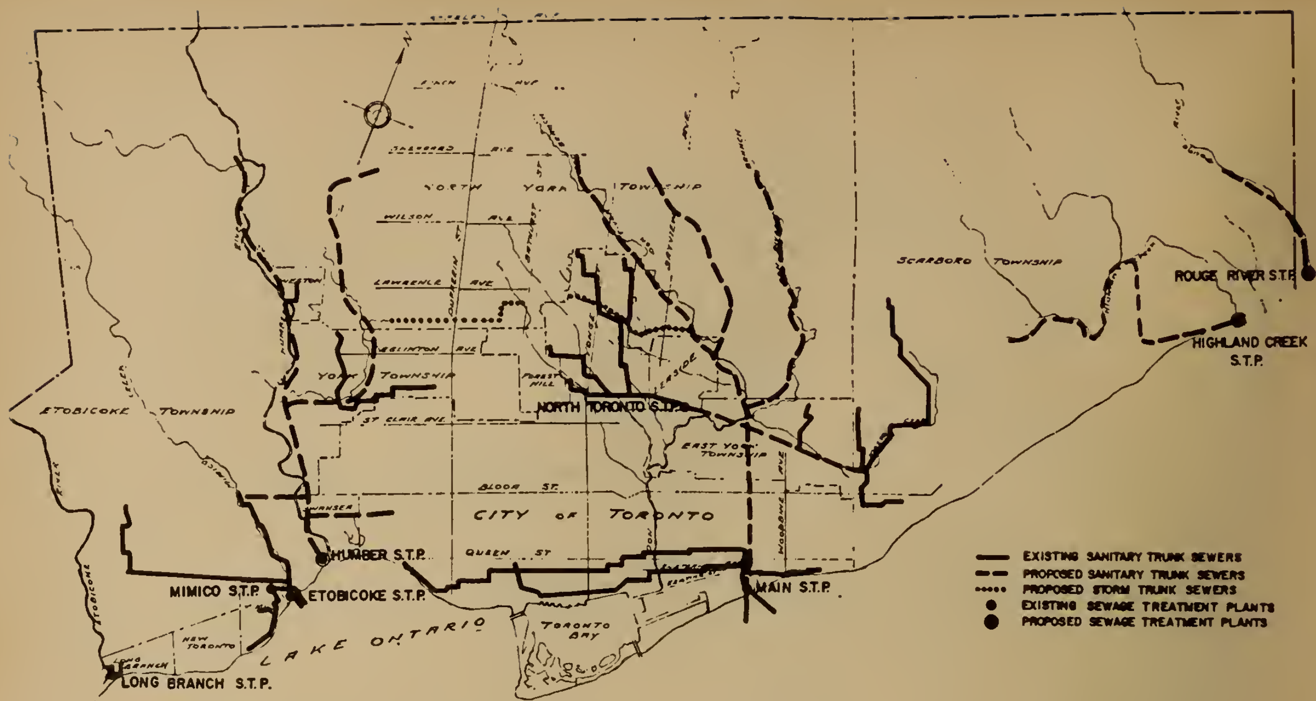


Fig. 3. Ultimate trunk sewers and sewage treatment plants.

50 per cent. The digested sludge can then be dewatered on vacuum filters, heat dried and disposed of as a fertilizer, or burned.

A treatment plant with secondary treatment to serve a population of one million persons will produce daily about 2,500 tons of raw sludge, 1,250 tons of digested sludge, 500 tons of sludge as dewatered on vacuum filters, 135 tons if heat dried, or, if burned, 25 tons of ash. It is quite apparent that the volume of wet sludge, even if digested, is great and if not hauled to farms and deposited on the land, requires that drying or incineration facilities be provided. The main sewage treatment plant at Ashbridge's Bay has facilities for either burning or heat drying the sludge.

The provision of complete treatment of the sewage to remove 95 per cent or more of the suspended solids and biochemical oxygen demand, together with chlorination of the effluent is planned for the main treatment plants to serve the metropolitan area.

The construction of eight treatment plants in the township of North York, as listed in Table II, scattered as they are over an area approximately double that of the city of Toronto, has served a useful purpose, but does not constitute a permanent solution for the disposal of sewage in that area of metropolitan Toronto. These plants have been constructed with a minimum of expense, on the understanding that eventually they would be abandoned and the sewage conveyed to adequate plants near the shore of Lake Ontario. In all cases, they are located in the river valleys, which will enable them to be taken out of service when sanitary intercepter sewers are installed in those valleys. The reason for the construction of numerous small plants was the pressure of development over a wide area. Some of them were installed and paid for by land subdividers since they were less objectionable and less expensive than individual septic tanks, which would have been the alternative in an unsewered area.

Sewage Treatment in the Future

The main sewage treatment plant at Ashbridge's Bay, which provides only primary treatment at present, was constructed with the approval of the Ontario Department of Health, which body directed that the installation of secondary treatment facilities must be commenced within four years of the time the primary plant was completed. Consulting engineers have now been engaged by metropolitan Toronto to prepare plans for the immediate construction of this second stage, and extension of the sea wall protecting the site from Lake Ontario is presently underway at an estimated cost of $200,000.

The main plant will be enlarged eventually to serve a population of one million persons, with a dry-weather flow capacity of some 120 million gallons per day. This plant will serve the entire Don River watershed within the metropolitan Toronto limits, except for a small portion of the flow which will continue to be treated at the North Toronto sewage treatment plant.

To serve residents in the Humber River and Mimico Creek watersheds, construction of a sewage treatment plant near the mouth of the Humber River has been recommended.

This plant will finally receive sewage from the village of Swan-

Table III. Current Authorized Sewage Treatment Projects.

Plant	Estimated Cost	Work to Start
Main Plant	$26,000,000	1954
Humber Plant	14,000,000	1954
Highland Creek Plant	12,000,000	1954
Mimico Plant (Addition)	300,000	1954
Rockcliffe Plant (Temporary Addition)	175,000	1954
Weston Plant (Temporary Addition)	125,000	1954
Long Branch Plant	1,000,000	1955
North Toronto Plant (Vacuum Drying)	400,000	1955
Etobicoke Plant (Addition)	1,000,000	1955
TOTAL	$55,000,000	

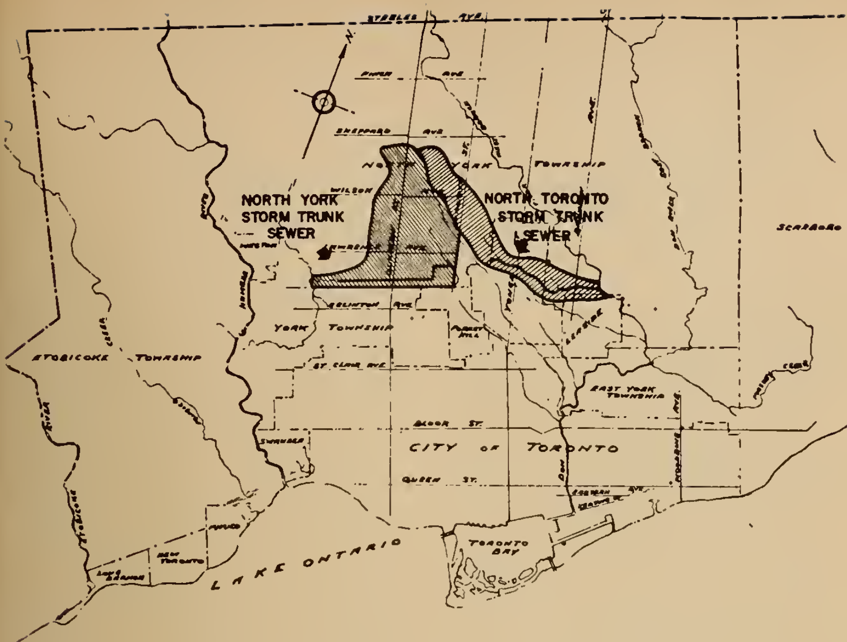


Fig. 4. Storm trunk sewer construction.

sea, the township of York, that part of the township of North York west of a height of land in the vicinity of Dufferin Street, the greater part of the township of Etobicoke, and a section of the westerly part of the city of Toronto, presently draining to the main plant at Ashbridge's Bay. Ultimately, it is expected that the plant will have a capacity of 87.5 million gallons per day, and serve a population of 800,000.

The North Toronto plant will be continued in operation, with its present overload relieved by construction of a sewer link to the interceptor leading to the main plant. Modern sludge handling equipment will be installed to relieve a serious situation developing at present with regard to disposal of sludge.

A third major plant will be constructed at the mouth of the Highland Creek, at the easterly end of the township of Scarborough. It will ultimately serve an area of some 23,000 acres, including the land assembly area at Malvern. Construction of this plant is now underway, with the initial unit designed to provide complete treatment for four million gallons of sewage per day. It is expected that its capacity will have to be doubled in a very short time, and that further enlargements will be made as development of its drainage area proceeds.

A further plant at the mouth of the Rouge River may be constructed at some date in the future, to serve Pickering township, to the east of Scarborough, and a small part of metropolitan Toronto.

The following plants will remain in service for a number of years, with possibly some expansion of facilities: Etobicoke, Glendale, Weston, Mimico, and Rockcliffe.

The Long Branch plant is severely overloaded, and consideration is being given to its improvement or its abandonment, and construction of an entirely new plant, probably in conjunction with the township of Toronto, which adjoins metropolitan Toronto on the west, to serve the lower Etobicoke Creek valley.

Table III outlines current sewage treatment projects, as authorized and given priority by the Metropolitan Toronto Council.

Table IV. Extensions to Trunk Sewers.

Sewer	Estimated Cost	Work to Start
Highland Creek Trunk	$ 7,000,000	1954
Black Creek Trunk	1,400,000	1954
Humber River Trunk	2,800,000	1954
Coxwell Trunk	2,800,000	1954
Humber Valley Trunk	500,000	1954
Etobicoke Trunk	1,250,000	1956
Massey Creek Trunk	740,000	1957
West Branch Don River Trunk	2,100,000	1956
Don River Trunk	510,000	1959
Wilket Creek Trunk	900,000	1956
High Park Trunk	450,000	1960
East Branch Don River Trunk	2,526,000	1956
TOTAL	$22,976,000	

Metropolitan Trunk Sewer System

On July 1, 1954, metropolitan Toronto, under by-law No. 144, assumed control of trunk sewers indicated on Fig. 2, asserting powers vested in it by the Municipality of Metropolitan Toronto Act. As may be seen from the plan, most sewers which drained sewage from a neighbouring municipality were assumed by the metropolitan corporation, in an attempt to eliminate one difficulty which past experience had indicated would stifle development. Other major interceptors were assumed on the basis of the area served by the sewer. Because of the combination of sanitary and combined systems in the area, as pointed out earlier in this paper, it was not possible simply to classify every sewer above a certain diameter as a trunk sewer. Careful consideration was given to this problem before the decision was reached as to which sewers would be classified as metropolitan trunks, and consultations were held with the municipal engineers of each of the area municipalities.

Plans for the extension of the trunk system are now well advanced, and in some instances, construction is under way. Figure 3 illustrates the proposed interceptor sewer extensions, which will, in the main, follow the river valleys.

Table IV lists the various projects and their value.

The Highland Creek trunk is at present nearing completion, having been designed by the township of Scarborough, engineering department, and checked by the metropolitan works department. It is expected to extend from the new plant at the mouth of Highland Creek to Brimley Road and Lawrence Avenue, early in 1956.

The Black Creek trunk, which extends from our Rockcliffe sewage treatment plant to our Baker Downs sewage treatment plant, along the valley of Black Creek, is now well advanced in the planning stage. Preliminary surveys are complete, soil boring work has been carried out, and will be further extended in the near future. Construction will be well advanced by the end of 1956.

The Humber River trunk sewer, extending from the river mouth to a point near Lambton golf course will be started early in 1956.

The Coxwell trunk extending from the main plant at Ashbridge's Bay northerly to the Don River in East York has been turned over for design to consulting engineers. Soil investigations are currently in progress for this 96-inch diameter sewer, which is proposed to be constructed in tunnel, at depths up to 160 feet below surface level. Experts in soil mechanics have been engaged to interpret the findings of the drilling contractor, in order to advise the proper structural design, and to predict the method of tunnelling most likely to be found necessary. Tenders are to be invited shortly.

The Humber Valley trunk, authorized for 1954 commencement, is now completed, and extends sanitary drainage facilities some 1½ miles northerly along the Humber River from a point south of Summerlea golf course. Temporarily, sewage from the area served by this sewer will be treated at our Weston sewage treatment plant.

The Etobicoke trunk is a northerly extension of the Humber River trunk, and will extend from Lambton golf course to a point north of the town of Weston.

The next four projects in the list, the Massey Creek, the West Don River, the Don River and the Wilket Creek trunks, as well as the East Don River trunk, form the Don River drainage system, radiating out from the northern terminus of the Coxwell trunk sewer. Their design and construction will follow commencement of the Coxwell trunk, which provides their outlet and a connection with the main sewage treatment plant. The East Don trunk, however, has been advanced to 1955. In a recent decision, the metropolitan council refused to permit further development of small sewage treatment plants proposed by subdividers, and proposed instead the immediate installation of the permanent trunk sewer. This interceptor will provide a drainage outlet for 15,000 acres in the township of North York.

The High Park trunk is designed to intercept flow from the northwest section of the city of Toronto, and may drain an area of approximately 2,500 acres. Its construction is set for the future, after preliminary development of the Humber plant.

Storm Drainage

As authorized by metropolitan council, storm projects are:

Project	Estimated Cost	Work to Start
Open Creek Channel...	$1,000,000	1954
North Toronto Trunk..	1,100,000	1954
North York Trunk.....	2,000,000	1954

As yet, the metropolitan corporation has not assumed any storm sewers as such, preferring to give the matter careful study before making a decision. Because of their purpose, storm sewers tend to be larger, and more costly, than sanitary trunks. Therefore, metropolitan Toronto will try to keep all sizeable watercourses open within the newly expanding areas, to avoid capital cost of construction of these large sewers at the present time. However, two major storm drainage projects are included in metropolitan Toronto's works program. Areas drained are outlined on Fig. 4. Both sewers are urgently required to permit development of a considerable area of the township of North York.

The North Toronto storm trunk will remove storm water from the North Toronto combined sewer system, and thus relieve the North Toronto sewage treatment plant. Several creeks are to be intercepted at the point where they enter the present North Toronto system and be diverted along a former creek bed by open channel and by piping where necessary. It is hoped to make it an attractive feature of the city of Toronto's parks system by the use of proper landscaping. Work is now under way on this project. The removal of creek water from the North Toronto trunk system will create capacity in those sewers for draining sanitary sewage from a large area of North York.

The North York storm trunk will intercept a number of creeks at present flowing from North York into York township, the village of Forest Hill, and the city of Toronto, and discharge the flow to Black Creek, a tributary of the Humber River. Major relief will be given to overloaded sewers in York township and Forest Hill by this project. Three contracts have already been awarded on this work.

Another function which was given to metropolitan Toronto under the act was the supervision of design, construction and maintenance of all works draining to metropolitan watercourses, trunk sewers, or sewage treatment plants. As a result, during the period since January 1, 1954, all thirteen area municipalities have submitted plans of proposed drainage works to the metropolitan administration for approval of design and financing. The chief advantage is the establishment of uniformity throughout the area in sewer design, as well as an overall control of expenditure which maintains metropolitan Toronto's splendid financial position. Construction standards have been left to the area municipalities to enforce, for a large inspection staff would be required to oversee all works in the area and in all cases the various municipalities have well trained and experienced personnel.

Associated with the foregoing, all new land subdivisions are reviewed for the metropolitan Toronto planning board and a report made about availability of sanitary drainage and treatment facilities. Recommendations and comment are also made on surface drainage requirements.

In the field of industrial waste, regular inspection of abattoirs, tanneries, refineries, soap works, etc., are made.

In conclusion, a brief summation of the points brought out by this paper might be in order. We have seen that the Toronto area is one of the fastest expanding districts in North America; that the rapid expansion is creating tremendous difficulties in many fields of public services, particularly water supply, drainage and sewage treatment, and transportation. Because the city of Toronto and its suburbs were experiencing difficulty in finding the way to provide the area with the services it needed, the municipality of metropolitan Toronto came into being.

Metropolitan Toronto at once engaged competent experts to set out a master plan for the provision of the services, with the financial resources of the entire area now available to back the debenture debt which must be assumed to pay for them.

(*Continued on page 36*)

Radar Echoes from the Aurora and the use of Doppler Techniques

A. G. McNamara,
National Research Council,
Radio and Engineering Division.

The history of radio reflections from aurora is quite young. In Norway in 1940, Harang first observed unusual echoes at times of aurora using a frequency of 40 Mc/s. These "aurora echoes" occurred at frequencies at which normal ionospheric echoes could no longer be obtained, i.e. in the VHF range, from 30 Mc/s. to several hundred megacycles.

World war II saw the advent of high-power VHF radar, and after the war some of this equipment became available for research purposes. Since then, auroral radar studies have been pursued strongly in Canada, Norway, and the United States and in England. At Saskatoon, where visual studies have been carried on for many years, radar observations of aurora were begun by Currie, Forsyth and Vawter in 1948.

The Aurora

Canada is very well situated for auroral observations as may be seen by referring to the map (Fig. 1). The auroral zone is the region in which the visible auroral occurrence is most frequent. This zone is a roughly circular annulus of about 23° radius centred at the geomagnetic pole. The geomagnetic pole, which is defined by the main part of the earth's external magnetic field, is not coincident with the magnetic dip pole, but is actually situated near Thule in Greenland. The magnetic control of auroral occurrence arises because the high speed particles which enter the atmosphere to produce the aurora, are charged particles and hence are constrained to follow certain paths.

The high-speed primary particles strike the air molecules during their passage through the atmosphere and excite and ionize them. The visible light which is emitted is called the aurora. The lower edge of auroral arcs and bands are remarkably constant in height — some 94 per cent of all auroras lie between 90 and 130 km. above the earth, the most frequent height being 108 km. (100 km. = 62 miles.)

The ionized particles within the aurora are mainly positive ions of oxygen and nitrogen and (negative) electrons. The index of refraction of a medium is modified by the presence of free charged particles. This effect can be very pronounced at radio frequencies with the charge densities encountered in the ionosphere. The index of refraction (in the absence of an external magnetic field) is given by

$$n = \sqrt{1 - \frac{Ne^2}{\pi m f^2}} \quad \ldots\ldots\ldots (1)$$

where e = the electric charge of the ion.
m = the mass of the ion.
f = the frequency of the electromagnetic wave.
N = the number density of the ions.

From equation 1 it is apparent that the deviation from free-space propagation is inversely proportional to the mass of the ions present. Hence, since the positive ions are of the order of 30,000 times the mass of the electrons, the interaction with the electromagnetic wave will be due almost entirely to the free electrons.

Actually the reflection process is complicated by further considerations such as the size of the electron cloud relative to the wave length employed, the density of the cloud, the density gradient within the cloud, the geometrical shape of the cloud, and its orientation with respect to the transmitter and the receiver.

The author discusses the theories of radio reflection from the aurora, which has been studied extensively by radar and Doppler techniques only in very recent years. It is concluded that auroral radar observations can provide information not only about the aurora itself, but also about the physics of the upper atmosphere and radio propagation in the ionosphere.

A critical reflection process, similar to that which occurs at normal ionospheric layers, has been supported by Currie and Forsyth to account for auroral echoes. If the electron density becomes sufficiently high to reduce the refractive index, n, to zero or to negative values, then the wave cannot penetrate the ionized region and total reflection occurs. This is called the critical electron density and its value may be found from equation 1. The condition is that

$$\frac{Ne^2}{\pi mf^2} \geqslant 1 \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

or, the limiting critical density is

$$N_c = \frac{\pi mf^2}{e^2} = 1.24 \times 10^{-8} f^2 \ldots . (3)$$

If this reflection process is assumed to be valid, the reflection of 106 Mc/s. waves implies an electron density of 1.4×10^8 electrons/cm^3., at least within small volumes of the aurora. This value may be compared with the normal maximum electron density of the E-layer which is of the order of 10^5 electrons/cm^3.

The first VHF radar equipment operated at Saskatoon produced 50-kilowatt 35-microsecond pulses at 106 Mc/s. with a highly directional antenna. Later, a similar radar on 56 Mc/s. was added to permit dual frequency operation. More recently, a 196 Mc/s. set and a 91 Mc/s. Doppler radar have also been employed.

In Ottawa several years ago, during the course of the National Research Council's meteor radar program, auroral echoes were observed several times with the 200-kw. meteor radar operating at 33 Mc/s.

Figure 2 shows the observed distribution of echoes obtained at Saskatoon, corrected to take account of the variation of auroral occurrence with position. The presence of the maxima and minima are due largely to the lobe structure of the radar beam. Superimposed is a curve representing the theoretical distribution (for a height of reflection of 105 km.) which would be expected. In azimuth, the maximum echo occurrence is centered at geomagnetic north.

A vitally important observational fact is indicated in Fig. 2. Echoes cannot be obtained, even from the most intense auroras, when they are at high angles of elevation from the radar station. With the VHF radars at Saskatoon, echoes have never been obtained from aurora at elevation angles greater than about 18 or 20 degrees. This strong "attenuation" effect is clearly shown in Fig. 2 by the deficiency of echoes in the second lobe.

Figure 3 gives a graphical description of the echo geometry, showing how echoes are obtained at ranges of 350 to 1150 km. Angle-of-arrival experiments at Saskatoon have shown that the reflecting regions lie in a thin layer of very constant height at about 105 km. This height agrees closely with the lower border of most visible auroral forms. The orientation of the main part of the earth's field (the dipole field) is also shown. It is along these lines of magnetic force that the incoming primary high speed charged particles travel.

Fig. 1. Canada is well situated for auroral observations, as indicated by this map, which shows the auroral zone, in which visible auroral occurrence is most frequent. The relative positions of the geomagnetic, magnetic dip, and geographic poles are also shown.

At present there are three entirely different theories of the reflection process which attempt to explain the absence of echoes at high angles. These may be described as (1) the ground scatter theory, (2) the coherent scatter theory, and (3) the absorption theory. Harang, in Norway, has proposed that a forward reflection occurs to the ground via sporadic E-type clouds of ionization which are associated with auroral disturbances. The radiation strikes the ground and some of it is scattered back over the same path to the transmitter. In a manner analogous to oblique ionospheric reflection at lower frequencies, the ionized clouds will only reflect waves of a given frequency when the product of the critical frequency of the cloud and the secant of the angle of incidence on the lower surface of the horizontally stratified cloud is equal to or greater than the frequency of the wave employed. By the angle-of-arrival measurements at Saskatoon, we have shown that

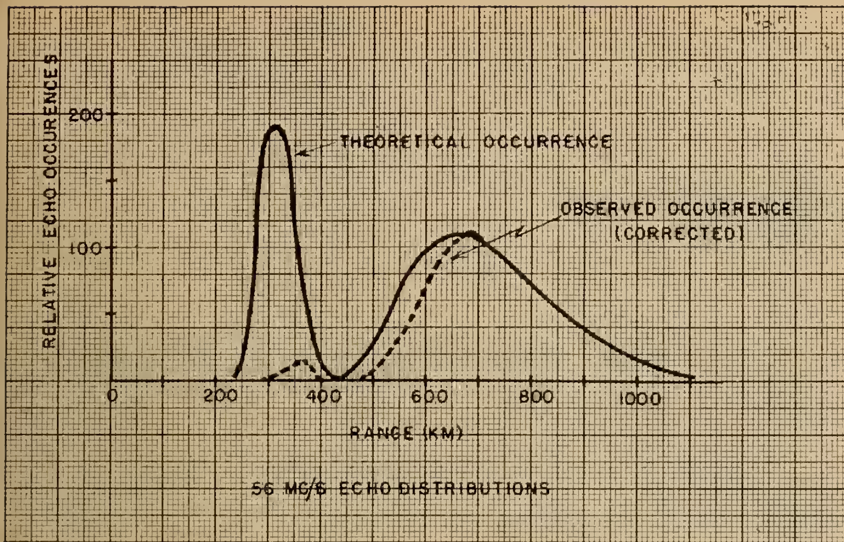


Fig. 2. Observed distribution of radar echoes obtained at Saskatoon.

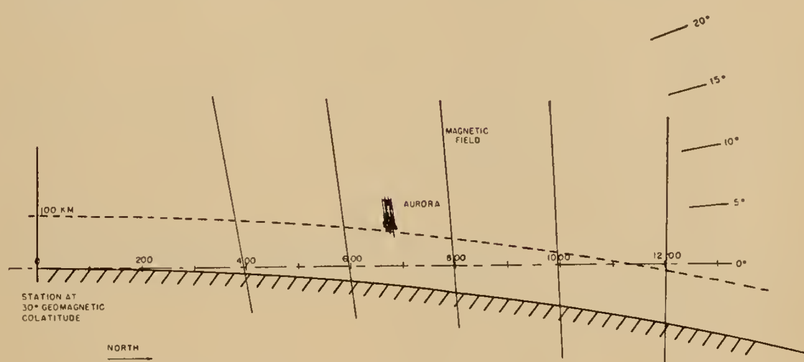


Fig. 3. The geometry of auroral radar reflections.

the echoes observed at Saskatoon do not arise by such a process, but rather are the result of direct reflections from ionospheric regions.

The other two reflection processes involve direct reflection. The coherent scatter theory of Moore and Booker assumes that the auroral ionization is in the form of long trails oriented along the lines of the magnetic field. Furthermore it is assumed that the ionization density is less than the critical value. When the radiation is incident normally upon these trails, the reflected signal is enormously enhanced by virtue of coherent re-radiation by all the electrons in the trail. This perpendicularity condition can only be satisfied in certain regions northward of the radar station.

The absorption theory, proposed by Forsyth and Currie, postulates that a strongly absorbing region must exist below each reflecting centre, and that the re-radiation pattern of the electron clouds is omnidirectional. At low angles of elevation, the radio waves can pass above the absorbing region and meet the reflecting cloud. At higher angles, the waves must pass through the absorbing region and are lost.

At present the observational evidence seems inadequate to exclude one or the other of the latter two theories.

Doppler Techniques

A new line of radio investigation of auroral reflections has been employed within the past few years. This is based upon the use of Doppler radar techniques. With this type of apparatus, a signal is transmitted whose frequency and phase are accurately controlled by a continuously-running precision crystal oscillator. The returning echo signal is mixed with this reference frequency in the receiver. If the two differ in frequency, their beat note emerges from the receiver as an audio frequency note which is the Doppler shift. If the frequency shift of the transmitted radiation is produced by a moving target, the Doppler beat is related to the radial velocity component of the target by

$$f_D = \frac{2v}{\lambda} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

where λ is the radio frequency wavelength.

In the apparatus employed, $\lambda =$ 3.31 metres (90.7 Mc/s.) and hence

$$v = 1.65\ f_D \quad \text{metres/sec.} \ldots\ldots (5)$$

This radar was actually a "double-Doppler" radar in which two coherent detectors are supplied with two reference signals phased at 90 degrees. The phase relation of the resulting two audio output signals indicates the direction of motion of the target, i.e., whether the Doppler shift is positive or negative.

To record and analyze the signals returned from the aurora, a spectrum analyzer was designed to display the spectrum of the echoes in a form suitable for rapid recording. A sideband separator circuit differentiates between the positive and negative Doppler components and directs them toward their respective bank of five tuned audio circuits. The centre frequencies of the five tuned amplifiers in each bank are staggered uniformly across the audio passband. The outputs of the tuned amplifiers are rectified and applied to individual milliammeters which are photographed simultaneously by a single-frame electrically-operated camera. The meter readings are used to plot graphs showing the spectra of the signals.

The spectra obtained exhibit two types of frequency shift. Firstly, the transmitted spectral line is broadened, more or less symmetrically, to widths of from fifty to perhaps several hundred cycles. The widths may be correlated with theoretical deductions about turbulence, target duration, or expansion and collapse of ionized surfaces under the action of diffusion and recombination. Secondly, *en masse* shifts of the spectrum are observed which can be correlated with the movements of the entire auroral formation.

Conclusion

In conclusion, it may be stated that auroral radar observations can provide not only information about the occurrence, structure, and origin of aurora, but also about the physics of the upper atmosphere and radio propagation in the ionosphere. √

DISCUSSION

. . . of Technical Papers

The Tide and the Crisis

By G. E. Hall, President, University of Western Ontario, London, Ont.
***The Engineering Journal*, December 1955 issue, page 1671**

K. F. Tupper, M.E.I.C.[1]

Dr. Hall has pointed out very clearly the situation which will arise in just a few years' time. He has also referred to the various ways in which the situation may be met, which are three in number.

The first way is by exclusion. We can keep the would-be university students out. This can be done by raising admission standards, by setting admission quotas, by raising tuition fees, or by some combination of these methods. I share Dr. Hall's emphatically stated opinion that excluding students is not an acceptable solution.

The second way is by dilution. We can revert again to the position which prevailed between 1945 and 1950 when universities had too many students and not enough teachers. This way is also not an acceptable one. When I was a student at the University of Toronto the ratio of students to professors in the faculty of applied science and engineering was about 23:1. For many years during that period the ratio was near this value. During the period of post-war veteran "bulge" the ratio of students to professors rose beyond 100:1. At that time we had the almost ridiculous situation that students were receiving lectures in classes of 1100 using Convocation Hall as a lecture room. I submit that that was a poor way to carry on university teaching. We were forced to do it with the veterans, but it will not do as a way of meeting the situation which lies ahead.

The third way is by expansion. We can augment and expand our institutions of higher education. I do hope that this will be the chosen course. I also hope that we will recognize the necessity of increasing the number of such institutions. I am convinced that there is a size beyond which a university should not grow. Some of our universities may already have reached this size. While quotas restricting the number of students in an institution may be bad for society they may be good from the point of view of the institution. If I am right, even in part, then we must give every encouragement to the establishment of new colleges and to the growth of the smaller ones which have been started in recent years.

I was interested in Dr. Hall's suggestion that there might be more direct support of universities by industry. I think it is essential that universities should receive their financial support from as many sources as possible. Only in this way will it be possible for them to maintain the freedom which is essential for their healthy existence. I express the hope that the support of universities will not fall by default wholly into the hands of government. There is a real danger of this, in which case higher education would become another branch of the civil service. Universities need income from fees, they need bequests, they need gifts from industry and from living individuals.

[1] President, Ewbank & Partners (Canada) Limited, Toronto, Ontario.

Photoelasticity for Design Improvement

by

I. W. Smith, Associate Professor of Mechanical Engineering, University of Toronto.

***The Engineering Journal*, January 1956 issue, page 15.**

T. R. Loudon, M.E.I.C.[1]

May I congratulate Prof. Smith on his very clear and concise description of the photoelastic method. This method is an excellent addition to ordinary stress calculations. There are many cases of stress concentrations which can only be solved by photoelastic analysis.

I have used this method for the past thirty-two years and I have always wondered why it is not used more by manufacturers. My own conclusion is that those who insist upon giving the impression that the method entails some deep mathematical solutions are to blame for creating the wrong impression.

Any engineer who has a good university training can operate the method quite easily.

Dr. W. Shelson, M.E.I.C.[2]

The fundamental stress-optic laws were established just over a century ago by Neumann, Maxwell and Wertheim, but the application of this remarkably effective aid to structural analysis has not yet attained the widespread use that is its due. Thus, in presenting this illuminating and comprehensive review of photoelastic stress analysis, Professor Smith

[1] Engineering, The De Havilland Aircraft of Canada Limited, Toronto.

[2] Hydro-Electric Power Commission of Ontario, Toronto.

has made an important contribution towards the wider acceptance of this technique by underscoring both its usefulness and flexibility.

Any reader of this paper will undoubtedly realize from the many photoelastic methods and techniques described that this field is not one that can be easily mastered. What may not be as evident is that a knowledge of photoelasticity alone is an entirely inadequate basis for the solution of the structural problems confronting the designer. The competent photoelastician must have, in addition to photoelastic "know-how", a thorough grounding in the mathematical theory of elasticity, strength of materials including theories of failure, physical and geometrical optics, and a modicum of chemistry relative to plastics. Above all, photoelastician must be aware of conventional mechanical and structural design, and keenly cognizant of the complexity of the designer's task. Perhaps, the relatively slow application in industry of photoelastic analysis has, to a considerable extent, been the result of a lack of engineers with the necessary training for this demanding work.

I would like to make some specific comments on matters dealt with in this paper. Professor Smith notes that initial stresses may exist in the model before any load is applied, and that these initial stresses may be determined and the final fringe pattern adjusted accordingly. It will be realized that simple algebraic subtraction of fringe orders may lead to inaccuracies unless the directions of the stresses prior to and after loading are identical. It is likely too that part of the initial fringe pattern is not due to stresses, but is the result of inhomogeneities in the material. This may account for the incomplete effectiveness of annealing procedures in removing the initial fringe pattern.

The paper refers also to the use of photoelastic stress analysis in vibratory and impact studies. In view of the present limited knowledge of the precise significance of the fringe pattern under dynamic conditions, the use of photoelastic analysis in such cases would appear to be inadvisable except for research purposes.

Most engineers are probably unaware of the use of photoelasticity in three-dimensional problems, and this paper clearly reveals the essential features of this fascinating development. The difficulties in obtaining similitude when Poisson's ratio is one-half are well brought out. The comment by Hickson in reference (61), mentioned by the author, that "the errors caused by differences in Poisson's ratio are not as significant in the maximum principal stress as in the lesser ones" does not much simplify the problem of determining accurately the maximum principal stress since this stress is not obtainable independently of the lesser stresses. Thus, the general use of three-dimensional photoelasticity must remain for some time on a qualitative or comparative basis in design and as an elegant check on theoretical analysis.

R. M. Sachs[3]

Professor Smith's paper is a lucid summary of the field of photoelastic stress analysis and should be a great help in familiarizing designers with the benefits which can be realized from the use of this method.

In the field of design with which I am most familiar, that of aircraft gas turbines, competition for low weight is vigorous. There are constant pressures to reduce factors of safety on all mechanical parts. For the designer to be able to accede to these pressures, a more precise knowledge of stress levels encountered during operation is necessary. We feel that photoelastic method of stress analysis is one very valuable tool which is contributing to that knowledge. For many items, such as fabricated structures, frames, and shells, structure tests to failure with the use of strain gauges and stress coat are thought to give more relevant design information than photoelastic stress analysis could. The reason is that the loads involved in these members are usually very large and infrequently applied, and the criteria of failure are excessive yield or complete collapse. In these structures, local regions of high stress are usually permissible due to the ductility of the material used, allowing a redistribution of stress in a more even manner, until finally excessive yield or collapse occurs.

Generally speaking we feel that photoelastic stress analysis is unlikely to give much relevant information to a designer of a composite structure which is intended to be stressed in the plastic range under the design limit load.

Some of the most critical parts in a gas turbine engine are the blades, discs, and shafting. These parts are frequently subjected to fluctuating loads for long periods of time. It is here that we derive the greatest help from the photoelastic methods of stress analysis. The stress concentration factors illustrated by fringe patterns in pictures of photoelastic tests are very significant for parts loaded in this manner. An example of a detail which is extremely important and requires careful attention to prevent fatigue failures is the root fixing which provides a mechanical connection between the turbines or compressor blade and the disc. This connection must withstand very high steady tensile loads due to centrifugal forces and at the same time must resist fluctuating loads due to the uneven gas forces loading the blade itself. In most cases where we have witnessed a root fixing failure, it has been due to fatigue caused by the fluctuating loads rather than a direct failure due to the steady loads. For help in this particular problem we have referred to the results of work carried out by R. B. Heywood (Ref. — "Tensile Fillet Stresses in Loaded Projections" by R. B. Heywood, Institute of Mechanical Engineers, Applied Mechanics Proceeding 1948, Vol-

DISCUSSION

The editor invites discussion of papers appearing in the *Journal*.

Readers may contribute to this section by sending appropriate comments to the *Journal* office.

[3] Design Analysis, Orenda Engines Ltd., Toronto.

ume 159, page 384). It is interesting to note that Dr. Heywood's analysis and the empirical formulae resulting, depend mainly upon photoelastic stress analysis.

Professor Smith's bibliography attests to the volume of published data, based upon this method of analysis, which is available to assist the designer. Despite the wealth of information available, many machine elements being designed employ profiles, combinations of holes, fillets, steps etc. which cannot be analysed adequately using existing data. It is therefore certain that an increasing number of engineering organizations will be setting up photoelastic stress analysis facilities of their own.

The Author

Since he was among the first to use photoelasticity for stress determination, having a pair of Nicol prisms long before Polaroid was available, it was a great privilege to have Professor Loudon present at the meeting and to hear his comments. The author shares the view that by dispelling some of the mystery, photoelasticity should gain wider use. There are of course many difficulties, some of which at the present state of the art seem nearly insuperable. Dr. Shelson has introduced a note of caution by mentioning two of the problems. While the presence of initial stresses (or other optical disturbances) in a model is usually shrugged off by writers, the photoelastician is loath to place full dependence on the results of using such a model. Since the time of writing the original paper, the manufacture and sale of Fosterite has been discontinued and it has become necessary for those doing stress freezing to cast their own materials. Probably the most favoured of these is the epoxy resin, such as Bakelite ERL 2774 or Araldite 6020, solidified with phthalic anhydride, and given a heat treating cycle that is supposed to leave an optically clear (though amber coloured) casting. Blame for residual stress and other casting defects can no longer be directed toward the material supplier, but it is perhaps preferable to have these under direct control.

Dr. Shelson also points out that dynamic stress work must be handled with care. For example room temperature creep, which is an irritation when working with static stresses, becomes an affliction when dealing with rapidly fluctuating stress. It is also very difficult to induce the required vibratory stress in a model (for example the second mode torsional in a cantilever) without departing from similarity to the prototype, and it is still more difficult to "see" photoelastically the stresses that are developed. But this is a reason for enticing more people into the fold of photoelasticity, for its progress must inevitably be slow if there are only a few with the patience to pursue and overtake the problems.

As a stress analyst confronted with many widely varied problems, Mr. Sachs' comments are valuable. It is true that photoelasticity is only one form of experimental stress analysis and that it cannot be expected to solve everything. The low modulus of elasticity of the model materials results in large deformations, particularly in a "stringy" type of structure, and these may invalidate the method. On the other hand new cementing and casting techniques make possible a model complexity not hitherto achieved and it is to be hoped that greater versatility will bring photoelasticity out of the research laboratory into the design laboratory. Even when similarity between the model and the prototype cannot be obtained completely, some information, if interpreted correctly by the analyst, is preferable to a complete lack of applicable information.

A Complete Sanitation Program for Metropolitan Toronto

L. B. Allan

(continued from page 30)

We have examined at some length the many difficulties, and the plans which are now envisaged in order to overcome them, in relation to sanitary and storm drainage and sewage treatment over the entire metropolitan Toronto area.

That a tremendous job faces us, no one can deny. Our program involves a capital expenditure of some eighty million dollars in the next twenty years. Within five years, we hope to have trunk sewers and sewage treatment available at any point inside our boundaries. After the basic service is available, it can then be expanded and improved, so that metropolitan Toronto will rank with the finest communities in the world in the field of drainage and sewage treatment, as it already does in so many other respects. √

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Erratum. — The author of the paper "The Possibility of Complete Solar Heating of Canadian Buildings" (Nov. 1955 issue, p. 1501) was inadvertently quoted without reference to his membership in the Engineering Institute of Canada. Apologies to Prof. F. C. Hooper, M.E.I.C.

ABSTRACTS . . .

OF RECENTLY PUBLISHED ENGINEERING LITERATURE

BIG LOOPS IN SUBMARINE CABLE LINES SOLVE PROBLEM CAUSED BY DEEP MUD

Engineering News-Record, June 2, 1955, p. 48.

A mile-wide bay with a bottom of soft, deep mud presented an unusual problem to builders of a communications link between the big Naval Air Station at Corpus Christi, Texas, and a new radio transmitting center across Oso Bay, in which soft silt had an average depth of 110 ft. with pockets believed to be as deep as 300 to 400 ft.

The local electric company had learned that poles would not stand up for any length of time in this mud. Hence the builders of the new communications link decided to use submarine cables. However, submarine cables of sufficient strength to meet the conditions found at this crossing would weigh 10 lb. per foot of length, which meant that they would sink slowly in the soft mud.

How deep the cables would sink or how long it would take them to reach a state of equilibrium could not be determined accurately. To meet this situation, it was decided that the cables should be laid across the bay bottom in looped lines of sufficient length to provide for settlement of the cables to the bottom of the soft mud. Using the best available information as to the depth of the mud, a tentative final profile was computed and then the length of the loops required to lay that length across the bay was increased about 60 percent to reduce strain on the cable should settlement be rapid at any one point along the cable line.

Finally, 60 ft. was added to the length of the cable to permit a reserve length of 30 ft. to be coiled in a big anchor manhole at each end of the submarine line.

Use of this reserve is not anticipated, but that arrangement has the advantage of simplifying the task of adding to the length of the submarine cable should periodic inspection of the manholes indicate that the computed amount of settlement was in error.

RUBBER CONVEYOR BELTS

R. W. Parris, *Rubber Developments,* v. 7, n. 4, Winter 1954, pp. 98/104.

Hundreds of miles of rubber conveyor belting are in operation giving efficient service and conveying annually millions of tons of materials and products at a very low cost. Rubber conveyor belts are made in a wide variety of types for conveying almost every kind of conveyable material.

In the majority of applications, the working life of the belt is governed by its degree of resistance to abrasion.

A rubber conveyor belt consists of a fabric interior, to provide the necessary strength, and a covering of rubber which serves the dual purpose of resisting abrasion and protecting the fabric from moisture. In some belts the fabric is treated to make it resistant to mildew, while recently chemically-treated cellulosic yarn of greatly enhanced strength has been used for the construction of belts. Where the maximum possible strength is required, the belt is reinforced with steel cord.

Some Special Types

For conveyance of products and materials up or down steep inclines, special types of belt are available. For packages, the belt has a gripping surface formed of numerous small isolated blocks or fingers. For lumpy or granular materials, cleats are provided on a smooth-faced belt. The cleats may be of metal or of rubber.

A rubber-coated steel band conveyor belt has been developed in Sweden. A belt which can shed water from the material being handled or can retain the water, according to requirements, is formed with moulded rubber ridges, ⅛ in. high in its surface. The incline of the belt and the angle of the belt idlers are adjusted according to whether the water is to be shed or retained.

A belt conveyor of novel construction, termed the cable belt conveyor, has recently been introduced. The belt itself is not subjected to driving pull, this being taken by two steel ropes, one at each side of the belt. The ropes are supported by pulleys mounted on ball-bearings and set at approximately 18 ft. centres. Spring steel straps are moulded in the belt at approximately 2½ ft. centres and project at each side of the belt for a few inches. At each of the projecting edges of the belt a shoe with rubber inserts is fitted so that it slides on the strap for a limited distance.

An entirely different type of belt conveyor, known as the *Zipper* closed-belt conveyor-elevator, is in effect a moving pipe line. It consists of: (a) a flat endless base-belt similar to the conventional rubber and fabric conveyor belt; (b) Flexible rubber side-walls hinged to the shoulders of the base-plate; and (c) interlocking rubber teeth moulded on the outer edges of the side walls. Immediately after material has been fed on the belt, the side walls are automatically closed around the material and the teeth interlocked. Rubber fins at the base of the teeth seal the belt and keep material from sifting out. The belt is automatically opened for unloading.

Idlers

Conveyor belts are supported on idlers, each idler consisting of one or more idler rollers mounted in a supporting bracket which is fixed to a base plate. For troughed belts the idler unit has three or five rollers so mounted that the belt forms a trough shape. Idler rollers are designed to retain lubricant and to rotate easily, thereby minimizing both belt tension and wear on the driving surface of the belt.

When abrasive or corrosive materials are being handled it is advantageous to provide rubber-covered idler rollers. Impact idlers are used at loading and transfer points to minimize wear on the belt. Where impact is very severe, as when logs or large heavy lumps of material are dropped on the belt, pneumatic tyres may be used to form the idlers.

A recent development is the hammock idler. The hammock idler consists essentially of a rubber tube which is flexed according to the load on the belt and allows the belt to assume its own shape of trough. As the extent of troughing necessary will depend upon the load being carried, the idler incorporates means for adjustment to meet these requirements. The use of the hammock idler reduces spillage as any tendency for the load to be nearer one edge of the belt is quickly corrected. The rubber tube is resistant to both abrasion and to continued flexing. Any impact which occurs when the loaded belt traverses the idler is readily absorbed by the rubber, but this type of idler is not intended for heavy impact duty at loading points.

The life of rubber conveyor belting will be prolonged by correct installation, frequent inspection and immediate correction of faults or repair of damage. The loading point of a conveyor receives most abrasion and nearly all the impact, and the life of the conveyor is therefore largely governed by the wear it receives at this point. To minimize this wear the material being handled should pass from the chute to the belt at the same speed and direction of travel as the belt and with a minimum amount of impact. Belt repair outfits are available and also portable vulcanisers for effecting belt repairs and for making vulcanised belt joints.

LATEST IN BUTT-WELDING . . . LONG RAILS BY FLASH PROCESS

Railway Age, v. 138, n. 23, June 6, 1955, pp. 26/29.

At Albuquerque, N.M., a new chapter is being written in the history of continuous rail. There the Santa Fe is taking short ones (39 ft.) and fashioning them into long ones (about 1,440 ft.) by the Matisa-Schlatter flash butt-welding technique. The set-up at Albuquerque, represents the first use of this process in the United States.

Mobility Was Problem

Welding of continuous rail in Europe is done at so-called *depot* or permanent set-ups. This practice is not generally considered practical here because of the greater distances the long rails would have to be transported. Development of the Matisa-Schlatter process is the outcome of many months of intensive effort to adapt the Swiss version of the electric-flash method for use in this country, and especially to develop equipment of the required mobility.

As now perfected the equipment is permanently housed in three specially designed steel box cars. These cars contain:

(1) The plant used for generating the necessary electrical power for the welding process, and such additional power as is required to operate the various motors and lighting facilities required during operation.

(2) The welding unit, an air compressor and a water-cooling unit for cooling the welding electrodes.

(3) The grinding machines and a winch for moving the welded rail.

Arrangement at Albuquerque

The welding equipment is arranged on two tracks at Albuquerque. The welding and grinding cars are on one track and the power car is spotted on a second track directly opposite the welding car. The production line begins at a rail-feeding ramp at the rear end of the welding car and extends through the welding and grinding cars to a portable building which houses equipment for testing the welds.

Portable platforms at car-floor height, with access stairs to the ground level, are provided between the cars, between the grinder car and the inspection building, and completely around the rail-feeding ramp. These platforms provide easy access to any point on the welding line.

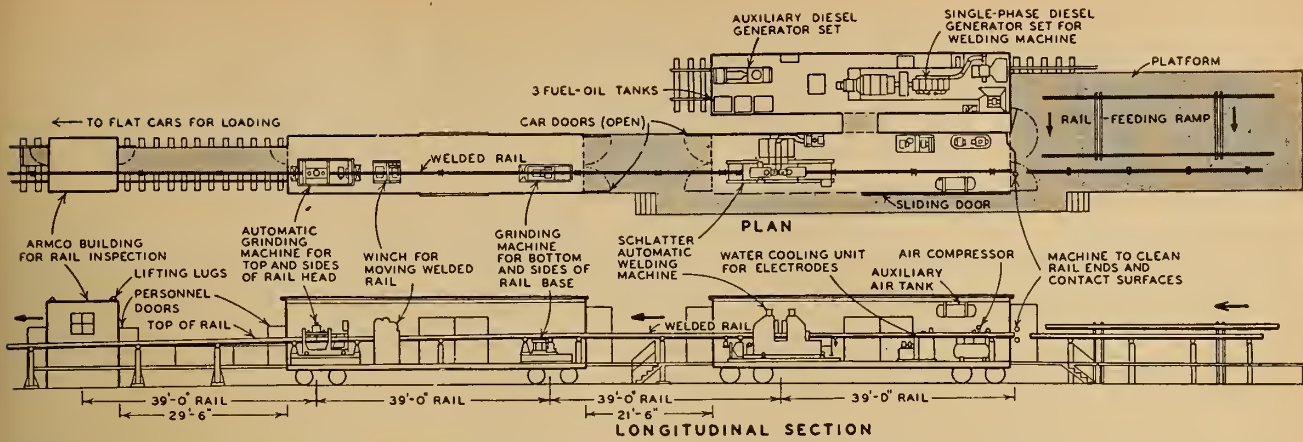
The preparation, welding, finishing and testing of the joints is carried out at six stations located along the length of the welding line. These stations are equally spaced so that each operation may be carried on simultaneously with all the others, thus insuring assembly line production.

The usual practice on the Santa Fe is to weld the rails into lengths about 1,440 ft. (37 rails) long. As the lengths come from the production line they are loaded directly on a string of 31 flat cars. On each car the rails are supported on a single specially designed assembly of 12 roller-bearing rollers mounted on a common shaft, thus accommodating 12 strings of welded rail. The draft gears of each car are blocked to prevent slack action in the train. Two trains have been provided so that one may be loaded while the other is transporting the rail to the unloading site.

Production and Personnel

The welding line is operated in two shifts with the expectation that full production, when reached, will approximate 180 welds per day. Eleven men are required for each shift, including the foreman and all personnel necessary to handle the rail.

Only full-length No. 1 and No. 2 rails are being welded on the Santa Fe. All rail sent to the welding line is blanked at both ends except that a limited number are drilled at one end only for use as end rails of the strings.



LAYOUT of production line at Albuquerque. As indicated by heavy arrows rail flows through the various fabricating and testing operations to its final discharge in 1,440-ft lengths for loading on strings of flat cars.

COMMUNICATION . . . WHERE DO WE GO FROM HERE?

Vannevar Bush, *Electrical Engineering,* v. 74, n. 5, May, 1955, pp. 367/369.

Today there are diverse and complex means for communication. You are not interested in having me recite a catalogue of them. Nor have I any intention of lifting your spirits with a rhapsody on the wonders of modern communication. In fact, I think some of those wonders are still rather crude.

The simplest form of communication is between individuals, and the principal instruments — in addition to direct speech — are the telephone, the transmitted message, and the letter. We take just pride in our telephone system. Some people can now make calls all over the country merely by turning a dial; and more will soon be able to do so, without human intervention, and without human error except their own.

The sounds heard over the telephone bear a surprisingly close resemblance to those of the human voice, close enough in fact to satisfy any reasonable demands. What else is there to do? Well, the telephone is still, on occasion, a nuisance, breaking in on our hours of rest, work, or contemplation in a most peremptory manner. There may be ways, aside from having competent secretaries, by which conversations could be carried on when both participants, rather than just one, want to talk. Certainly there are more effective ways than those employed today of carrying on a conference of several persons. The only difference between a conference around a table, and one over a telephone is the absence of gestures and facial expressions.

Correspondence

Billions of letters are being written. This process is still extremely crude. To write the letter an individual talks to a stenographer or a machine, and what has been said is reproduced, often none too precisely, by a girl who pushes keys on a typewriter. This process can be shortened by talking to a machine and mailing a disk or tape, to talk back on a distant machine, but this does not readily produce a convenient record.

When a letter is mailed, a half dozen persons have to read the address and toss it into its appropriate compartment. This is utterly archaic. It is quite possible to read addresses photoelectrically, if they are in proper code, and to render all sorting automatic. The great bulk of the mail could be thus handled.

The second principal form of communication is from one to many, or from a small group to a large audience. It is usually unidirectional. The greatest instrumentation here is the printed word. Much progress is being made in printing. Better methods of printing can confidently be expected as well as better methods of distributing what is printed.

Entertainment is a form of communication. It is fortunate that entertainment and advertising have made possible the enormous growth of radio and television. Together with the press and magazines, these media are producing an informed electorate and a united public opinion throughout the country beyond anything that was possible without them.

The progress of civilization in peace time depends not only on current thoughts and findings, but on the skill and facility with which we create, store, interchange, consult, and utilize the whole record of collective past experiences. Enormous strides are being made in the development of methods for creating a record of what is learned—in printed words, by photography, or on a magnetic tape. Also, strides are being made in developing means for the transmission of ideas from one to another or from a central point to great audiences. But in one exceedingly important phase of the whole problem, little progress indeed is being made. This is the phase of finding in the record the information needed.

Libraries

Libraries are filled to overflowing and their growth is exponential. Yet in this vast and ever-increasing store of information particular items are still sought by horse and buggy methods. We are being smothered in our own product. While the work of thousands of men, full of significance and timeliness to others, is recorded with great care, a large and increasing fraction of this work is, for all essential purposes, lost simply because it is not known how to find a pertinent item of information.

The problem is not essentially one of techniques. It is rather one of deciding who is to do the job of clearing up the confusion and under what auspices. There are many good techniques available. Recently I participated in a study of how mechanization could be applied to the problem of searching in the Patent Office, where millions of items need to be scanned for equivalents of the combination presented in patent applications. There are several ways in which items can be scanned at the rate of 1,000 a second, selected in accordance with a complex code, and reproduced automatically.

But to code the scientific literature or legal documents or any other part of the mounting records and thus to place them under the control of machinery responsive to our will is a stupendous undertaking. Worse than that, it is everyone's business and the assigned responsibility of no one group in particular. The whole art of data handling is improving every day, and it would be a mistake to freeze upon a single system prematurely. So it probably would not be wise to plunge in at once and undertake a comprehensive and extensive program for, to use an example, the entire bulk of scientific literature. The time has most certainly arrived when special sections of the record can be subjected to mechanization with genuine benefit to those who use them.

Communication is the lifeblood of democracy. An informed and intelligent electorate is our bulwark against political chaos. Education of the people is dependent on the means of communication that are available. In its simplest form, a teacher talking to a group of pupils, communication is an essential element. But in the more complicated processes by which the citizens of democracy become informed, the problem of communication is more involved and extensive. Today there are intricate and powerful means for the interchange of thought among the entire population. On the skill and wisdom with which these means are employed depend the stability and prosperity of our republic.

IMPORTANCE OF KNOW-HOW IN CHEMICAL DEVELOPMENT

Industrial & Engineering Chemistry. v. 47, n. 5, May, 1955, pp. 982/984..

The cost of industrial research has been increasing at a staggering rate. For many years the chemical industry classification provided the largest segment of industrial research. However, in the last few years, the chemical industries now provide little more than 10% of the total or approximately $300,000,000 per year. Research expenditure has been made possible by a rapid increase in the number of scientists and engineers employed.

Almost as significant as the increase in research workers is the greatly increased cost per professional scientist or engineer; the annual average cost of a professional in industry has increased from $6,300 in 1927 to $21,500 in 1952.

The unit cost of a research worker, however, does not completely explain the increases noted. A number of forces have combined to increase the complexity of research projects over the past years.

It is obviously impossible to compare identical projects, but some typical examples give some indication of the changes at Shell's Emeryville Research Center. As shown in Table I, in the period 1933-38 pilot plant developments averaged 14 man-years, but in the period 1944-48 this had increased to 50 man-years per project. And when one examines figures that include not only the pilot plant development but also the research prior to it and the engineering effort that followed, the total manpower utilized per project increased from 55 man-years in the period 1928-38 to 160 man-years in the period 1946-53.

Table I
CHEMICAL PROJECT
MANPOWER REQUIREMENTS

Period	No. Projects	Man-Years Project
Pilot Plant Investigations		
1933-38	16	14
1944-48	11	50
Commercial Projects		
1928-38	24	55
1939-45	13	125
1946-53	26	160

One of the reasons for increased research expenditure is the increased demand for chemical products. Since the cost of chemical research has averaged approximately 3% of sales for a number of years, this increased production would alone account for much of the increase in research expenditure.

No one in this field need be told that during the period of expansion, competition has increased materially. The few companies engaged in petrochemical manufacturing in 1931 have been joined by many others, until at the present time there are approximately 140 individual companies operating 300 plants. This rivalry has made it necessary for management to establish with certainty that capital expenditures will be made only for processes that are economically superior. This has led to a great increase in the use of process engineering evaluations, necessitating more detailed development and engineering efforts.

The rapidly increasing cost of construction also must be considered and every effort made to design plants requiring a minimum of capital investment consistent with reasonable manufacturing costs. Perhaps the most reliable index of construction costs is that provided by the *Engineering News Record.* This figure shows that the cost of construction has more than doubled since the beginning of 1946.

With this background, showing the influence of rapidly increasing markets, greater competition, and inflationary forces on research and development expenditures, there is a real incentive for research and development management to minimize expense by utilization of any available knowledge bearing on a specific problem. Among the sources of data available are the chemical literature. If chemical industry would exchange more information through increased publication, duplication of research and development effort could be materially reduced. When one considers the total expenditure in this field of $300,000,000 annually, even a small fraction shared would represent a real saving to everyone. Disclosures in the patent literature also provide knowledge which can be used effectively.

The most important source of information on which to base process development is the utilization of one's own research and development know-how on related processes. This source is obviously available in proportion to the extent of prior experience in the field involved, whether it applies to exploratory or bench scale research, pilot plant investigation, process design, or commercial operating experience.

Month To Month

JAN. FEB. MARCH APRIL MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.

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

Overseas Look for Canadians

Promotion of increased Canadian participation in foreign development works has been sponsored by the Canadian Manufacturers' Association, the Engineering Institute of Canada and the Canadian Construction Association.

Reason for the joint action of these three national organizations was the feeling that the opportunities which these projects present for Canadian manufacturers of capital goods can be improved in two ways: first, by improving and speeding up the channels of information in order that Canadian suppliers may be fully aware of potential requirements at the earliest possible stage; and, secondly, by promoting increased interest and activity in such projects on the part of Canadian engineering consultants, contractors, management specialists and technicians.

The joint liaison committee is headed by Hugh Crombie, m.e.i.c., vice-president and treasurer, Dominion Engineering Works, Montreal, who will represent the C.M.A.; B. A. Culpeper, m.e.i.c., manager and chief engineer, C. D. Howe Company, Montreal, who will act for the Engineering Institute; and C. G. Kingsmill, m.e.i.c., assistant to the president and director of Angus Robertson Limited, Montreal, who will represent the Canadian Construction Association.

Through this committee arrangements are being made for the collection and exchange of information regarding foreign undertakings in which Canadian engineers, contractors and manufacturers would be interested. The services of the Department of Trade and Commerce at Ottawa will also be utilized in this undertaking.

C.M.A. members who have overseas affiliations have been asked to report, on a continuing basis, on foreign developments and, with the co-operation of the other two sponsors, manufacturers will be kept abreast of important overseas contracts entered into by Canadian engineers and contractors.

This move should also be, in the long run, of value to Canadian manufacturers interested in consumer goods export. Experience has shown that Canadian exports of capital goods and technical services have a tendency to stimulate the foreign market for all sorts of other Canadian products which may be used in association with the products concerned.

Engineers' Joint Committee Formed

The civil engineers of Toronto have a concerted program of technical meetings this year, through the efforts of a committee representing Toronto members of the Institution of Civil Engineers (Britain), the American Society of Civil Engineers and the Engineering Institute of Canada.

On October 18, 1955, the first in a series of joint meetings of direct civil engineering interest was held. The inaugural paper was presented by Charles Hershfield, m.e.i.c., before a large audience in the McLennan Building of the University of Toronto. His subject was "One Cycle Moment Distribution for Structural Analysis".

The next meeting is scheduled for February 9, 1956, when a paper on "Waterworks and Fluid Mechanics" will be presented by Dr. Grant Huber in Room 103 of the School of Nursing of the University of Toronto. Professor Huber will discuss what effects fluid mechanics has, or should have, on our practical treatment of waterworks design. Specific reference will be made to the waterworks problems of Metropolitan Toronto.

The schedule includes also a tentative meeting on March 8, with a paper prepared by the Ontario Hydro structural research department; and one on April 12, at which the results of the N.R.C.

Cover Picture

The cover picture illustrates the installation of a 4-ft. diameter parabolic antenna reflector as part of an airborne profile recording system. Capable of measuring ground elevation on profiles to plus or minus 10 feet, it may also be used to measure terrain clearances from 1000 to 25,000 feet as a radar altimeter. The unit compensates for minor deviations of the aircraft from chosen barometric flying height so that the record obtained indicates the terrain contour along the flight line. Simultaneous ground position photography is featured.

Photo courtesy PSC Applied Research Limited.

Cobourg Beam tests will be presented by the Department of Building Research, N.R.C.

The joint civil engineering section came into being during the fall of 1955, the plan having been proposed in March to the sister societies by Harold Fealdman, M.E.I.C., on behalf of the executive of the Institute's Toronto Branch. The Institution of Civil Engineers had given its approval and offered financial assistance in May. Co-operation with ASCE was worked out later and in December agreement and financial support was announced by the Society.

Mr. Fealdman was appointed chairman of the committee. The secretary is B. Hardcastle, M.E.I.C. (c/o McColl-Frontenac Oil Company Limited, 8 Spadina Road, Toronto, Ont.) Their work in the interest of co-operative technical activity has been rewarding, and they volunteer to provide further information to anyone interested.

Ten Years of Aircraft Design and Production

When the second world war was over, Canada found itself with a great many new industries on its hands. In many instances the industries were not previously natural to this country but had been developed because of the exigencies of war conditions. One of these appeared to be the aircraft industry.

At the war's end most Canadians would have said there was no future in Canada for the aircraft industry and yet we now find it one of our most important industrial efforts. This has been a wonderful thing for Canada, not only from the point of view of employment for Canadians, but from the point of view of national defence.

Conspicuous in the group of companies that have been operating in Canada since the war's end is A. V. Roe (Canada) Limited. On December 1, 1955, they celebrated their tenth anniversary. This company has been unique not only in the field of aircraft manufacture but in the aero engine as well.

Back in 1945 Sir Roy Dobson and his associates representing the Hawker Siddeley group purchased the Crown owned Victory Aircraft plant at Malton, where Lancasters had been made during the war. The company's operations were very small in the beginning and certainly did not need a plant of this size. However, it was fortunate that the arrangements were made on such a generous scale because before long every inch of floor space was in demand.

In the beginning the company had 300 employees—today it has 22,000. It now consists of four separate companies with nine manufacturing and engineering establishments covering a total floor space of five and a half million square feet.

The companies controlled by Avro are Avro Aircraft Limited, Canadian Car and Foundry Company Limited, Canadian Steel Improvement Limited, and Orenda Engines Limited.

The list of products which are now manufactured includes four types of aircraft, two gas turbine aero engines, aircraft repair, overhaul and modification, aircraft ground handling equipment, mobile training systems for the R.C.A.F., guided missiles research, precision forgings and castings for aircraft, aero engines, consumer products, textile and wire and cable industries, light alloy products, heavy steel castings, railway equipment of all kinds for Canada and export to 26 foreign countries, railway track layouts, steel fabrication, electric street cars, electric trackless trolleys, gasoline and diesel powered buses, mining cars and equipment and machine shop products.

The company has many distinguished achievements in the field of aircraft design and manufacture. First of all there was the Jetliner, which came within a few days of being the first jet propelled airliner in the world. It was an excellent machine and made a first-class showing. Unfortunately, it now seems it was abandoned in order to devote more time and attention to fighting machines.

Next, the company turned its attention to an all-weather fighter, which was required for the defence of Canada. This became the CF-100. An engine as well as a plane had to be designed. However, in the beginning the CF-100 got into the air powered by Rolls-Royce engines. It was the height of wisdom to test the new plane with proven engines rather than that a new plane and new engines should be tested together.

The history of the Orenda is a story in itself. Looking back it seems almost impossible that such a modern engine could have been built so successfully the first time the team made a try at it. Today all the CF-100's are powered with the Orenda and as well it is used as the power unit in the F-86, which is being built by Canadair in Montreal.

To do justice to what this company has accomplished would take a book at least the size of this *Journal*. This short article is not intended to be a history, but simply an acknowledgment of what this group of intrepid workers has accomplished and a tribute to them.

Here's hoping that in the next ten years the company may set up another record that will compare well with that which they have made in the last ten years.

Conference on Human Problems of Industrial Communities

The Right Hon. C. D. Howe, Minister of Trade and Commerce, has been appointed chairman of a committee to assist in selecting 30 Canadians to attend the Duke of Edinburgh's study conference on the Human Problems of Industrial Communities in the British Commonwealth and Empire.

This conference, which will take place at Oxford, England, from July 9 to July 27, 1956, will provide an opportunity for people from all parts of the Commonwealth to study the practical working of industry in the United Kingdom and to discuss their common problems and how they are being tackled. The total membership of the conference will comprise 280 men and women broadly between the ages of 25 and 45 who are engaged in the managerial, technical and labour-operative roles of industry. They will be selected from among those who now hold, or are likely to hold, positions of responsibility, and who are taking an active interest in the life of their community. The industries from which members of the conference will be drawn include manufacturing, mining, transportation and distribution.

The Canadian selection committee, of which Mr. Howe is chairman, will consist of representatives of both management and labour. The vice-chairmen of the committee are Claude Jodoin, president, Trades and Labour Congress, Ottawa, and W. S. Kirkpatrick, vice-president, Consolidated Mining and Smelting Company of Canada Limited, Montreal. In reviewing applications for membership in the conference, the committee will try to ensure that all industries and regions in Canada are represented in the group which will go to Oxford. Secretary of the Canadian Committee is A. W. A. Lane, Room A-157, No. 1 Temporary Building, Ottawa.

The Duke of Edinburgh has said: "I cannot emphasize too strongly that this is a study conference not for research workers but for young people actually engaged in industry. Its main value will not lie in the report of the speeches and discussions. Its value will depend upon what the members make of what they see and hear. Its value will lie in the ability of the members to describe their points of view and experience for the benefit of others and their ability to distinguish what is likely to be useful in their own special cases. Ultimately it is hoped that the members will be able to extend their influence in their own countries and industries to the end that industrial enterprises are so organized that they form an integral part of a happy and healthy community."

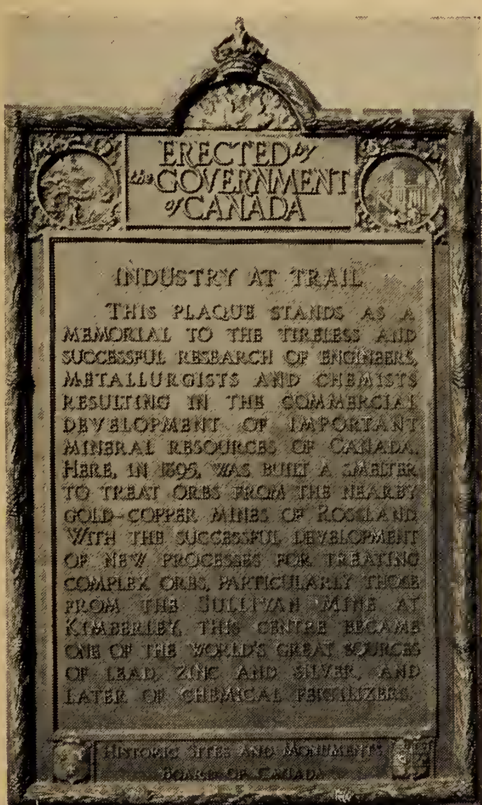
The Monument at Trail

A monument to "Industry at Trail," marking the "—tireless and successful research of engineers, metallurgists and chemists—" has been erected by the Historic Sites and Monuments Board of Canada. The plaque was unveiled by Dr. W. N. Sage, professor emeritus of history at the University of British Columbia, and B.C. representative on the Historic Sites and Monuments Board, at a ceremony held at Trail on November 19, 1955. The unveiling program was arranged by a local committee which included representatives of the district branches of the C.I.M.M., the C.I.C. and the E.I.C.

The monument is a mark of recognition afforded by the Federal Government to pioneer research and its practical application in the field of natural resource development in the Kootenays. It is the first monument ever dedicated to a modern industry by the Historic Sites and Monuments Board of Canada.

The members of the Kootenay Branch, who provided the *Journal* with this story and photographs, are particularly gratified to note specific mention on the plaque of the work of engineers. They also note with satisfaction, as did more than one official speaker at the ceremony, that the industry chosen as the first to be marked for significant research and development progress is one representing Canadian processing of domestic raw materials, with native energy resources, through to refined metals and finished chemical products. Most significant, perhaps, is the inherent recognition that the most important resource of all is trained manpower — and the recognition of the importance to Canada of men highly skilled in the physical sciences and engineering.

The erection of this unique monument, and the inscription on its plaque, should be sources of pride and justifiable satisfaction to every Institute member and Canadian engineer.



St. Lawrence Seaway and Power Project

The *Journal* reviews the news and progress of the St. Lawrence project.

Progress by Ontario Hydro

Total earth moving for Ontario Hydro's section of the St. Lawrence power project to the end of November amounted to some 6,100,000 cubic yards, indicating the progress that has been made. This includes excavation on the powerhouse site, dyke work, cofferdams, railway and highway relocation, and other phases of work.

During November the first section of the relocated No. 2 highway was opened to traffic. This 7.2-mile stretch from Cornwall to Moulinette area will divert traffic away from the construction work in the powerhouse and administration areas. A further layer of asphalt pavement will be laid next spring.

Interesting advances have been made in the construction of the new St. Lawrence transformer station. Most of the ground work has been done; the ducts are in place, while footings and foundations now are ready for equipment and structures. Some of the steel was being erected by the month end.

Cofferdam encloses excavations for power houses.

Good progress had been made on the diversion canal being constructed by C. A. Pitts General Contractor Ltd. Additional equipment had been moved to the site and with the diversion of traffic from the former No. 2 highway, a speed-up in the tempo of operations had resulted. Because of the diversion canal, a second length of access tunnels had been necessary to pass under this waterway, which will parallel the present Cornwall canal. Excavation for these tunnels had been completed; the concrete anchor pad for the steel tunnel liners has been poured, and the liners were in place by the end of November.

At the powerhouse site, excavation had been proceeding normally despite adverse weather conditions. An estimated total of more than 800,000 cubic yards of excavated material had been hauled away to the disposal area. More holes were drilled in the powerhouse area and these were grouted, using over 23,000 bags of cement for a total of some 85,000 bags to date.

Meanwhile, on the Cornwall dyke, work continued on stripping of borrow in section 2. The haul roads had been prepared and excavating the clay crossing in section 3 had started.

During November, channel improvement work progressed favourably. Removal of the western end section of Spencer Island pier to an elevation of 220.0 was completed in the Chimney Island sector. Pile driving for the bridge in the causeway to Spencer Island also was completed. A total of more than 230,000 cubic yards had been excavated to date.

Similar progress has been made on the Galops Island work, where shovels continued excavating in the main cut. Dewatering of the first excavation bay was completed and the cofferdam was increased in this area. Total excavation to the end of the month in the Galops Island area amounted to over 1,000,000 cubic yards and clearing of the island was virtually completed.

Rehabilitation work continued with little interruption at Iroquois during November despite inclement weather. A total of 55 houses had been moved to the new town site by the month end. There was much progress in laying sewers, water mains and other facilities in the new town site.

Meanwhile, at Mille Roches about 40 houses had been surveyed during the month in preparation for the development of town site No. 2. Necessary tree clearing was started and surveys completed for access roads to cross the railway at Mille Roches and Moulinette to the site of the new town.

In general, the progress of the work was outstanding during November, with some 35 major supply and construction contracts in progress. There were some 2,700 persons employed on Ontario Hydro's part of the project.

Progress by NYSPA

Progress during November was highlighted by two major achievements. On the 11th the first concrete was placed in Iroquois dam, and during the month the steel superstructure of the Barnhart bridge, connecting the island and the mainland, was completed. In addition, the total excavation quantities for all construction contracts now exceeds six and one-half million cubic yards out of a total estimated fifty million cubic yards.

In the powerhouse area, excavation was continued. More than 100,000 sacks of cement had been used in foundation consolidation and as a seal for rock excavation. While placing of embankment for the south forebay dyke had been discontinued for the winter, suitable material is being stockpiled for construction in the spring. On the river side of the main powerhouse cofferdam, steel sheet pile baffles were being reinforced to provide added protection from ice damage.

At Long Sault dam, as blocks of concrete rise in the right abutment end, and begin to define the shape of the structure, rock was being removed at the other end of the excavated area. In cut "F" excavation was accelerated as more than one and one-quarter million cubic yards of earth had been moved to date.

In addition to the placing of concrete at Iroquois dam, the driving of steel cofferdam cells progressed and earth excavation yardage reached the million mark. At the Massena intake, more than a half million cubic yards of earth had been excavated as construction of the dyke progressed.

Placing of concrete on the Barnhart bridge substructure was completed and construction of the access road and railroad on Barnhart Island was being pushed through in order to be ready to receive traffic when the bridge is opened. Steel girders now span the Grass River between abutments of the Grass River bridge, and preparations are in progress for placing concrete on the highway over the bridge.

Channel improvement excavation continued. At Red Mills Point, work progressed in spite of high water, built up by strong winds, overtopping the cofferdams. About 1,600 feet of cofferdams had been constructed in the Galop Island south channel in preparation for extensive under water excavation. A 12-cubic-yard dredge arrived and started work in the Chimney Island area.

With some 52 major supply and construction contracts in progress, production of engineering drawings and specifications continued on schedule. Specifications for channel improvements in the Sparrowhawk Point - Toussaint's Island area and emergency diesel generators were completed and issued during the month. Inspection and expediting of major items of essential equipment and materials continued to receive the priority demanded by the accelerated construction schedule. At end of November some 3,200 persons were employed on the work.

Progress by SLSA

As of November 25, on a total of 22 contracts valued at approximately $50 million awarded to date by the St. Lawrence Seaway Authority, and covering services by consulting engineers, the work completed stands at approximately 15 per cent of the total value of contracts awarded.

As winter begins to set in and the closing of navigation is announced, the 10 dredges working in Lake St. Louis and Lake St. Francis all summer and fall cease operations where they have been deepening the future channel to 27 feet. Cofferdamming in the Laprairie basin will be restricted because of the usual winter ice jam and rise of water levels. Excavation sites not clear of water cannot be worked.

Most of the work goes on, however, as winter conditions present no serious problems in the heavy earth cuts at Iroquois and Côte Ste. Catherine. Rock excavation of the overland channel at Côte Ste. Catherine and between Jacques Cartier and Victoria bridges proceeds as usual. Enlargement to piers of the Jacques Cartier bridge is carried on. About 75 per cent of the labour involved in building the navigation channel will continue working throughout the winter.

Below the Jacques Cartier bridge, where entry to the future channel will be made from Montreal harbour, Miron et Frères, Ltée. have a mile-long contract to excavate 2,000,000 cubic yards of material, of which 500,000 cubic yards are rock. Completion is called for by November 30, 1957. Excavation on this contract as of October 31 was 22 per cent completed. Considerable cofferdamming had been finished, and part of the site dewatered. Dyke construction was also progressing satisfactorily.

Atlas Construction Company had completed the water intake for the municipalities of Longueuil and Jacques Cartier. On their contract for enlargement of Piers 1 to 11 of the Jacques Cartier bridge, grouting around several of the piers was proceeding, along with work in the vicinity of Pier No. 11 in preparation for the enlargement. Work must be completed by September 30, 1956. Later, the southerly end and approaches to the bridge must be raised permanently.

On the MacNamara-Pigott-Peacock-McQuigge contract up-river from Jacques Cartier bridge towards Victoria bridge, for excavation of 1½ miles of seaway channel and dyke, due for completion by June 30, 1957, cofferdams were complete and the entire contract area dewatered. Excavation was about five per cent ahead of schedule, with about 43 per cent of the 3 million yards total removed. The dyke had been built to within five feet of finished grade throughout its length; riprap had been placed to within five feet of grade.

Tenders for the St. Lambert lock, to be built at the south shore end of Victoria bridge, were received December 20. Completion was called for August 31, 1958. This work will extend nearly a mile and will require removal of some 2,400,000 cubic yards of material. Also required will be some 400,000 yards of concrete.

The most easterly of the two channel and dyke contracts for some seven miles of channel and dyke in the Laprairie basin, to carry vessels past the Lachine Rapids, is with the Walsh-Canadian Construction Company Limited. It calls for excavation of 3.8 miles of channel and the requisite dyke, as well as construction of a turning basin for ships and the extension of the water intake for St. Lambert. Excavation required will be some 2,000,000 cubic yards of rock and nearly 5,000,000 cubic yards of common excavation, for completion by December 15, 1957.

On this contract cofferdams have been completed, a section of the channel has been dewatered, and rock excavation commenced during October. Temporary pumping facilities are now supplying water to St. Lambert. The contractor has laid 360 feet of 36-inch concrete pipe for the permanent water intake.

Adjoining this contract on the west and south is a like one, 3 miles, in length. Due for completion by August 31, 1958 it involves excavation of some 1,200,000 cubic yards of rock and some 2,500,000 cubic yards of common material. Contractor is Northern Construction Company and J. W. Stewart Limited of Vancouver. The contractor had completed some cofferdamming and about ¼ mile of channel had been dewatered. Channel excavation had been commenced and work was completed on a temporary water intake to serve Laprairie.

The work for the Côte Ste. Catherine lock and approaches was awarded to Canamont Construction Limited and Canit Construction Limited, for completion by July 31, 1958. It extends a distance of 2 miles and in addition to the lock it includes excavation of a navigation channel and dykes which form the approaches to the lock. It also includes the excavation of a turning basin downstream, regulating works for the upper reach of the canal and a reservoir pool upstream of the lock.

Common excavation required here will amount to some 2,800,000 cubic yards, rock excavation to some 1,653,500 cubic yards. Concrete work will call for some 1,750,000 bags of cement. Some 3 per cent of the material had been removed by end of October, and progress had been made in the placing and rolling of fill and raising of cofferdam.

Construction of ¾ of a mile of the overland channel along the south shore from the Côte Ste. Catherine lock towards the Indian village of Caughnawaga, is being carried out by Miron et Frères, Ltée., for completion by November 30, 1956. This contract includes some 340,000 yards of common excavation, 490,000 yards of shale and 800,000 yards of limestone, plus the laying of 100,000 cubic yards of rock cushion on each side of the channel. The contractor here had completed the north and south cofferdams for the lock, and had removed most of the earth and shale and 40 per cent of the rock.

The last contract awarded by the authority to Northern Construction Company and J. W. Steward Ltd. at a price of $4,877,700 adjoins this one, and proceeds further overland to the Honore Mercier bridge. This excavation, some 2.8 miles in extent, will involve 2½ miles of dyke. It includes 4,600,000 cubic yards of earth and 2,900,000 cubic yards of rock, as well as cofferdams and unwatering. Work is to be completed by August 31, 1958.

Lake Channels Dredged

For dredging the seaway channel in Lake St. Louis, Marine Industries Limited have a contract for the removal of 3,800,000 cubic yards of overburden and 100,000 cubic yards of solid rock. This firm was also awarded a contract for dredging 600,000 cubic yards of sand, silt and clay from the channel at Lancaster Bar in St. Francis.

At the western approach to the Beauharnois canal, in Lake St. Francis, McNamara Construction Company Ltd. has a contract for dredging 1,100,000 cubic yards of sand, silt and clay from the Seaway channel. Canadian Dredge and Dock Company, Ltd. is the contractor to dredge 2,700,000 cubic yards of overburden from the channel from Fraser Point to Cornwall in Lake St. Francis. Two of the dredging contracts are ahead of schedule. The other two are progressing satisfactorily. About 30 per cent of the total material has been removed.

International Section

Across Iroquois Point, Pentagon Construction Company Limited and Iroquois Constructors Limited were jointly awarded a contract to construct a canal and lock. This installation will serve to carry vessels past the Iroquois control dam which will control the level of Lake Ontario. About 1 1/3 miles in length, the contract requires excavation of about 4,500,000 cubic yards of material, mostly heavy glacial till.

Approximately 26 per cent of the excavation on this contract had been completed to the end of October. Previously cofferdams had to be built at the upstream end. Work was proceeding on the erection of a concrete mixing plant and equipment repair shops had been provided.

Of some 8,300,000 cubic yards of material to be removed under dredging contracts awarded, at least 2,000,000 cubic yards or some 24 per cent, have been removed already this season, and navigation on the seaway does not begin until the opening of the navigation season of 1959.

A number of excavation contracts were not awarded until late in the summer and fall yet nearly 5,000,000 cubic yards of material had been removed on lock and channel and dyke contracts, most of which had to be unwatered first. This is some 14 per cent of the total yardage to be removed under such contracts already awarded, (but upon some of which, recently awarded, no work had yet commenced) of some 35,000,000.

The Authority has established a special lookout platform at Iroquois Point, from which may be seen the machines at work in the cut for the Iroquois lock and approaches. The work at Montreal may be easily surveyed from St. Helen's Island, from the Jacques Cartier bridge, and Victoria bridge or from the riverside drive which passes through St. Lambert.

The Authority has conducted several official tours over the works for Canadian, United States and foreign governmental representatives and for the press. It has likewise supplied the services of its officers as guides to a number of independent tours which various educational and business groups have arranged with the Authority.

Changes in Soulanges Section

It has been decided to construct separate single locks at the lower end of the Beauharnois canal, instead of the twin-flight locks contemplated under plans developed some years ago. Provision, however, will be made for the twinning of these locks in the future should the need arise.

Although the normal difference in water level between Lake St. Louis and Lake St. Francis is about 84 feet, variations in the water levels require that the locks each be designed for a maximum lift of 47 feet; otherwise, the lock dimensions will comply with the standards adopted elsewhere. To avoid interference with the flow of traffic on Highway No. 3, a two-lane tunnel will be built under the upper end of the lower lock in place of the movable bridge originally planned. This change will result in an increase in cost of about $1,100,000.

Additional facilities for which the overall first cost has been estimated at $37,320,000, will include the installation of movable spans in three existing bridges, two of which are combined highway and railway bridges and the third a railway bridge.

SLSA Hydraulic Laboratory

It is announced that Neyrpic Canada Ltd. of Montreal has been awarded a contract for the construction and verification of hydraulic models of Montreal harbour and of the Lachine rapids, and for various test programs on the models.

Two river models have already been built in the N.R.C. laboratories at Ottawa, the first to permit of an exact appraisal of the effect of the Gut dam at the head of the Galops rapids, the second for detailed studies of the most effective and economic methods required for channel improvements north and south of Cornwall Island.

The purpose of the models now proposed is to provide means for studies of the Lachine section in a manner similar to those made by the Authority and by Ontario Hydro in the international rapids section, and in regard to the Niagara development where such tests have all resulted in great economies in construction.

The Authority will construct a hydraulics laboratory building at Ville La Salle, in which the models are to be built and operated. Lalonde and Valois, consulting engineers, have been retained to prepare plans and to supervise the construction. The hydraulics laboratory and the studies and reports emanating therefrom will be under the control of a Lachine models committee, of which two members will be appointed by SLSA and two members by the model testing organization.

The Lachine rapids reach model will reproduce a nine mile section of the river from Dorval Island to below Heron Island, with a fall varying from 30 to 34 feet. The Montreal harbour model will represent the section of the river from a point ¾ of a mile above Victoria bridge to a point off Longueuil, 1½ miles below Jacques Cartier bridge.

Three contracts for enlargement of Welland canal locks were awarded by the St. Lawrence Seaway Authority on December 6 as follows: McNamara Construction Co., $359,755; Swansea Construction Company, Ltd., $698,260; and Aiken and MacLachlan, Ltd., for $104,000.

Progress by SLSDC

On the American side of the river, SLSDC has three major contracts under way on the 10-mile Sault canal, with its Robinson Bay and Grass River locks, and two dredging contracts further upstream.

At the far upstream end of the work a cross-island channel is being cut through by "The Gentleman", a huge 650 ton dragline from the Kentucky coal fields, with a 14 yard bucket on an 85 foot boom. Here the Badgett Mine Stripping Corporation has a contract for digging 3.9 million yards at a bid price of $1,372,800, less than half the Government's estimate.

Further downstream where the channel location leaves the river and cuts across-country, a Kiewit-Morrison Knudsen Joint Venture group has a contract for moving 12.5 million cubic yards of channel excavation at a price of $6,452,540. This is a dragline operation and is now well started. Two dredging contracts, for 3 million yards of earth on the Cornwall Island section and some 60,000 yards of rock in the 1000-Island section complete the work in hand on channel excavation.

Excavation for Grass River lock, a 2,500,000-yard earth excavation job, 80 feet to rock, is being carried out by the Dutcher Construction Co. at a price of $2,197,843. This lock location was moved 500 feet in planning, into a difficult marine clay material to avoid a dangerous fault line. In spite of the difficulties encountered in dewatering and in handling the sticky material the contractor has more than half completed the work and hopes to meet the February 1956 completion date.

The contract for excavation for the Robinson Bay lock further upstream, involving 2,600,000 cubic yards of earth material, was originally awarded to the Jack and Jim Maser Corp. at $990,900. After half completing the contract, the Masers defaulted in September, and it is now being finished by the Tecon Corporation of Dallas, Texas. Completion is called for early in 1956.

Awards of contracts for construction of the two locks are yet to be made. The whole project will be pushed to completion over the 1956 and 1957 construction seasons, in order that limited 14 ft. draft navigation may be possible by July 1958 at which time the old 14 foot Cornwall canal on the Canadian side is closed. As of December 1 employment stood at some 450.

Canadian Seaway Authority officials visited Washington, D.C., December 8 and 9 for meetings with the Saint Lawrence Seaway Development Corporation for further discussions on the Polly's Gut bridge and allied matters in the international rapids section. Discussions regarding tolls were carried on between the two tolls committees, United States and Canadian, which are studying this subject and

London Meetings

Above. The opening of the International Conference on Combustion. Left to right, Sir Ernest Smith, R. E. Heartz, D. M. Watsin, P. L. Jones, B. G. Robbins, J. D. Peattie and Prof. O. A. Saunders.

President R. E. Heartz and the general secretary visited Britain in October and took this opportunity to entertain overseas members of the Institute, at headquarters of the Institution of Mechanical Engineers. Below left. Old friends at the E.I.C. reception: Sir David Pye, past-president, I. Mech. E., Dr. Heartz, Allan Quartermain, and Sir John Hacking, past-presidents of I.C.E.; Brian Robbins, secretary of I. Mech. E.

reporting from time to time thereon.

Canal Redesigned

The Canadian and United States governments have announced agreement with a scheme of the International Joint Commission for toning down extremes of high and low water in Lake Ontario. It is a plan for protecting perennially-threatened shore areas in the Montreal district by redesigning part of the St. Lawrence seaway canal there.

External Affairs Minister Pearson has made public a letter approving the I.J.C. plan. "Arrangements now have been made," he said, "for the redesign of a portion of the new 27-foot canal in the vicinity of Montreal, which will allow a flow of 40,000 cubic feet per second to be bypassed from Lake St. Louis to Laprairie basin through the canal during the non-navigation season.

"This will not only provide more favourable ice-forming conditions in the narrows between Lake St. Louis and Laprairie basin . . . but should also be of benefit to upstream interests on the St. Lawrence River and Lake Ontario."

Thirty-five Years Ago

Comment on the *JOURNAL* of January 1921

The *Journal* started off for 1921 with an issue in January somewhat plumper than most of its predecessors. A large part of the increase was in the advertising pages, where several new names may be noted, including some still with us.

I am told that the *Journal's* uprise in advertising was because it had acquired a full-time solicitor, S. A. Neilson, M.E.I.C., now on the staff of the faculty of engineering of McGill University.

Not all of our 1921 advertising patrons have lasted out the years, e.g., Armstrong-Whitworth, Ltd., which offered a great array of products ranging from brass rod to diesel engines. Its plant was in Longueuil, across the river from Montreal, and was probably the first in Canada to use pulverized coal as a metallurgical fuel.

The company's managing director was the late M. J. Butler, M.E.I.C., a choleric Irishman. I well remember riding over the Victoria Bridge with him long before it was widened, in his Armstrong-Siddeley car, a vehicle as long and unwieldy as many a small truck. Half-way across we met a farmer with a load of hay. No amount of squeezing and jockeying would allow us to pass, so Mr. Butler gave his chauffeur $20, he bought the hay and the farmer pitched it over the rail into the St. Lawrence. We passed.

Annual Meeting Papers

The technical papers in this *Journal* were all preprints of some to be presented at the *Institute's* annual meeting to be held in Toronto in February. The first was a design of a sewage disposal plant for a seaside city, by C. J. Yorath, A.M.E.I.C.; the *Journal* had not yet adopted the practice of identifying authors by their professional connections. The paper dealt with an hypothetical city and conditions, but the design was worked out in considerable detail, some of the computations being given in extenso.

J. C. Keith, A.M.E.I.C., followed with a paper on "Cost-plus Contracts". I wonder if this is the J. Clarke Keith for whom the Ontario Hydro's steam generating station in Windsor is named? I was surprised to learn that cost-plus contracts were quite novel in 1921, one of the earliest in America dating back only to 1907, according to Mr. Keith. Admitting that there are disadvantages in the cost-plus system, the author made out a pretty good case in its favour, citing a sewer contract where the final expenditure under cost-plus was about 20 per cent less than the lowest lump sum tender received.

Then one of our few chemical engineering members, L. E. Allen, M.E.I.C., discussed "Hydrated Lime". He pointed out that our chemical industry used more than one-half of our production and that the rest went mostly into civil engineering works as a constituent of mortar and plaster and as an additive to concrete, as a plasticizer and waterproofer. He wrote of the water-cement ratio as being "now well established as governing the strength of concrete" and strongly advocated the use of up to 10 per cent of hydrated lime in concrete to allow of the reduction of this ratio without loss of concrete strength or of work ability. We still use some hydrated lime in concrete, but not as much as Mr. Allen thought we were going to.

James Milne, M.E.I.C., had a paper in this *Journal* on the Toronto filtration plant, comparing the operation of the 1912 slow-sand filters with that of the 1917 drifting-sand filters. Both gave a perfectly satisfactory water, but the cost per million gallons of water filtered was higher for the latter than for the former. At any rate, when Toronto built a new filtration plant not many years ago, it did not use the drifting sand type.

Mr. Milne's paper was followed by one by E. A. Ryan, A.M.E.I.C., on the heating and ventilation of paper-machine rooms, with a long discussion by E. A. Briner, M.A.S.M.E. The two together gave an excellent picture of the state of the art then; I doubt if it has changed much in thirty-five years.

Personalities

The rest of the editorial matter deals with plans for the forthcoming annual meeting, a special nomination of H. G. Acres, M.E.I.C., for the post of vice-president—and a plea to the government to appoint an engineer to the Railway Commission.

Among the personals, I find that A. G. L. McNaughton, A.M.E.I.C., was on his way to England for a year's visit and that R. L. Weldon, JR.E.I.C., had just become mechanical engineer for the Three Rivers Pulp & Paper Co. The first is, of course, Gen. A. G. L. McNaughton, now chairman of the Canadian Section of the International Joint Commission and Mr. Weldon is president of the Bathurst Power and Paper Company.

One member is announced as having set up as a contractor in Toronto, in which business he "expects to continue . . . for some years to come". Don't they all?

The late J. M. R. Fairbairn, M.E.I.C., was the incoming president, so his portrait appeared in the *Journal*, a determined looking young man, but without the imperial bearing so characteristic of him in later life.

The Battlefields Memorial Commission, of which Col. R. W. Leonard, M.E.I.C., was a member, announced a design competition for the monuments it proposed to build at St. Julien, Courcelette, Vimy Ridge, Passchendaele, Hospital Wood, Dury Cross Road and Bourdon Wood, all points where Canadian troops helped to win Allied victories in the late war.

The Branches

Life in the branches seemed to be going along about as usual. Metering of a selected area in Halifax had cut water consumption down by about 65 per cent, but it was complained that building laws and plumbing regulations were hard to enforce on account of civic politics."

The Ontario Provincial Division was still trying to get an engineers' licensing act passed in that province and after a good bit of apparently acrid discussion, authorized its committee on the matter to use all legitimate means to forward such legislation. The Vancouver Branch was concerned because it was rumoured that "certain powerful interests propose . . . to endeavour to have certain amendments enacted, eliminating the compulsory clauses of the Engineering Profession Act."

The *Institute* was growing; there were an even hundred applications for membership published in this *Journal* and 17 for transfer.

Engineering Careers in Canada

On page 89 of this issue readers will find the first of three articles that will appear in the *Journal* covering the role of the engineer in the Canadian armed forces. Our purpose in publishing them is twofold, first, to inform readers of what the members of our profession are doing in the defence of Canada, and second, to help the services in their search for new technical personnel. It was our intention to run these stories according to established custom with the navy coming first. However, to save time, and with proper apologies to the sailors, they will appear in the order they are being received from Ottawa.

It is proposed to continue with a further series of articles on similar lines about careers in various fields of Canadian industry.

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

The R.C.E.M.E. Corps Association held its tenth annual general meeting and dinner at the R. C. E. M. E. School, Barriefield, Ontario on October 22 last.

The president, Lieut.-Col. A. G. Edward of Montreal, was reelected for a second term, while the honorary secretary-treasurer, Lieut.-Col. LeSueur Brodie of Toronto was also re-elected. Lieut.-Col. J. K. Bradford of Toronto was elected first vice-president.

Guest speaker at the annual dinner was T. W. Eadie, M.E.I.C., of Montreal, president of the Bell Telephone Company of Canada Limited. A special feature of the dinner was the presentation to Gen. The Hon. A. G. L. McNaughton, M.E.I.C., honorary colonel commandant of the Corps of the Canada Decoration with two clasps, by Col. J. R. Dunlop, M.E.I.C., director of the Corps.

Delegates who attended the meeting and dinner were Lieut.-Col. E. D. Gray-Donald, M.E.I.C., chairman, Quebec Command chapter; Maj. O. B. Berringer, M.E.I.C., chairman, Eastern Command chapter; and Maj. L. Raisbeck representing Western Command chapter. Besides those mentioned above the following unit officers were present: Col. C. W. Jones, M.E.I.C., commanding the R. C. E. M. E. School, Barriefield; Lieut.-Col. L. Martin, M.E.I.C., commanding 3 Technical Regiment, Montreal; Lieut.-Col. L. M. Harding, commanding 4 Technical Regiment, Toronto; Maj. A. Anderson, 5 Technical Regiment, Hamilton; and Maj. O. Dunn, 6 Technical Regiment, Windsor.

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

Elections and Transfers

At the meeting of Council held at headquarters, on Friday, December 16th, 1955, a number of applications were presented for consideration and on the recommendation of the Admissions Committee the following elections and transfers were effected:

Members:

J. S. Arczynski, *Toronto*
W. L. Gross, *Montreal*
A. Mackie, *Toronto*
J. W. L. Monaghan, *Toronto*
E. M. Monteith, *Toronto*
J. E. Sutton, *Victoria*
E. I. Wigdor, *Montreal*
S. Wood, *Ottawa*

Juniors:

J. B. Laurie, *Montreal*
B. P. Nicholls, *Montreal*
J. R. Wells, *St. John's*

Transferred from the class of Junior to that of Member:

P. J. Boivin, *Kenogami, Que.*
N. E. Duncan, *Montreal*
G. Ewing-Chow, *Georgetown, B.G.*
J. L. Gariepy, *Sorel*
W. S. Jones, *Houston, Texas*
W. C. Leith, *Montreal*
M. H. Margles, *Toronto*
J. H. C. Massie, *Toronto*
A. R. D. Robertson, *Victoria*
G. C. Robinson, *Saint John*
T. E. Smith, *London*

The following Students were admitted:

McGill University

J. Achtman	A. Lipes
G. J. Akamoto	R. G. Lubelsky
R. J. Allore	L. J. Luyks
H. L. Atkinson	C. J. E. MacKay
G. Banks	P. G. Mackay
F. Barna	H. A. Macpherson
R. G. Begley	A. A. McAlear
R. E. Belair	J. G. M. McKirdy
P. R. Belanger	R. K. McNamee
G. Bellefleur	V. de P. Marceau
D. Bohonos	D. M. Martin
G. Boulais	S. R. Mester
J. E. Buchan	A. Miroshnichenko
I. A. Burla	W. G. Montgomery
J. R. G. Collard	D. R. Morrier
H. C. Clowes	W. H. Moulton
G. T. Connery	F. S. E. Murphy
C. H. Cormier	J. Mushka
T. A. Crooks	F. S. Nemet
R. H. Crosbie	M. Novac
A. S. Derrick	A. Novakoff
L. De Simone	P. Ostapeic
W. D. Duanne	J. Ozers
W. E. Dunford	J. F. L. Pelletier
Y. C. Dupuis	R. Picard
D. J. P. Evans	C. R. Pilon
V. V. Filipovich	A. L. Poddubny
G. L. Fox	E. V. M. Prives
B. Garceau	W. C. Ramsden
F. E. Godwin	G. A. D. Reed
V. Golde	D. W. Reesor
S. Greenberg	R. I. Robertson
F. A. Guilbault	A. A. Robillard
J. R. Hall	J. A. Rowley
J. M. Hammel	V. Schecter
F. J. P. Heffernan	D. M. Smith
R. G. Hollett	W. J. Smith
B. A. Howarth	M. A. Sochocky
H. M. Ichiyen	T. de G. Stewart
C. K. Januskevicius	S. Sura
J. H. Johnsen	J. Terauds
L. T. Kishino	G. G. E. Trudel
A. Klicius	C. Villeneuve
R. S. Knott	J. J. Vincent
H. F. Kolodny	T. J. Wagg
H. I. Kornbluth	D. Wainberg
W. Larson	G. R. A. Weiss
R. S. Leiffer	M. Werbin
E. V. Leon	

University of Manitoba

B. E. Akins	L. R. McGinnis
V. M. Austford	F. T. McGregor
R. N. Ayukawa	D. G. McKenzie
K. A. Bailey	W. J. McQuay
T. L. Blais	I. A. Nattress
F. R. Bruckner	D. K. Newey
D. G. Burdeny	Y. Okamura
G. Call	E. M. Pashniak
G. F. Carleton	J. S. Paulsen
J. G. Carruthers	B. O. Pedersen
R. G. Caughey	F. Penner
B. Chan	B. C. Peterkin
G. Chymko	L. Petrie
L. A. Clay	G. G. Phillips
W. D. Crowe	E. Pollock
E. P. Debusschere	A. F. Potter
E. Dolhun	V. R. Price
W. J. L. Duncan	A. Priestley
G. Dyck	J. W. Puchalski
C. Feuer	I. Reinhart
T. C. Fraser	D. J. Rennie
T. A. Ferens	N. Richards
G. E. Grant	H. P. Rostig
M. Gumprich	H. J. Schleier
R. S. Hayward	L. F. Schmidt
R. A. Hewett	J. P. Sharby
D. M. Heys	D. M. Shook
E. W. T. Hnatiuk	D. B. Sigurdson
A. G. Hook	P. R. Simmonds
B. R. Hryhorczuk	L. R. Smith
L. E. Hurwitz	W. W. Starr
B. M. Jacobs	J. A. Stewart
L. R. Jacobson	S. P. S. Sulymka
E. Kaarsoo	R. D. Sweeney
H. Kowaalik	A. R. Szewczyk
G. J. Lapointe	M. Tennenbaum
P. Leung	R. P. Tomlinson
C. G. Luckman	W. J. Tischinski
M. F. Macpherson	R. C. Verner
T. Maftechuk	J. T. Woods
W. R. Martin	R. J. Wright
J. A. Martino	V. A. Yamasaki
J. M. Moore	W. K. Zimmerman

University of Toronto

J. D. Acheson	D. K. L. Kwong
D. A. Allen	J. C. Pickett
D. C. Brownlow	T. B. Seawright
G. N. Hesler	R. E. Stone
G. R. Howland	F. T. White
J. R. Inglis	H. O. Wieler
P. Kalnins	G. T. Will
R. Kurkjian	S. W. P. Wyszowski

University of Alberta

H. G. Basler	M. A. Kehr
F. F. Beck	F. Lukawitski
D. M. Carlisle	H. Nahaiowski
J. J. Chilibeck	F. T. Russell
H. K. Hanson	E. L. Taylor
T. E. Horne	D. M. Walker

Nova Scotia Technical College

D. R. Bourke	J. O. Hachey
A. J. Comeau	J. C. Sinclair
J. W. W. Fawcett	

University of New Brunswick

A. W. Gibson	R. H. MacIntosh
D. H. D. Jackson	H. H. Sherrard

Carleton College

K. E. Gardiner	W. G. Halvorson

Loyola College

R. K. Cox	S. M. Perrotta

Lakehead Technical Institute

G. W. Brown	R. T. S. Nash

Mount Allison University

G. W. Hannah

Graduates

L. Richard, B.Eng. (Mech.) 1955, Toronto.
K. E. Newbold, B.A.Sc. (Engrg. Physics) 1955, Toronto.
J. M. Neal, B.A. Sc. (Engrg Physics) 1955, Toronto.
J. D. Crickmore M.Sc. (Mining) Stanford 1955.

Applications through Associations:

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections and transfers have become effective:

ALBERTA

Members:

R. F. Andretsch	K. G. Clarke

Junior to Member:

W. D. Usher	J. Steudel

SASKATCHEWAN

Members:

L. S. Earp	B. C. Palmer
F. A. Kidd	D. R. Rowe
J. H. Lapp	P. R. Wilson
R. L. McPherson	

Students:

H. R. Akehurst	J. J. Lipsett
D. Bartkiw	R. L. Mackenzie
D. W. Bishop	J. W. MacNeill
S. T. Bramwell	F. D. McCarthy
S. S. Brkich	J. M. McNeil
M. Cherney	A. W. Millard
E. W. Chornomydz	L. C. Miller
J. I. Daniels	F. W. A. Mosienko
S. I. Deckert	M. M. Muth
M. J. Demetrick	G. T. Narfason
G. C. M. Derbowka	G. G. Popoff
E. J. Dueck	W. A. Posehn
J. A. A. Field	V. A. G. Rein
D. G. Fisher	V. L. Ryhorski
T. B. Fletcher	R. Schindelka
F. W. Fossey	H. Schmidt
D. M. Galbraith	K. G. Schoenroth
F. K. Gerbrandt	W. J. Serne
T. P. Gilchrist	A. C. Shuster
R. W. Gillanders	R. O. Sochaski
W. H. Glaister	J. R. Stoffel
A. A. Gorkoff	G. R. Straub
H. M. Hleck	J. A. Thom
E. A. Hodgins	K. H. Thompson
L. A. Kaeding	M. B. Todd
H. J. King	L. E. Torfason
J. S. King	J. L. Townsend
B. W. Kischuk	S. S. Turek
G. Kobelak	S. D. Walker
P. Kozicki	D. J. Walsh
Paul Kozicki	M. W. Weddige
R. B. J. Kroeker	E. G. E. Wurts
G. E. Laliberte	T. Yoshida
D. L. Lawrysyn	

Junior to Member:

J. T. Dokken	K. J. MacRae
R. M. Heaton	

MANITOBA

Junior:

W. Naumko

NOVA SCOTIA

Members:

D. R. Downing	J. C. Eaton

Junior to Member:

A. M. Macdonald	D. E. Rudolph

Correction

In the December 1955 issue of the *Journal*, page 1693, under "Elections and Transfers"—Council Meeting of November 19, 1955, through a clerical error Mr. J. E. Wright, Toronto, was shown as a Member, whereas he was elected a Junior.

NEWS OF THE ASSOCIATIONS & CORPORATION

Information received through co-operation with the provincial organizations

Ontario

News of the Members

H. W. Tate of Toronto has been promoted from executive vice-president to president of De Leuw, Cather and Company of Canada, Ltd. at a recent meeting of the company which is associated with De Leuw, Cather and Company of Chicago.

De Leuw, Cather and Company of Canada Ltd., located at 52 St. Clair Avenue East, Toronto, was formed early in 1954 and at present employs nine professional engineers. Prior to joining this firm of consultants, Mr. Tate was assistant general manager of the Toronto Transportation Commission with which he had been associated for many years.

Norman A. Grandfield is now manager of the Public Utilities Commission of Brantford, Ont. A graduate in electrical engineering of Queen's University, Mr. Grandfield was formerly manager of the Public Utilities Commission of the City of Galt.

Donald H. MacDonald is on the engineering staff of H. G. Acres and Co. Ltd., of Niagara Falls, Ont.

Fred H. Edwards, formerly with the Canadian Westinghouse Company in Hamilton, is now assistant professor of electrical engineering at the University of Massachusetts, Amherst, Mass.

Professor Edwards graduated in electrical engineering from the University of British Columbia in 1949 and joined Westinghouse at that time. While with the Canadian Westinghouse he undertook post-graduate work and received a master's degree in electrical engineering from the Nova Scotia Technical College. He was appointed to the staff of the University of Massachusetts early this fall.

John W. Emerson is now engaged in the private consulting practice of John Emerson and Associates with Cleveland office at 1277 Ramona Avenue, Lakewood, Ohio.

Mr. Emerson graduated in engineering from the University of Toronto in 1930 and two years later obtained his master's degree. Before moving to the United States several years ago he was with John Inglis Company in Toronto

Robert B. Jennings, who was formerly claims and contract engineer with the Trans-Canada Highway division, Department of Public Works, is now associated with the Department of Planning and Works of the City of Ottawa

Dr. W. C. Winegard and **Dr. J. W. Rutter,** of the Department of Metallurgy of the University of Toronto, took part in a recent Canadian symposium on melting, diffusion and related topics. The meeting was held in Ottawa, under the auspices of the low temperature and solid state physics group of the National Research Council, to bring together scientists from Canadian research institutions and universities interested in various aspects of the problems of melting and the liquid state.

T. N. McLenaghan, of the Abitibi Power and Paper Company, Ltd., has been transferred from the Fort William division, where he was control superintendent, to the Iroquois Falls division of the company as assistant to the mill manager.

Dusan Lazarevich and Associates, Toronto consulting engineers, have moved to new offices at 244 Dupont Street, Toronto. We are informed by **D. P. Lazarevich** that the new phone number is WAlnut 10-6631.

Brian A. Tucker, of Canadian Westinghouse Co. Ltd., has been moved from Hamilton where he was employed as contract administrator, to Montreal, where he is senior technical representative of Westinghouse in one of the plants of Canadair, Ltd.

C. A. Dunham Co. Appointment

Announcement has been made by **A. J. Dickey**, president of C. A. Dunham Co. Ltd., of the election of **Richard M. Mitchell** as executive vice-president and assistant general manager of the company.

A graduate in engineering of Queen's University and also of the Harvard School of Business Administration, Mr. Mitchell has been actively connected with the heating and air conditioning industry for the past seven years. During the Second World War he served with the Royal Canadian Engineers, retiring with the rank of lieutenant-colonel.

H. C. Schwegler is now associated with the Dominion Electric Manufacturing Co. Ltd., of 60 Leslie Street, Toronto. He was formerly engaged in sales engineering with D. M. Fraser Ltd., of Toronto.

A. J. Vale has resigned from the employment of H. G. Acres and Co. Ltd., of Niagara Falls, Ont., to join the Atomic Energy of Canada Ltd., Deep River, Ont., as a design electrical engineer.

Heads National Carbon

The appointment of **John S. Dewar** as president of The National Carbon Company, a division of Union Carbide Canada Ltd., Toronto, was announced recently.

Mr. Dewar is a graduate in chemical engineering of Queen's University, and has been with National Carbon since 1943.

Lt. Col. R. H. Milne, of Toronto, has recently completed his tenure of command of the 2nd Field Engineer Regiment, R.C.E., whose headquarters are in Fort York Armouries, Toronto. Succeeding him in commanding the Regiment is **Lt. Col. A. G. Keith,** M.R.I.C.A., who is associated with A. D. Margison and Associates Ltd., of Toronto.

Colonel Milne graduated in civil engineering from the University of Toronto in 1941 and saw extensive service during the Second World War. He joined the 2nd Field Engineers Regiment shortly after return from overseas and was given command in 1952. He is chief engineer of the Department of Buildings for the City of Toronto.

W. E. Ewens has announced the opening of a consulting engineering practice in transit planning and traffic engineering. His offices are located at 462 Morrison Road, Oakville, Ont. Services offered in the transit field include long range and immediate planning, route studies, costs and all forms of transit research, particularly as related to smaller transit properties. Traffic services include all phases of traffic engineering, surveys and consultations.

Mr. Ewens is a graduate in civil engineering of the University of Toronto, and was with the Toronto Transportation Commission, as research engineer. He is a director of the Canadian Section of the Institute of Traffic Engineers.

Geoffrey C. Winkler has resigned his position as methods engineer at the Ford Motor Co. of Canada Ltd., Windsor, Ont., to accept a position as industrial-mechanical engineer with ACF Electronics, a division of American Car and Foundry Industries Inc., in Alexandria, Va.

Alberta

E.S.S. Plans Busy Year

Hugh Atkins, president of the Engineering Students' Society, when interviewed stated that they now have a membership of 670 students. This excellent percentage of the total student class speaks well for the membership campaign of the E.S.S.

Roy Mutter, secretary of the E.S.S., stated that a full program of monthly meetings was planned as well as many special events. The annual smoker, which has already been held, was extremely successful this year, with everyone on his best behavior.

First on the list of special events will be the annual Engineers-Nurses dance, a charitable undertaking, the proceeds from which go to the World University Service. In January the annual Engineers' Ball and Queen Contest will be held. This is the highlight of the E.S.S. program. Atkins stated that the Queens this year would be the most beautiful ever and that the model engineering displays would be the most outstanding to date.

In February and March the regular meetings will feature papers presented in the Webb Memorial Student Paper Competition. This competition, which is held in honour of the late Professor Webb, offers prizes of $25.00, $15.00 and $10.00 for the best papers presented to the E.S.S. during the regular term.

Finally, to complete the year, the annual Engineers' Banquet will be held in March.

Our interview with Hugh Atkins and Roy Mutter was too short to cover sports and other activities in which the engineers take part, but from what was learned it appeared that E.S.S. is, if anything, bigger and better than many readers will remember from their university days.

(Reprinted from *The Alberta Professional Engineer*, Nov. 1955.)

British Columbia

Annual Meeting in Victoria

Three hundred members and engineers-in-training affiliated with the Association of Professional Engineers of B.C. attended the two-day convention and annual meeting in the Empress Hotel, Victoria, on December 2 and 3. It was the first time the meeting had been held away from Vancouver since the Association was formed in 1920, and approximately 50 per cent of those present came from outside Victoria. Also in attendance were representatives of four other provincial Associations of Professional Engineers: E. W. Christian and A. E. McDonald, from Alberta; R. Bing-Wo, Saskatchewan; W. J. Patton, Manitoba; and Col. T. M. Medland, executive director of the Ontario Association.

Discussing their new duties are some of the members of the 1956 Council of the Association of Professional Engineers of British Columbia at the Association's annual convention held at the Empress Hotel, Victoria, on December 2 and 3. Left to right: W. O. Richmond, vice-president; J. E. Liersch, president; M. A. Thomas, all of Vancouver, and A. J. Saunders, Victoria.

C. D. Howe Addresses Luncheon

The Rt. Hon. C. D. Howe, Minister of Trade and Commerce, addressed an overflow audience at the annual luncheon on December 3. Mr. Howe said preliminary surveys of investment plans indicate that capital expenditure by governments and business in 1956 will be at least as high and probably higher than for the current year, and that this prospective expansion is not limited to any one area but seems to extend from coast to coast. He went on further to say that building activities during 1956 were more likely to be limited by shortage of materials than by a shortage of available capital. He warned, however, that there is no room for complacency, and advised that we have not yet been completely successful in mastering the problem of combining stability with progress.

J. E. Liersch Is New President

J. E. Liersch, vice-president of the Powell River Company, a forest engineer, was installed as president of the Association. He succeeds Dr. H. C. Gunning, dean of the Faculty of Applied Science at the University of British Columbia, who will serve another year on Council as past president. Elected as members of Council for 1956 were Professor W. O. Richmond, vice-president; A. C. Buckland, F. A. Lazenby, R. R. McNaughton, A. J. Saunders, and M. A. Thomas. Four additional members of Council will be appointed by the British Columbia Government.

Awards

At the annual awards luncheon on Friday, December 2, the Association Gold Medal was presented to F. S. Death, as the student in the 1955 graduating class at the University of British Columbia whose undergraduate record was considered by the Faculty to be most outstanding.

The Letson Memorial Prize, donated in memory of his father by Major-General H. F. G. Letson, C.B.E., M.C., E.D., for the best report or thesis submitted in support of an application for registration as a mechanical engineer, was awarded *in absentia* to N. L. Williams for his report "The Comparison Tower Concept for Predicting Cooling Tower Performance". Mr. Williams is at present on loan from the B.C. Electric Co. to the Chalk River development.

The Association Book Prizes of $25.00 value, which are annually awarded to engineering undergraduates in 3rd year Applied Science, will be presented during the president's visit to the campus next spring. Winners are: R. A. Sterne, chemical; J. J. F. Loewen, civil; W. N. Junas, electrical; K. H. Darke, geological; and E. Hay, mechanical.

The Ingledow Prizes, donated by T. Ingledow, for general proficiency in each year of engineering at the university, went to: W. R. Rasmussen; T. F. Somerville; J. J. F. Loewen; and L. G. Maranda.

Life Membership medallions were presented to: G. M. Irwin, Victoria; G. P. Sharpe, Salmon Arm; and W. Jamieson, Westview.

The president then called upon those about to receive certificates of registration and reminded them that they were publicly entering upon the privileges and responsibilities of a great profession; that they were bound by the same code of ethics as all professional engineers and that they must preserve the tradition of the profession faithfully as their most cherished possession. Certificates were then presented to the following: W. R. Cheriton, Vancouver; E. I. Dery, D. Logan, and D. G. Sutherland, all of Victoria; P. H. H. Hookings, and J. A. Procunier, of Vancouver; B. R. MacFarlane, of Port Alberni; H. M. Thurgood, of Campbell River; and Z. Wolski, of Westview.

In a special ceremony at Jubilee Hospital, Dr. Gunning, accompanied by Mr. Liersch and Registrar J. A. Merchant, presented a certificate of registration to A. C. Packard, who had been stricken with polio and was unable to attend the luncheon.

In addition to two days of business sessions there was a full program of social events, including two morning coffee parties and a Friday evening banquet for the 70 ladies who accompanied their husbands to the convention. For the men there was the annual stag party

(*Continued on page 106*)

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Frederick William Cowie, M.E.I.C., retired chief engineer of Montreal harbour, died in Montreal on October 30, 1955.

Mr. Cowie was born in Caledonia, Ont., on March 27, 1863. He received his education at Woodstock College and graduated from McGill University in 1886 with a B.A.Sc. degree in civil engineering. While at Woodstock College he studied special courses in mathematics and astronomy and spent his summer vacations as assistant in charge of the Astronomical Observatory there, and also worked on the survey of the Niagara Falls Park Commission. Upon his graduation from McGill he was employed as assistant engineer with the Montreal Harbour Commission, working on the St Lawrence ship channel.

In 1908, Mr. Cowie was one of a group of engineers who made extensive surveys of the principal harbours of Europe and the United Kingdom. This knowledge was put to use by Mr. Cowie during the first world war when he was sent as a consultant to Halifax where harbour expansion was underway. He was also responsible for planning the steady flow of grain shipments out of Halifax and Montreal at that time.

Mr. Cowie retired as chief engineer of the Montreal Harbour in 1926, having attained that position in 1907. After his retirement he was actively engaged as a consultant on major harbours including those at Norfolk, Va., Boston, Mass., and Havana, Cuba.

In 1914, Mr. Cowie received the Telford Medal of the Institution of Civil Engineers for a paper entitled "Transportation Problems in Canada and Montreal Harbour." More recently, he compiled the book, "Tales of the St. Lawrence," which is a series of incidents and stories connected with the River.

He was a member of the American Society of Civil Engineers. Mr. Cowie joined the Engineering Institute in 1887 as an Associate Member and transferred to Member in 1898. He attained life membership in 1933.

George A. Kydd, M.E.I.C., retired civil engineer in Ottawa, Ont., died suddenly in Kentville, N.S., on October 25, 1955.

Mr. Kydd was born in Montreal on November 20, 1883, and attended Montreal public and high schools. He graduated from McGill University in 1905 with a B.Sc. degree in civil engineering.

Upon graduation he joined the Grand Trunk Railway as assistant engineer in charge of construction of a grain elevator in Midland, Ont., and then was also with the National Transcontinental Railway in New Brunswick for a time, and with the Canadian Pacific Railway. In 1913 he joined the Department of Railways and Canals and was engaged on work on the Trent Canal in Campbellford, Ont. In 1924 he became divisional engineer on the Welland Canal, and then in 1932, resident engineer on Hudson Bay Terminals for the Department of Transport in Churchill, Man., subsequently coming to Ottawa as district engineer. He retired from the Board of Transport Commission in 1953.

Mr. Kydd joined the Engineering Institute in 1902 as a Student, transferred to Junior in 1911, to Associate Member in 1914, and to Member in 1940. He attained life membership in 1947.

Hector Somerville Philips, M.E.I.C., president of Philips and Roberts, consulting engineers of Hamilton, Ont., died suddenly of a heart attack in Port Colborne, Ont., on October 20, 1955.

Mr. Philips was born in Airdrie, Scotland, on November 20, 1882, and was educated at Wigan High School, Lancashire, England, and at Heriot-Watt College in Edinburgh.

Mr. Philips was employed as assistant engineer on various waterworks in Scotland before coming to Toronto in 1911 as draughtsman with the City of Toronto working on the design of sewerage and sewage disposal works, and then as engineer on sewage design. In 1915 he joined the staff of Professor E. B. Phelps, consulting sanitary engineer of the International Joint Commission in connection with the pollution of boundary waters, and the following year became designing engineer for Canada Nitro Products Company Ltd. in Toronto, in which capacity he supervised the design of a sharpnel loading plant. From 1916 to 1919 he held a commission as a lieutenant in the Royal Canadian Engineers.

In May, 1920, Mr. Philips was named engineer-in-charge of sewer design for the City of London, Ont., and the following year was named to the similar position with the City of Hamilton, Ont., subsequently becoming designing engineer. After twenty-three years service, in 1944, Mr. Philips retired from this position to establish the firm of Philips and Roberts, consulting engineers in Hamilton. At the time of his death he was president of this company.

Mr. Philips joined the Engineering Institute in 1915 as an Associate Member and transferred to Member in 1922. He attained life membership in 1951.

Charles H. Pinhey, M.E.I.C., construction engineer, died in Ottawa on November 6, 1955.

Mr. Pinhey was born in Ottawa on March 20, 1867, and was educated at Ottawa Collegiate Institute (now Lisgar Collegiate). He graduated from the School of Practical Science, Toronto, in civil engineering in 1887. The following year he passed examinations for Ontario Land Surveyor, and in 1889, for Dominion Land Surveyor. He was employed by the Department of Railways and Canals as rodman, leveller, and surveyor on the Soulanges Canal from 1889 to 1896, and for the next five years, as engineer for Manning & Macdonald, also working on the Soulanges Canal. He also spent some time as engineer on construction of a wharf at Three Rivers, Que., and then subsequently retired from active engineering practice to manage his personal property.

Mr. Pinhey joined the Engineering Institute in 1887 as a Student, transferred to Associate Member in 1894, and to Member in 1940. He attained life membership in 1947.

William O. Marble, M.E.I.C., partner in the engineering firm of Hodgson, King and Marble in Vancouver, B.C., died on August 27, 1955 in Vancouver.

Born in Hampstead, New Hampshire, he received his general education in Haverhill, Mass., and then studied engineering under private tutors. He spent five years as a draughtsman and resident engineer with the city engineer's office at Haverhill, Mass., and then in 1900, eight years on the engineering staff of Purdy Henderson, New York, working on the design of structural steel. Mr. Marble was then transferred to Boston by the company and was in charge of their engineering office in that city. From 1909 to 1917 he was western manager of Purdy Henderson (Canada) with headquarters in Vancouver, B.C.

In 1917 Mr. Marble entered into partnership with Hodgson and King as consulting engineers in Vancouver.

He was a member of the Association of Professional Engineers of British Columbia, and served on the board of examiners of the structural branch of that association.

Mr. Marble joined the Engineering Institute in 1919 as a Member, and attained life membership in 1950.

Alfred E. Hopper, M.E.I.C., retired steamship inspector, died in Ottawa on November 13, 1955.

Born in Darlington, England on July 20, 1870, Mr. Hopper received his general education there. He spent six and a half years as an engineering apprentice with the North Eastern Railway Company in Darlington before coming to Canada in 1891 and joining the Grand Trunk Railway Company in Montreal. The following year Mr. Hopper became an engineer on a ship and travelled extensively for several years.

In 1910 he was named steamship inspector at Vancouver, B.C. Mr. Hopper came to Ottawa in 1919 as principal inspector of boilers and machinery with the Department of Marine and Fisheries. He retired from government service in 1950.

Mr. Hopper became a Member of the Engineering Institute in 1923 and attained life membership in 1953.

Personals

News of the Personal Activities of Members of the Institute

H. S. Short, M.E.I.C., recently retired from his position as contract engineer of the Ontario division of Dominion Bridge Company Ltd. He will continue to be associated with the company as consultant, sales and contracting.

Mr. Short has spent 50 years in the structural steel industry. He began his career as a draughtsman with the Canada Foundry Company in 1906. In 1912 he became draughtsman checker with the Hunter Structural Steel Company and then in 1915 began his long association with Dominion Bridge, progressing through the positions of draughtsman, assistant chief draughtsman, sales engineer for Northern Ontario and Quebec, and, for the past 13 years, as contract engineer.

Mr. Short is a director of the Sault Structural Steel Company and a director and past-president of the Canadian Institute of Steel Construction. He is also a member of the Association of Professional Engineers of Ontario.

H. S. Short, M.E.I.C.

R. T. Harland, M.E.I.C.

MacKenzie McMurray, M.E.I.C., has been appointed sales manager in charge of sales and contracting by Dominion Bridge Company Ltd., Ontario division. He was formerly production manager with the company.

Mr. McMurray graduated in 1939 from the University of Toronto in metallurgical engineering and spent the following year at the University as a demonstrator in mining engineering.

In 1940 he joined the staff of Dominion Bridge's Toronto branch and spent the next five years as metallurgist and chief inspector at the Sorauren Avenue plant, then engaged in the production of munitions. He occupied a number of positions in the company's Toronto and Lachine, Que., plants until 1949 when he was appointed welding engineer at Toronto, a position he held until 1953 when he became production manager at that plant.

In 1954 Mr. McMurray received the degree of master of commerce from the University of Toronto. He is a member of the Association of Professinal Engineers of Ontario, of the American Society of Metals, and of the Canadian Welding Society.

He is a member of council of the Engineering Institute, and a past-chairman of the Toronto Branch.

M. McMurray, M.E.I.C.

M. D. Young, M.E.I.C.

Hydro Officials Promoted

The City of Winnipeg Hydro Electric System announces the appointment of **R. T. Harland,** M.E.I.C., as chief engineer and **M. D. Young,** M.E.I.C., as assistant chief engineer. Mr. Harland succeeds **D. C. Bryden,** M.E.I.C., who is now the utility's assistant general manager.

Mr. Harland graduated from the University of Manitoba with a B.Sc. degree in electrical engineering in 1938. In 1941 he received his M.Sc. degree from the Massachusetts Institute of Technology. He joined the staff of the Winnipeg Hydro in 1941, but from 1942 until the end of the war, served with the R.C.A.F. Returning to the Hydro in 1945, he became assistant principal engineer in 1948, and in 1952, principal engineer in charge of design.

M. D. Young, the new assistant chief engineer, graduated from the University of Manitoba in 1925 with a bachelor's degree in electrical engineering.

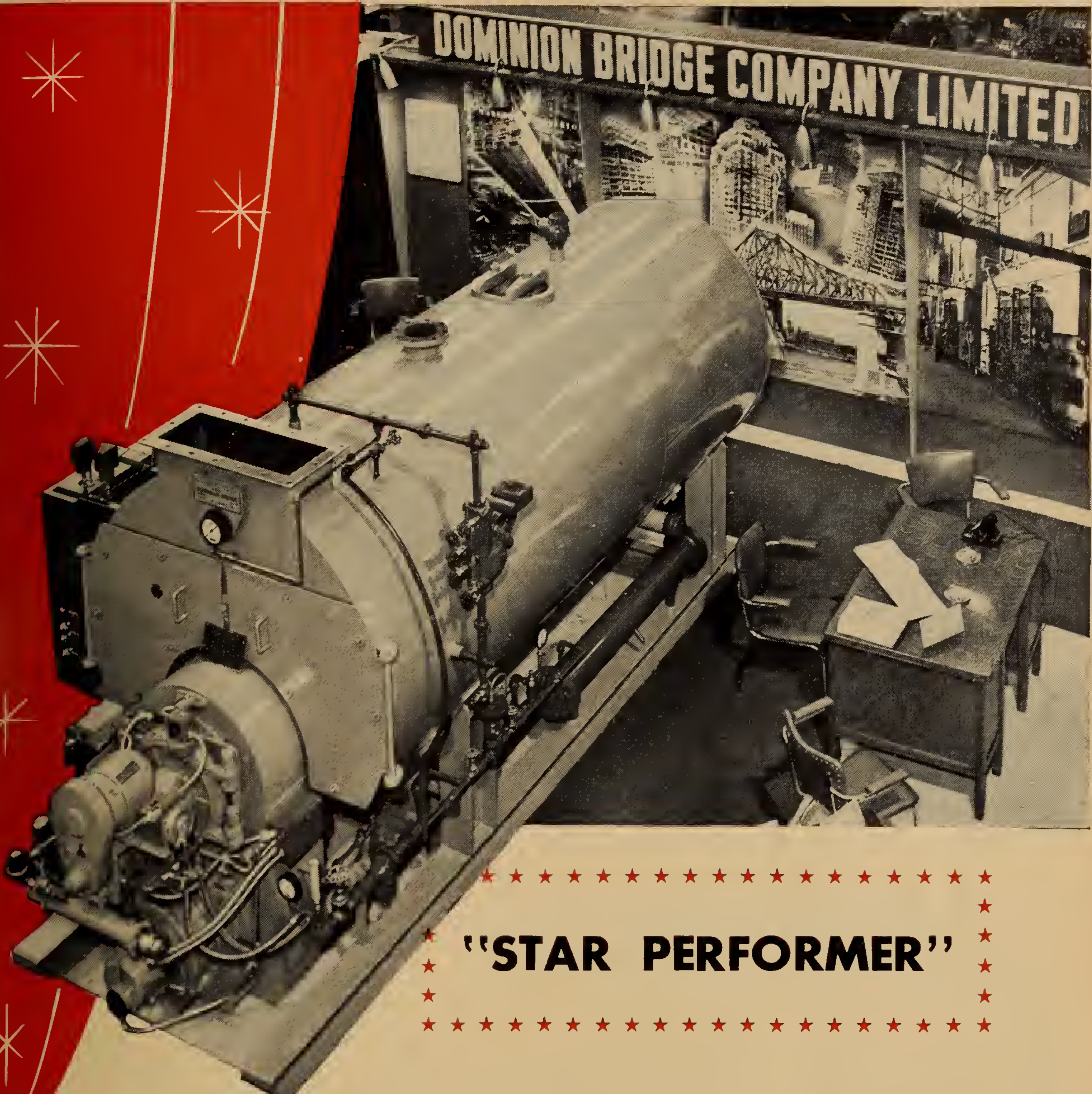
He joined the staff of Winnipeg Hydro in 1926 and has progressed through the positions of distribution engineer in 1930, assistant superintendent of distribution in 1938, assistant general superintendent in 1943 to general superintendent in charge of distribution in 1946.

Both Mr. Young and Mr. Harland are members of the Association of Professional Engineers of Manitoba and the Manitoba Electrical Association.

William O. Horwood, M.E.I.C., is now assistant to the president of International Equipment Company Ltd. at their head office in Montreal. Mr. Horwood was formerly branch manager of Lyman Tube and Bearings Ltd. in Toronto.

A mechanical engineering graduate of McGill University, class of 1937, he had joined Lyman Tube and Bearings Ltd. in 1945 and has also been eastern sales manager of that company's tubing and railway division.

J. H. Smith, M.E.I.C., vice-president and general manager of Canadian General Electric Company Ltd., who was recent-



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• Personals

ly transferred to Montreal to head the company's appliance division, is now in Peterborough, Ont., where he will hold the corresponding position in the apparatus division.

James Lundie, M.E.I.C., has been appointed district engineer of the Canadian Pacific Railway's New Brunswick district, with headquarters in Saint John. For the past two years Mr. Lundie has been locating engineer for the C.P.R. at Hemlo, Ont., where he built the recently opened Manitouwadge sub-division.

Mr. Lundie has been with the C.P.R. since his graduation in civil engineering from the University of Saskatchewan in 1930.

In 1939 he was appointed bridge and building master at Regina, and from 1944 to 1950 served as division engineer at Schreiber, Ont., Woodstock, Ont., and London, Ont. He was then appointed assistant district engineer at Toronto, a post he held until taking on the Manitouwadge project.

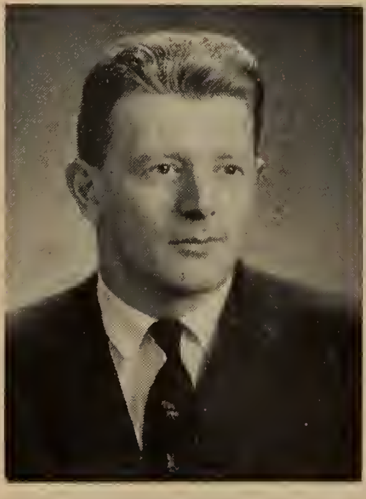
D. L. Dickson, M.E.I.C., has been named vice-president of the Eastern Electrical Supply Company in Montreal. He joined the company earlier this year as sales engineer.

A graduate of the College of Technology in Belfast, Mr. Dickson has also been electrical assistant with the Electric Tamper & Equipment Company in Montreal.

D. C. MacCallum, M.E.I.C., president of Racey, MacCallum and Associates Ltd., announces the appointment of **George L. Houghton,** M.E.I.C., as executive engineer in charge of the Toronto division of the company, and **R. Murray Campbell,** M.E.I.C., as executive engineer in charge of the Montreal division.

Mr. Houghton was previously assistant to the vice-president, Toronto division and Mr. Campbell was previously assistant to the president (technical).

Lionel Swift, M.E.I.C., has been appointed assistant general manager for Canadian Hoosier Engineering Company Ltd. in Montreal.



G. L. Houghton, M.E.I.C.

Lionel Swift, M.E.I.C.

Mr. Swift is a native of Shawinigan Falls, Que., where he received his early schooling and where he worked for some years before starting his studies at McGill University. He graduated in electrical engineering in 1934 and then spent the following two years on the Shawinigan Water and Power Company's training course. He worked in the generating and transmission department until 1945 when he was transferred to the Quebec Power Company.

With Quebec Power he successively occupied the positions of superintendent of the engineering department, superintendent of the electricity division, and finally, general superintendent of operations.

He is a member of the Corporation of Professional Engineers of Quebec, and of the American Institute of Electrical Engineers. He was also assistant professor in the electrical department of Laval University.

F. M. Kraus, M.E.I.C., has now established his own consulting engineering business in Montreal. He was previously with the Stadler Hurter Company in Montreal as structural design engineer.

Mr. Kraus received his doctor of engineering degree from Politecnico Di Turin in Italy in 1947.

R. M. Campbell, M.E.I.C.

W. A. Bentley, M.E.I.C.

William A. Bentley, M.E.I.C., has been named contract engineer for the Ontario division of Dominion Bridge Company Ltd.

Mr. Bentley received his education at Central Technical School and the University of Toronto. He spent a year with the Solway Process Company in Syracuse, N.Y., and then returned to Toronto in 1927 to join the staff of the McGregor-McIntyre Iron Works. After that company was taken over by Dominion Bridge in 1928 he served in various capacities until 1941 when he was appointed resident engineer of the Sorauren Avenue munitions plant. From 1946 he has been sales engineer in charge of mining sales, and in 1951 and 1952 he was on loan to the steel division of the Department of Defence as chief of the fabricating section.

Lt. Col. J. L. Dery, M.E.I.C., has joined Franki Compressed Pile Company of Canada Ltd. and will take charge of the new branch office to be opened in Ottawa. He was formerly with Pentagon Construction Ltd. in Montreal.

A graduate of the Royal Military College of Canada in 1934, Mr. Dery was in the Montreal district office of the Department of Public Works of Canada from 1934 to 1946. He served overseas during the Second World War with the R.C.A.

He has also been associated with Labrador Construction Ltd. and with Key Construction Limited in Montreal prior to joining Pentagon Construction in 1952.

Dr. W. C. Gussow, M.E.I.C., was recently honoured by the American Association of Petroleum Geologists. He was named distinguished lecturer and spent the month of November travelling extensively through the United States lecturing on "Problems of Oil Migration". While in Los Angeles he was the keynote speaker of the Association's annual regional meeting.

Dr. Gussow who practices as a consulting geologist in Calgary Alta. has travelled and worked in 18 different countries. He holds his B.Sc. and M.Sc. degrees from Queen's University in geology and mineralogy and before entering private practice was employed as chief geologist for the Shell Oil Company of Canada.

• *Personals*

R. N. Fournier, M.E.I.C., has been named manager of the mid-west district of the wholesale department of Canadian General Electric Company Ltd. in Winnipeg, Man.

A graduate in engineering physics from the University of Saskatchewan, Mr. Fournier joined C.G.E. in 1937. He served during the Second World War with the R.C.N.V.R. and returned to C.G.E. in 1945 as manager of the supply division in Halifax, N.S. Since 1952 he has been manager of the Maritime district of the wholesale department with headquarters also in Halifax.

J. G. Malus, M.E.I.C., has taken a position as structural engineer with H. A. Simon Limited, consulting engineer, in Vancouver, B.C.

Mr. Malus was formerly in Regina, Sask., with the Canadian Pacific Railway. He graduated in 1952 from the University of Manitoba in civil engineering and joined the C.P.R. as transitman in the division engineer's office.

Wm. A. Arsenault, M.E.I.C., is now associated with Fraser-Brace Engineering Company Ltd. in Montreal.

Mr. Arsenault was previously employed as resident engineer with the Rankin Newfoundland Company at St. Lawrence, Nfld.

A graduate of Nova Scotia Technical College in 1937, he has also been resident engineer with the Nova Scotia Department of Highways at Amherst, N.S.

R. N. Fournier, M.E.I.C.

D. R. C. Morris, M.E.I.C., has been transferred to Beauharnois, Que., by the Aluminum Company of Canada. His position will be superintendent of the mechanical and electrical division. He was previously in Shawinigan Falls, Que., for the company as electrical superintendent of their plant there.

Mr. Morris graduated from McGill University in 1947 in electrical engineering.

W. G. Enouy, M.E.I.C., has been appointed manager of the new Ottawa district sales office of Robertson-Irwin Ltd. of Hamilton, Ont. He was formerly manager of the Montreal branch of the company.

Mr. Enouy graduated in 1927 from the University of Toronto and immediately joined the H. H. Robertson Company in Toronto. He was transferred in 1936 to Montreal as district manager and then recalled to Toronto in 1946, moving to Hamilton with the transfer of the company headquarters to that city. With the amalgamation

W. G. Enouy, M.E.I.C.

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of H. H. Robertson Company and Thomas Irwin & Son Limited as Robertson-Irwin Limited, Mr. Enouy assumed the duties of sales manager of the Robertson division, becoming subsequently general sales manager of promotion and development.

W. A. Ker, M.E.I.C., has been transferred to Victoria, B.C., by the Department of Lands and Forests, his new position is that of deputy comptroller of water rights and chief of the operations division. Mr. Ker was previously in Kelowna, B.C., with the Water Rights Branch of the British Columbia Government.

Mr. Ker is a civil engineering graduate of the University of British Columbia.

H. H. Todgham, M.E.I.C., and **C. W. Case,** JR.E.I.C., have formed a partnership as consulting civil engineers in Chatham, Ont. This new firm will offer consulting services in land surveying, drainage, structural design, and general municipal engineering.

Mr. Todgham was formerly a partner in the firm of Brisco and Todgham, Chatham, Ont., and has been in consulting practice with C. G. R. Armstrong in Windsor, Ont. He graduated from the University of Toronto in 1946 with a B.A.Sc. degree in civil engineering.

H. H. Todgham, M.E.I.C.

C. W. Case, Jr. E.I.C.

Mr. Case was deputy city engineer for the City of Chatham, having been appointed assistant city engineer after his graduation in 1950 from the University of Toronto.

C. H. Vatcher, M.E.I.C., has joined Salem Engineering Limited in Toronto as a sales engineer. Prior to this new position he was with Dominion Cutout Company Ltd. and Dominion Carbon Brush Company Ltd., also in Toronto.

A 1939 graduate of the University of Toronto, Mr. Vatcher has been with Canadian National Carbon Company Ltd., both in Vancouver and Toronto, and with the Toronto office of English Electric Company of Canada Ltd.

During the Second World War he

• *Personals*

served with the engineering branch of the R.C.N.V.R.

Donald C. Rotherham, M.E.I.C., has joined S.W. Explorations, C.M.&S. Company, in Trail, B.C.

A graduate in geology from the University of Saskatchewan, Mr. Rotherham was previously associated with Dee Explorations Limited in Saskatoon, Sask., as a geologist.

A. C. Findlay, M.E.I.C., is now with the engineering department of the head office of the Dupont Company of Canada in Montreal, and is engaged in project work for the company. Previously he was with Standard Brands Limited in Montreal as plant engineer.

Mr. Findlay graduated in mechanical engineering from McGill University in 1942. After a year with Steel Company of Canada Ltd., he joined the R.C.A.F. and served for two years as a flying officer. Upon his release from the service he became associated with Canadian Vickers Limited in Montreal, and then joined Standard Brands Limited in 1947 as project engineer.

A. J. Lewis, M.E.I.C.

A. J. Lewis, M.E.I.C., was recently appointed sales application engineer of the Scintilla Division of the Bendix Aviation Corporation, Toronto, and will assist Canadian airframe and related equipment manufacturers with electrical connector requirements and applications.

Brigadier D. A. G. Waldock, M.E.I.C., has been named chief superintendent of the Canadian Armament Research and Development Establishment at Valcartier, Que. He was previously director of Army Development at Army Headquarters in Ottawa.

Brigadier Waldock enlisted in the Royal Corps of Signals in 1939, was commissioned in 1940 and attained the rank of lieutenant-colonel in 1945. He was commissioned in the Royal Canadian Artillery in 1946 as a major and in 1952 he was promoted to the rank of colonel as commanding officer at Valcartier.

Early in 1955 he was named director of Armament Development at Army Headquarters, and in November was transferred to the Defence Research Board as chief superintendent.

Colonel C. R. Boehm, M.E.I.C., will relinquish command of Canadian Armament Development and Experimental Establishment and his appointment as deputy chief superintendent of the Canadian Armament Research and Development Establishment on being transferred to Defence Research Board headquarters as director of liaison. Col. Boehm will coordinate scientific liaison between D.R.B. headquarters and the defence research members on the Canadian Joint staffs in London and Washington.

A 1929 graduate of the University of Toronto, Col. Boehm was employed prior to the war as mining engineer in northern Ontario and Quebec. He was commissioned in the R.C.O.C. at the beginning of the war, transferring to the R.C.E.M.E. upon its formation. He served overseas with both corps for over five years.

In April, 1946 Colonel Boehm was promoted to his present rank and became deputy director of mechanical engineering at Army Headquarters, subsequently becoming director in 1948. Five years later he was appointed to London, England, as deputy Army member, Canadian Joint Staff, after

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Give you these benefits

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THE TORRINGTON COMPANY 90th ANNIVERSARY 1866-1956

Needle • Spherical Roller • Tapered Roller • Cylindrical Roller • Ball • Needle Rollers

• *Personals*

attending the National Defence College at Kingston, Ont.

Early in 1955 he was named deputy chief superintendent of the Canadian Armament Research and Development Establishment at Valcartier, Que., and at the same time he was commanding officer of the Canadian Armament Design and Experimental Establishment. the Army unit integrated with the Defence Research Board research station at Valcartier.

J. S. Busby, JR.E.I.C., assistant division engineer of the Coçhrane division of the Canadian National Railways, is the new secretary-treasurer of the North Eastern Ontario Branch of the Engineering Institute.

Mr. Busby served with the R.C.N.V.R. during the Second World War and then received his civil engineering degree from the University of New Brunswick in 1948.

That year he joined the Montreal Engineering Company as assistant purchasing agent, and then in 1950 first became associated with the C.N.R. as instrumentman in the Laurentian division. In 1952 Mr. Busby was junior assistant engineer in the Cochrane division and then assistant engineer in 1953 in the same division. He was appointed assistant division engineer in June, 1955.

He is a member of the Corporation of Professional Engineers of Quebec.

Mr. Busby joined the Engineering Institute as a Student in 1946, transferring to Junior in 1950.

Claude Senneville, JR.E.I.C., is now with the firm of Deschamps and Belanger, engineers and contractors of Montreal. He has recently returned from Europe where he was with Defence Construction (1951) Limited as area engineer in eastern France.

Mr. Senneville is a 1947 graduate of Ecole Polytechnique in civil engineering.

Christian R. deLannoy, JR.E.I.C., has been transferred by the Aluminum Company of Canada to Kitimat, B.C. He was previously in Isle Maligne, Que., as trainee with the company.

Mr. deLannoy received his B.Sc. degree from the Catholic University of Louvain in 1947, and his M.Sc. degree in 1950.

Kenneth H. Cram, JR.E.I.C., was recently appointed an assistant professor in the chemical engineering department of the University of Kansas. He was formerly with the chemical and metallurgical division of General Electric in Pittsfield, Mass.

Mr. Cram graduated in 1947 from McGill University with a bachelor's degree in chemical engineering and then spent three years with the Aluminum Company in Arvida, Que. Then he entered the graduate school at Princeton University and obtained a Ph.D degree in chemical engineering.

Harvey N. Burrows, JR.E.I.C., has been transferred by Canada Cement Company Ltd. to Fort Whyte, Man., as plant engineer. He previously held the same position in Montreal East, Que., for the company, and has also been plant engineer at the company's Port Colborne, Ont., plant.

Mr. Burrows graduated in 1947 from the University of Saskatchewan with a B.Eng. degree in ceramics, and has also been employed by Canadian Gypsum Company Ltd. at Hagersville, Ont.

Captain D. C. H. Francis, JR.E.I.C., has been posted to the School of Military Engineering of the British Army as an Exchange instructor at Chatham, Kent, England.

Captain Francis graduated in 1949 from the University of Saskatchewan with a B.Sc. degree in civil engineering. He joined the R.C.E. upon graduation and was stationed at the R.C.S. M.E., Chilliwack, B.C.

W. F. Allen, JR.E.I.C., is now project engineer with the Consolidated Toronto Development Corporation. He was formerly in Windsor, Ont., as a design engineer with the Ford Motor Company of Canada.

Mr. Allen is a 1949 graduate of Cambridge University in mechanical engineering, and has also been with the Department of Highways at Hamilton, Ont., as estimating engineer.

John T. Sinclair, JR.E.I.C., has been transferred to Toronto from Sarnia, Ont., by Imperial Oil Limited.

Mr. Sinclair graduated in 1949 from the University of Toronto with a B.A.Sc. degree in chemical engineering.

A. D. R. Robertson, JR.E.I.C., is with the Water Rights Branch of the Department of Lands and Forests of the British Columbia Government at Victoria, B.C., as hydraulic engineer.

A 1949 civil engineering graduate of the University of British Columbia, Mr. Robertson has also been connected with British Columbia Forest Service as project engineer, and with B.C. International Engineering Company Ltd. as design engineer in Vancouver.

Donald W. Gordon, JR.E.I.C., is now with the Bridge and Tank Company in Hamilton, Ont. He was formerly connected with Vulcan Iron Works Ltd. in Winnipeg, Man.

Mr. Gordon, who graduated in 1950 from the University of British Columbia in mechanical engineering, has also been with the tank department of the Toronto Iron Works.

William M. Kruse, JR.E.I.C., is now employed as a zone engineer with the mechanical department of Imperial Oil Limited at their Sarnia, Ont. refinery. He was field engineer with the Steel Company of Canada in Hamilton, Ont.

Mr. Kruse received his B.A.Sc. degree in civil engineering from the University of Toronto in 1950.

J. D. Dunn, JR.E.I.C., has joined Canadian Splint and Lumber Corporation, Ltd., as plant engineer in Pembroke, Ont. He was previously plant engineer at Nobel, Ont. for A. V. Roe of Canada Ltd.

Mr. Dunn graduated from Nova Scotia Technical College in 1951 with a

60 M.W. Turbo-generator installed in a British power station.

Four turbo-blowers (duty of each blower 80,000 cubic feet of free air per minute delivered at 30 lbs. per square inch pressure.)

Two 36 M.V.A. generator transformers and two 5,000 K.V.A. station transformers.

• *Personals*

bachelor's degree in mechanical engineering.

Douglas R. Wilson, Jr.E.I.C., has been appointed town engineer of Georgetown, Ont. He formerly held the same position at Greenfield Park, Que.

A civil engineering graduate of McGill University, class of 1951, Mr. Wilson spent some time on the divisional staff of Canadian National Railways and then joined H. W. Lea, consulting engineer of Montreal for two years.

In 1953 he was associated with Shell Oil of Canada as construction engineer with their Montreal East refinery and then in 1954 became town engineer of Greenfield Park.

Mr. Wilson served during the Second World War with the R.C.N.

Jean Louis Desautels, Jr.E.I.C., is presently employed as resident engineer with Defense Construction (1951) Limited, stationed at No. 2 (F) Wing, R.C.A.F., in Grostenquin (Moselle), France.

Mr. Desautels graduated with honours from the University of Toronto in 1951 with a B.A.Sc. degree in mechanical engineering, and has been with the Canadian International Paper Company at Three Rivers, Que.

W. E. Erlebach, Jr.E.I.C., has returned to Canada after receiving his Ph.D. degree at Cambridge University on an Athlone Fellowship, and is employed as an assistant research officer by Atomic Energy of Canada Ltd. at Chalk River, Ont.

Mr. Erlebach graduated from the University of British Columbia in chemical engineering receiving his B.A.Sc. degree in 1951 and his M.A.Sc. degree in 1953.

W. H. Loney, Jr.E.I.C., has been named plant engineer with Hobart Manufacturing Company Ltd. in Owen Sound, Ont. He was previously production engineer for the company.

Mr. Loney graduated in 1951 from the University of Toronto in mechanical engineering.

H. B. McLenaghan, Jr.E.I.C., is now in Fort Garry, Man., with Malcom Construction of Winnipeg, employed as an estimator. He was formerly with Structural Engineering Services in Calgary, Alta. as a structural engineer.

Mr. McLenaghan graduated in 1952 in civil engineering from the University of Manitoba and has also been associated with J. A. Lamb, consulting engineer in Calgary, and with the Central Mortgage and Housing Corporation as assistant resident engineer, also in Calgary.

R. Bryan Erb, Jr.E.I.C., has returned from a two year post-graduate course in England studying aerodynamics, and is now with Avro Aircraft Limited at Malton, Ont., as an aerodynamicist.

Mr. Erb graduated in 1952 from the University of Alberta in civil engineering.

Grant M. Locke, Jr.E.I.C., is now employed as design engineer in the atomic division of the Canadian General Electric Company in Peterborough, Ont.

Mr. Locke graduated from the University of New Brunswick in 1952 in civil engineering, and has recently been in Pittsburgh, Penn., with the Pittsburgh Des Moines Steel Company.

Jean Favron, Jr.E.I.C., is now with the aircraft design department of Canadair Limited, Montreal, as a designer. He recently returned from England, where he spent two years on an Athlone Fellowship.

He graduated in 1952 from Ecole Polytechnique with a B.A.Sc. degree in mechanical and electrical engineering, and then was employed as a mechanical design engineer with Canadian Industries Limited in Brownsburg, Que.

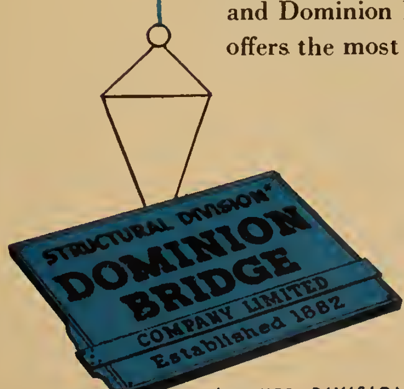
William M. Chisholm, Jr.E.I.C., is now on the staff of the Ottawa Hydro-Electric Commission as junior distribution engineer.

A 1952 graduate of Nova Scotia Technical College in electrical engineering, Mr. Chisholm has previously been with the International Nickel Company of Canada at Copper Cliff, Ont., and at Levack Mine.

Robert A. Newey, Jr.E.I.C., has now joined the staff of Dominion Engineering Company Ltd. in Montreal.

Mr. Newey is a mechanical engineering graduate of the University of Manitoba, class of 1953.

He has been in England, where he was an engineering student apprentice with C. A. Parsons & Company Ltd., in Newcastle on Tyne.



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• Personals

J. Glenn Allan, Jr.E.I.C., is now with Canadian National Railways, and is employed as junior assistant engineer in the Belleville division office, Belleville, Ont.

Mr. Allan graduated in 1953 from Queen's University in civil engineering and then joined the Department of Highways of Ontario in Toronto.

Sydney Narvey, S.E.I.C., has been named senior engineer with Canadian Kodak Company Ltd., working on the design and installation of the plant air conditioning systems. He was formerly chief engineer with Engineering Industries Company Ltd. in Toronto.

Mr. Narvey graduated from North Carolina State College in 1953 with a B.Sc. degree, and spent some time as sales engineer with the refrigeration and air conditioning division of John Inglis Company Ltd. in Vancouver, B.C.

Zoltan D. Simo, S.E.I.C., is now employed as mechanical superintendent with Canada Packers at Edmonton, Alta. He graduated last year from the University of Saskatchewan with a B.Sc. degree in mechanical engineering.

Raymond Dumas, S.E.I.C., who graduated last year from Laval University with a B.A.Sc. degree in civil engineering and has recently been in Munich, Germany, studying prestressed concrete, is now in Labrieville, Que., with Concrete Repairs and Waterproofing Company Ltd.

F. R. Scrase, S.E.I.C., has been transferred by Canadian National Railways from Belleville, Ont., to Stratford, Ont., working in the division engineer's office. He graduated this year from the University of Manitoba with a B.Sc. degree in civil engineering.

Myron Flett, S.E.I.C., who graduated this year from Nova Scotia Technical College with a bachelor's degree in mechanical engineering, is now working with the firm of R. M. Way & Company Ltd., consulting engineers in Toronto.

Leonard R. Walker, S.E.I.C., is now an engineering trainee at Canadair Limited in Montreal. He is a 1955 graduate of the University of Manitoba in mechanical engineering.

F. D. McIntosh, S.E.I.C., has joined the Department of National Defence, armaments branch in Ottawa, Ont., as methods engineer for inspecting services. He received his B.A.Sc. degree this year from the University of Toronto in engineering and business.

William Brownlee, S.E.I.C., who graduated this fall from McGill University with a bachelor's degree in mechanical engineering, is now working with Rolls-Royce Limited in Montreal.

A. H. Abbott, S.E.I.C., has joined the Department of Highways and Public Works of Nova Scotia as a structural engineer in Halifax, N.S.

Mr. Abbott graduated from the University of New Brunswick this year in civil engineering.

M. M. Krpan, S.E.I.C., an electrical engineering graduate of the University of Alberta, class of 1955, is now employed by the Hydro-Electric Power Commission of Ontario in Toronto.

Activities of the Forty-seven Branches of the Institute

and

abstracts of papers presented at their meetings

Belleville

J. A. Grant, M.E.I.C.,
Secretary-Treasurer

General Meeting

The Belleville Branch of the Engineering Institute of Canada held its second meeting of the 1955-56 season on November 14, 1955, at the Masonic Temple. Approximately 20 members and guests attended.

C. L. Curry, assistant chief supervisor of field maintenance at the Maitland Works of Dupont of Canada spoke on "Instrumentation in a Continuous Process Plant". His talk was illustrated by lantern slides and was found very instructive to his audience.

The speaker was introduced by B. H. Downman and thanked by C. E. Meyers.

Brockville

K. R. Bullock, Jr.E.I.C.,
Secretary-Treasurer

G. M. Woods, M.E.I.C.,
Branch News Editor

Engineers and Guests Tour R.C.A. Victor Plant

The Brockville Branch members and their families, approximately 75 people, spent an informative morning on October 15 visiting the R.C.A. Victor Co. Ltd. in Prescott, Ont.

The tour was conducted through the five major production lines, each 350 ft. long, by the R.C.A. staff members.

The visitors were shown the printed circuit which is a special feature or advancement this year. The production of printed circuits are subassembled on their own sections and then moved to the main assembly line where they are added to the main chassis.

W. V. Heyden on behalf of A. M. Patience, plant manager, welcomed the visitors in the cafeteria, giving them some interesting statistics.

1000 T.V. Sets a Day

Other factors or production figures of Canada's biggest radio and television factory can be visualized by considering the enormous scheduling and planning problems.

Approximately 20 tubes for each 1,000 sets means 20,000 tubes per day; 300 electrical and 200 mechanical components per set, equals 500,000 components a day; for every five workers, there are two inspectors to check for the quality of the product.

Each component is already counted and tested some way or other before it enters the factory. This close inspection and quality control follows the sets on their route through the whole production cycle until they are shipped.

Chairman Fred Walsh, on behalf of the members and their families, thanked the R.C.A. Victor people for their conducted tour and the lunch.

Principles of Investment

R. D. Steers, educated at Loyola College and an associate of the R. D. Steers investment firm, was speaker at the Junior Member meeting held at the Manitonna Hotel on November 3.

Mr. Steers subject was "Principles of Investment".

The speaker stressed the point that "one should consider stocks as a part of his investment program, as part of his planning for the future as a means of putting his surplus funds to work, but not as a detour into gambling." He continued by saying that "the investor should realize that there is no royal road to riches, but that one should expect a reasonable income on his money plus a slow steady growth in values."

One of the best investments, Mr. Steers stated is Canada Savings Bonds. They are negotiable and have an attractive interest rate.

The speaker was introduced by W Simmons and thanked by T. Reade.

Eastern Townships

J.-P. Champagne, Jr.E.I.C.,
Secretary-Treasurer

G. Lorne Wiggs Is Guest Speaker

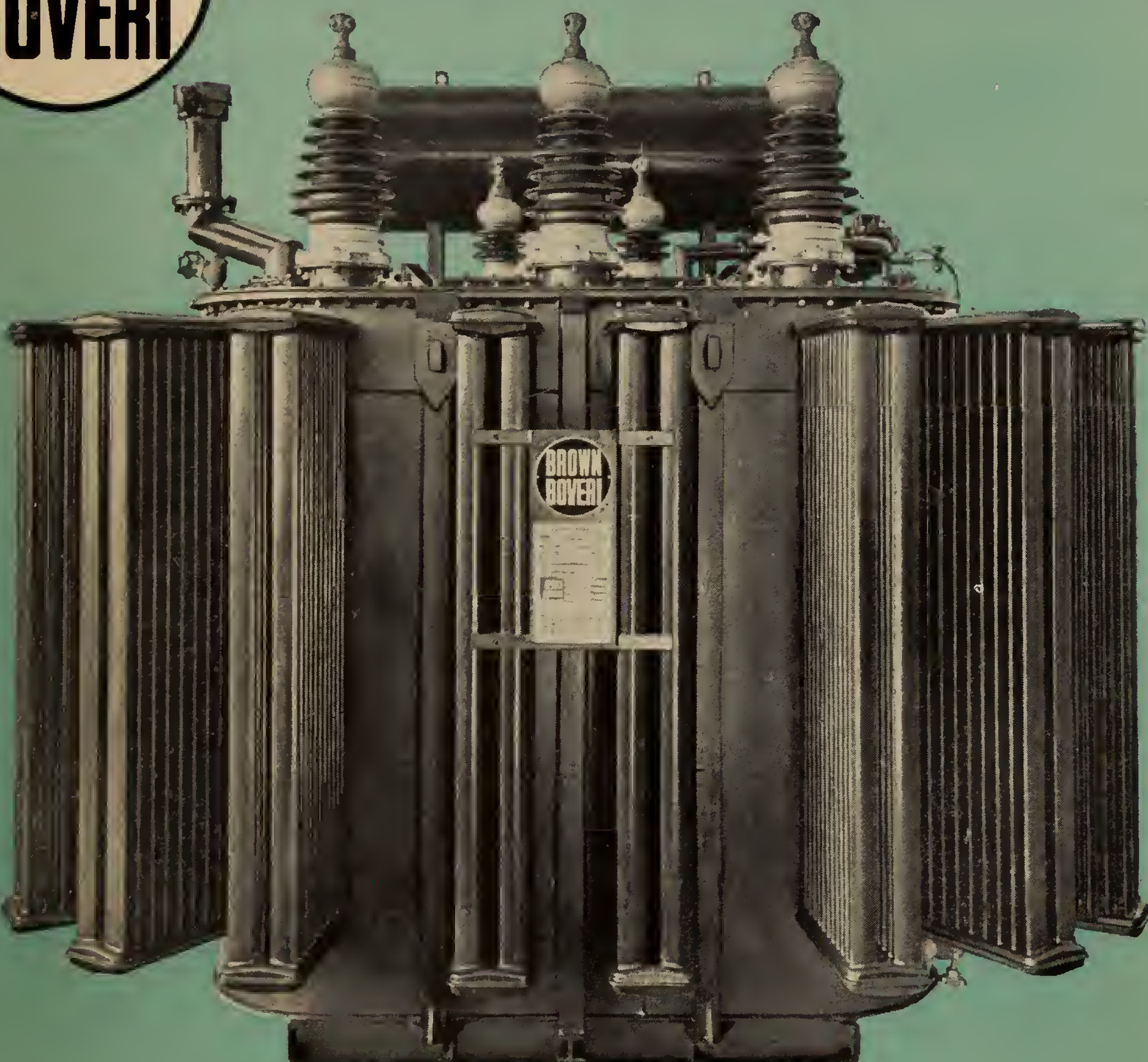
The eastern Townships Branch held a joint meeting with the Corporation of Professional Engineers of the Province of Quebec on Friday, November 11. G. Lorne Wiggs, Corporation president, was the guest speaker.

Mr. Wiggs said he was very happy to be in Sherbrooke in that he counts himself a resident since he spends his summers near one of Sherbrooke's "suburbs" — Magog. The Corporation has had a successful year, he said, in that it has brought its total membership up to 5,300, and has seen the completion of its new Montreal headquarters.

Corporation's Work Is Described

The demand for qualified engineers is still increasing, he said, as can be seen by the metropolitan newspaper ads for engineers to serve in Ottawa, Hamilton, Vancouver, Cleveland, etc. He admitted that the Quebec engineer does not quite, as yet, partake of the same privileges as engineers of other provinces; his role in the planning of a public building is second to that of the architect. However, the Corporation is working hard to enhance the prestige of the profession, he said, by keeping a strict surveillance over the use of the title of engineer; by insisting that public bodies hire engineers rather than other professionals when, due to the nature of the work, it can be performed as well, or better, by an engineer. Mr. Wiggs pointed out that more and more Quebec firms are employing engineers directly to design the electrical, mechanical and structural works of their projects rather than em-

Honorary Chairmen G. M. Dick (left) and A. C. Crépeau (right) of the Eastern Townships Branch welcome G. Lorne Wiggs (centre) president of the Corporation of Professional Engineers of Quebec and guest speaker on November 11.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• Branch News

ploying them indirectly through architects. A number of others, he said, are employing engineers as project managers to direct and control both architects and consulting engineers who prepare the plans and specifications for their projects.

Executive Changes

During the meeting two important changes in the executive of the local groups were announced. Jacques Lemieux was appointed chairman of the Eastern Townships Branch of the Engineering Institute to succeed Walter Sutherland who had resigned this office because of his frequent absence from Sherbrooke. Gaston Massé was elected regional representative of the Corporation of Professional Engineers. He succeeds George Dick whose term of office had expired.

At the E.I.C.-C.P.E.Q. joint meeting held in Sherbrooke on November 11. Front row, left to right, R. D. Mawhood, vice-chairman; J. Lemieux, chairman; G. Lorne Wiggs, C.P.E.Q. president; Dr. A. Crépeau, honorary chairman; and G. M. Dick, honorary chairman. Back row, left to right, J. P. Champagne, secretary; R. Painchaud, G. L. Côté, Léo Roy, Rev. Brother Léandre, G. Massé, and Pierre Bournival.

Fredericton

O. I. Logue, M.E.I.C.,
Secretary-Treasurer

N. E. Donahoe, Jr.E.I.C.,
Branch News Editor

Panel Discussion on Traffic

The November meeting of the Fredericton Branch was held on the 21st of the month at Colwell's Inn, with about 40 members present.

Professor H. W. McFarlane, chairman of the Fredericton Branch, presided. Following a short business meeting, a panel discussion took place concerning the traffic problem in this city.

Members of the panel were Bill Barrett, city engineer, C. E. Weyman, alderman, B. Barker, chief of police, and John Evans, chairman of the Junior Chamber of Commerce. Professor McFarlane acted as chairman.

Problems and Improvements

The panel opened the discussion stating the various problems which exist in this city, such as blind crossings, heavy

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• Branch News

traffic on certain streets, etc. The panel indicated what had been done to date in the way of improvement in speeding up traffic, in control lighting, as well as other aids.

Then the members questioned the panel and several interesting opinions and suggestions were forthcoming.

Commission Proposed

In concluding, Professor McFarlane said that a commission of responsible and technical men, well qualified in traffic problems should be set up to study the existing regulations, keeping in mind the growth of the city and the passing through of the Trans-Canada Highway.

After the meeting a lunch was served.

Hamilton

A. F. Barnard, jr.e.i.c.,
Secretary-Treasurer

Ross R. Packer, jr.e.i.c.,
Branch News Editor

Civil Defence Is Discussed By Brig. Todd

At the November dinner meeting in the Wentwork Arms Hotel the guest speaker for the evening was Brigadier P. A. S. Todd who discussed the subject of civil defence in Hamilton. Brigadier Todd, general manager of the Hamilton Transit Company and co-ordinator of civil defence for the Hamilton area, was introduced by D. Annan.

Brigadier Todd, who commanded the artillery of the Third Division during the second World War, stressed the duty of the Civil Defence organization to present its plans to citizens in view of the seriousness of any panic. Unfortunately Civil Defence is a misnomer, he said, in that the organization does not defend but goes into operation after a disaster has taken place.

Disasters

The types of disaster which may take place are a natural disaster, which is unlikely, due to Hamilton's geographical situation; a commercial disaster, which may take place at any time; or a hostile act in time of war. Consideration of the weapons in use must be given when planning for a possible hostile act. With the advent of A and H bombs, wardens have been felt unnecessary due to the fact that the whole city may be destroyed at once. Coventry, for example gave up the idea of civil defence in 1950. Hamilton decided to disband her wardens also.

Immediate Evacuation Impractical

This is the general opinion in Canada. The immediate evacuation of Hamilton upon the warning of an air attack, for instance, is impractical. Hamilton is in line with large eastern American industrial centres; near Lake Ontario which is easily recognized; and is in a vulnerable position should bombs miss their original targets. It has been estimated that with the aid of detection stations 2,300 miles north of Hamilton, and with planes flying at the rate of 700 miles per hour, the city would be permitted about three hours' warning only. It would be impossible to move 225,000 people out in so little time. It would involve the separation of families and the lack of food and shelter. Without shelter they would be exposed to radiation, and lacking medical attention.

Air Supremacy Essential

Several years ago it was realized that wars can be fought only with arms and supplies. Factories could not be deserted. The greatest defence, therefore, was air supremacy.

The uranium bomb, which is 140 times less expensive than the H bomb, and whose radiation extends 7,000 square miles, has influenced the civil defence plans developed in Hamilton.

It has been estimated that there are only 200 cities essential to war production. These could be destroyed with a minimum of 2,000 aircraft during approximately four to five days. Under these circumstances, factories mean nothing. For this reason, Civil Defence is considering evacuation before a war even starts.

Commercial Disaster

Of course, a commercial disaster can take place at any time. The work of

• Branch News

Civil Defence is that of co-ordinating existing services such as the fire and police departments, city engineering and the hospitals. Possibilities for commercial disaster are likely to increase with the development of Hamilton's harbour. Should such a disaster occur, Hamilton can make use of the services of neighbouring cities.

The Hamilton General Hospital is now equipped to handle 500 accident cases in four hours. By arrangement with the Bell Telephone Company the hospital can obtain 40 main lines. These were previously limited to four. In case of disaster, lists of necessary supplies to be ordered from many sources in Canada have already been prepared.

During the question period which followed Brigadier Todd's address, it was pointed out that the funds for Civil Defence in Hamilton are obtained from the municipalities (25%), from the Province of Ontario (25%) and from the federal government (50%).

Kitchener

John R. Runge, M.E.I.C., *Secretary-Treasurer*

J. L. Fair, M.E.I.C., *Branch News Editor*

Seaway Discussed by J. R. Montague

J. R. Montague, director of engineering of the Hydro-Electric Power Commission of Ontario, addressed the November meeting of the Branch. His topic was "Technical Aspects of the St. Lawrence Seaway" which was illustrated with slides showing some of the construction activities.

In spite of the immensity of the project and the many new problems to be solved, he said, it is expected that cost per kilowatt will not exceed that of other recent developments. Mr. Montague called attention to the impact of the Seaway on the economy of the St. Lawrence valley and the large investment involved in completing the power and navigation features of the project.

Relocation Work Described

A novel feature of the construction that was illustrated was the moving of houses on the large and rapid scale required to relocate the residential and industrial areas to be covered by the final water levels.

Light refreshments and a social hour were enjoyed after the meeting.

Montreal

G. M. Boissonneault, M.E.I.C., *Secretary-Treasurer*

M. Benoit, M.E.I.C., *Publicity Chairman*

Automation, Automatons and Men

On October 25 the Management Section of the Montreal Branch sponsored a meeting at which Dr. J. J. Brown of Aluminium Limited spoke on advanced methods of automatically operated assembly line production. The meeting chairman was George M. Foster of the Northern Electric Company.

The speaker gave an excellent treatment of the subject. Dr. Brown first defined automation and automatism. He favoured automation and declared that its incoming in industry was inevitable. Automation will lower production costs and reduce the number of workers. It will affect non-skilled labour and repairmen, but will develop a more diversified field of products which should absorb the surplus of workers. A long discussion followed from the large group present.

The vote of thanks was extended by J. Gray of the Northern Electric Company.

The Problem of Stream Pollution

On November 17 the Chemical Section of the Montreal Branch sponsored a panel discussion on stream pollution. The panel speakers were introduced by Chairman K. B. Owens, chemical sales engineer for Monsanto (Canada) Ltd.

Dr. L. Piché

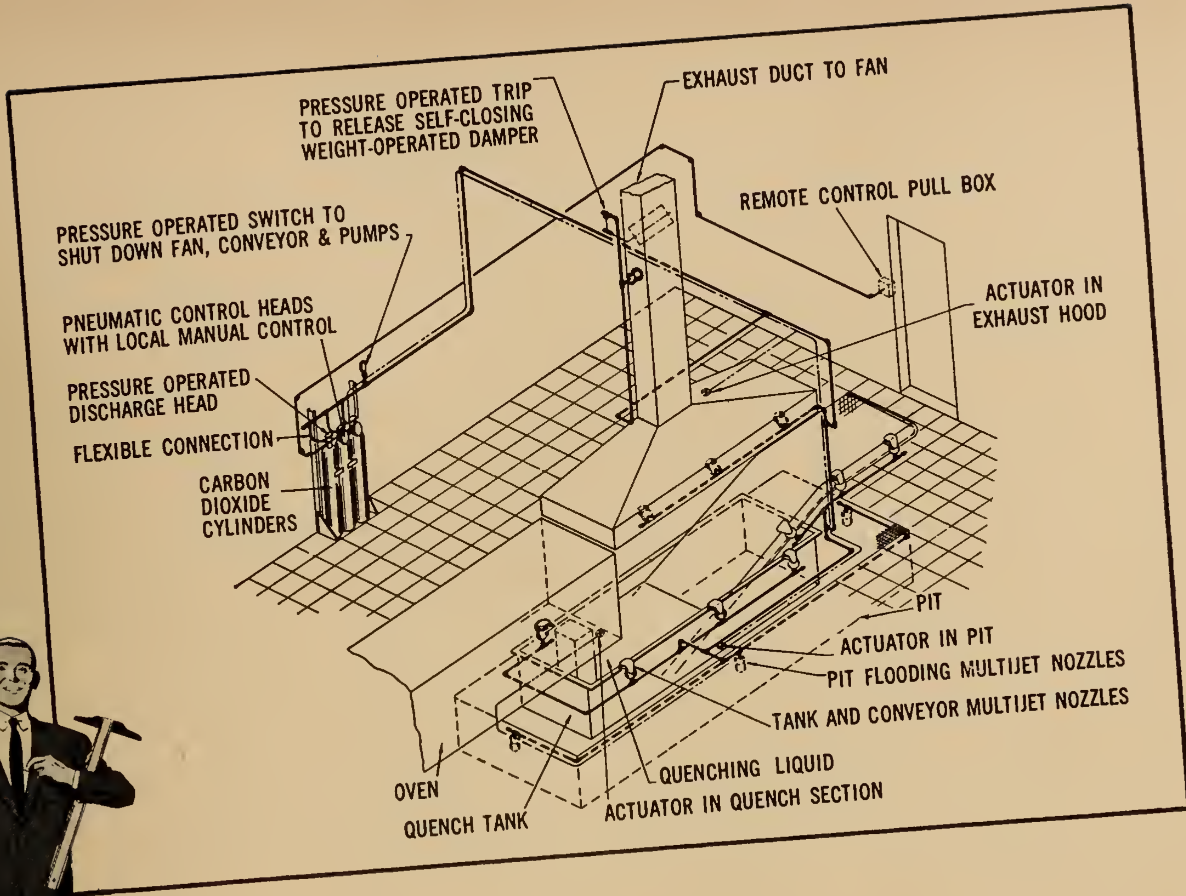
The first speaker was Dr. L. Piché, director, Department of Chemistry, University of Montreal. A comprehensive account was given of the causes of stream pollution and of the various methods used to indicate the type and degree of pollution, a necessary matter since these factors must be known before any concerted drive to clear the stream can be undertaken. In a more detailed coverage of the Ottawa River, charts and graphs indicated the location and degree of pollution present in the river below Ottawa. Emphasizing these points, Dr. Piché described both the Lower Ottawa and the North River at Montreal as "open sewers" in parts of their courses. It was very clearly demonstrated that both municipal and industrial sources were prime factors in the deterioration of water quality.

H. Clare

H. Clare, technical superintendent, Imperial Oil Company, outlined the methods by which the petroleum industry is attempting to reduce or eliminate the sources of stream pollution inherent in refining processes. Refineries handle millions of gallons of water per day and the problem of releasing these waters in the state received is one of varied mechanical or chemical treatment. The treatment plants required, while extensive and expensive, are part of the industry's obligation to the public. As well, a Pollution Control Committee, set up in 1943, co-operates with provincial governments in surveys which concern the industry.

D. Jones

D. Jones, speaking for the Canadian Pulp and Paper Association, covered the problem as related to that industry. Pollution causes are partly chemical, partly mechanical, and the industry is attempting by better processing methods to use more of its presently wasted materials. Much time and money is being expended in efforts to reduce pollution, but it was suggested that government and industry should co-operate in overall stream assessment, and that rather than restrict the industry



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Using safe, efficient carbon dioxide, Kidde systems snuff flames quickly, cleanly. The CO_2 leaves no mess to harm machinery or equipment, will not even damage work-in-process. And, thanks to patented Kidde rate-of-temperature-rise detectors, Kidde systems remain on guard 24 hours a day, completely independent of outside power sources.

Kidde systems use no clumsy mechanical triggering methods, have no falling weights. Pneumatic or Electrical Control Heads insure instant and complete CO_2 discharge. The moving parts of a Kidde system are self-enclosed for safety, need no replacement after a fire, have easy-to-read visual indicators which show at a glance if system is "set" or "released." What's more, special Directional Valves on the Kidde system let you protect more than one hazard from the same cylinder bank, giving you the most versatile protection on the market today!

Without obligating yourself in any way, let the Kidde man analyze the fire hazards in your plant. Then let him show you our recommendations. For more information, write Kidde today.

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unduly, controlled pollution of certain river areas might be the answer in some cases.

D. Kirkbride

D. Kirkbride, development manager, Canadian Industries Limited, covered the development of pollution control by governments. Legislation and increasing industrialization go hand in hand. England began as early as 1814, and both the U.K. and the U.S.A. have steadily increased the range of pollution controls, with Canada beginning to feel the same need. It was emphasized that increasing problems make present legislation inadequate and new laws must be passed to enable industry and government to handle the problem in co-operation.

The small crowd made up for its lack of numbers in a spirited and lengthy discussion period lasting almost to midnight.

H. R. Stokes-Rees of Hydro Technic Ltd., thanked the speakers for the wide coverage of the subject. Meeting arrangements were by L. A. Phillips.

Linoleum Manufacture

On Tuesday, October 11, O. R. Brumell, spoke on "Linoleum Manufacture" to a highly interested audience. Marc Benoit introduced the speaker.

After a brief history on the manufacture of linoleum, Mr. Brumell entered into detail of modern methods used to produce the material.

He explained the differences in the types of backing, discussed their relative merits and described fully such parts of the process as printing, drying, etc.

A study on the economic outlook concluded his talk. A lively and instructive period of pertinent questions followed, all ably answered by Mr. Brumell. W. D. Kerr thanked the speaker.

Ottawa

R. F. Legget, M.E.I.C.,
Secretary-Treasurer

Carl B. Crawford, Jr.E.I.C.,
Branch News Editor

Colour Television

Ricardo Muniz, manager of the television-radio division of Canadian Westinghouse Company Ltd., was guest speaker at a luncheon meeting of the Ottawa Branch on November 10. In his talk Mr. Muniz suggested that the future of the T.V. industry lies in colour telecasting. A recent survey indicated that three out of four persons would buy colour T.V. sets if the price were reasonable and programs were available. The price of a 21-inch console set is now about $800. Colour picture tubes cost about five times as much as the equivalent black and white tubes. At the present time there does not appear to be much chance of lowering these prices.

First T.V. Colour Station April, 1956

Mr. Muniz said that the first coast to coast colour T.V. program in the United States was a showing of the "Tournament of Roses" from Pasadena on January 1, 1954. There are at the present time 100,000 channel miles installed for colour T.V. broadcasting. In the U.S. there are about 40 hours per month of colour T.V. programs and this is to be increased to 80 hours per month. In Canada some colour T.V. receiving sets are in use in the Toronto area receiving programs from the U.S. The first all-colour T.V. station is expected to begin operation on April 1, 1956, in Chicago. In Canada, the C.B.C. is delaying any commitments in the field of colour television until demand is sufficient to warrant entering this field.

Development of Colour T.V. Traced

The speaker traced the development of colour television, pointing out that the first development was an entirely new electronic system which would make black and white sets obsolete. For obvious reasons this was not a suitable system and later the development of a system compatible with the black and white system was achieved. Preliminary studies in this development were made in basic physiology of the human eye. Mr. Muniz outlined the basic electronics of television, including the complications of colour television. He pointed out that the number of tubes for colour television would have to be increased from 20 to 28.

Change-over May Be Rapid

There are now about 700,000 television sets in Canada for receiving black and white programs. Most of these sets have 17 inch screens or larger, indicating that much of the early development of television was missed in Canada. In addition to the growing demand for colour T.V., manufacturers are anxious to open up the market for colour television. With the rapid development to maturity of colour television, the speaker thought that the change-over from black and white would be a rather rapid process.

The speaker was introduced by W. B. Pennock, vice-chairman of the Branch, and he was thanked by R. E. Hayes, past chairman of the Branch.

Hon. Robert Winters Is Guest Speaker

The Hon. Robert H. Winters, Minister of Public Works, was guest speaker at the second evening dinner meeting of the Ottawa Branch to be held this season. Mr. Winters, in tracing the history of Trans-Canada highway developments, compared the highway with the building of the first Trans-Canada railway. He recalled that the last attempt to build a Trans-Canada highway was begun in 1930 to alleviate unemployment but that this effort was held up by World War II.

Trans-Canada Highway

Following the war, with an even greater need for a continuous highway link, the federal government, in 1948, invited the provincial governments to discuss ways and means of building a Trans-Canada highway. It was agreed that costs would be shared equally between the provincial and the federal government. Standards of construction were agreed upon. These included a minimum right of way of 100 feet, a minimum pavement width of 22 feet with a 10 foot shoulder, a minimum sight distance of 600 feet and a design axle loading of 18,000 lb. It was agreed that the route should in general cover the shortest distance across the country. Many difficulties, including the Korean war, combined to delay construction until it was evident that the completion date of December, 1956 would not be met. At the present time only about one-third of the highway is completed to the agreed standards. Recently, in consultation with the provinces, the original agreement was extended for another five years subject to parliamentary approval. In order to close the gaps where no highway exists, the Federal Government agreed to contribute 90 per cent of the cost on 10 per cent of the highway mileage in each province. Other construction costs are to remain on a 50/50 basis.

Mr. Winters pointed out some of the special difficulties existing in each province. He said that Ontario had the longest stretch of Trans-Canada highway and also the longest gap where no highway exists. British Columbia had some of the most difficult terrain to cross where costs would exceed one million dollars per mile.

Costs

In reply to questions Mr. Winters said that the 1948 cost estimate of $300 million was now thought to be only about half of the final cost, not including the cost of property. He stated that toll charges would not be made on any parts of the highway to which Federal Government contributions were made.

Mr. Winters was introduced by R. F. Legget, chairman of the Ottawa Branch, and the appreciation of the Branch was extended by K. M. Cameron, a former chairman of the Branch.

Newfoundland

C. W. Henry,
Secretary-Treasurer

Engineers' Wives Club Report

During the year 1954-55 the Engineers' Wives Association, St. John's Branch held six meetings. Our membership now numbers 41 and approximately 20 to 25 members attend our monthly meetings.

The social high-light of our season was, no doubt, the Halloween Dance held at the Chateau on October 29.

To add to our meetings we were fortunate in having on two occasions guest speakers, Miss E. Mallard, head mistress of Bishop Spencer College, and the Hon. R. F. Sparkes, Speaker in the Newfoundland House of Assembly. Mrs. Halme kindly showed coloured movies featuring some of the highlights of her stay in Bolivia at our January meeting, and at our March meeting Mrs. C. W. Henry showed coloured slides which were taken in Venezuela.

Our members continue to show quite an interest in child welfare, and brought many articles of children's clothing, both used and newly knitted. Their contributions were greatly appreciated by the Child Welfare Association.

The Bridge Tournament inaugurated during the previous year, was held again this season. Mr. and Mrs. Grant Jack were winners of the tournament and Mr. and Mrs. Clarence Knight were second.

Unfortunately, we were forced to discontinue the collection of used magazines for the Sanatorium owing to the fact that there were not enough members free to attend to the distribution of them at the hospital.

Our financial status this year was such that we were able to offer a prize of $25.00 to the Engineering Faculty at Memorial University and at the suggestion of Prof. S. J. Carew, this was awarded for Drawing I and was won by Arthur Knight of St. John's.

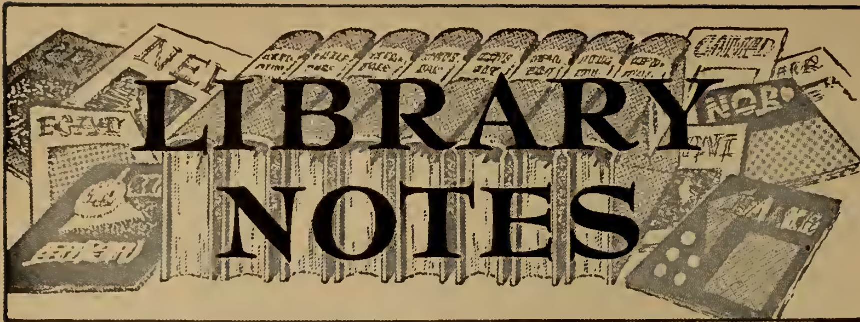
We continued during the season, to send congratulations to members who had new babies, "Get Well" cards to those who were ill, and messages of sympathy to any who were bereaved.

We also continued the practice of providing refreshments both for our own meetings and for those of the Engineering Institute, Newfoundland Branch.

Presidential Tour

On Friday, Sept. 23, Dr. R. E. Heartz, president of the Engineering Institute of Canada with Mrs. Heartz arrived in St. John's on the presidential tour. They were accompanied by Dr. L. Austin Wright, the general secretary of the Institute and the honorary treasurer E. V. Gage and Mrs. Gage. On Friday morning Mrs. Heartz and Mrs. Gage were guests of honour at a coffee party given by the Engineers' Wives Association at the home of Mrs. V. A. Ainsworth, 10 Forest Road; on Saturday, a luncheon was held in their honour at Bally Haly Golf Club. Preceding the luncheon, Mrs. Clarence Knight on behalf of the Association, presented Mrs. Heartz with a beautiful draw-string bag made by the Jubilee Guild, as a souvenir of her visit to St. John's. In thanking the Association, Mrs. Heartz said how happy she was to have had the opportunity of coming to St. John's and meeting the members of the Wives Club.

On Friday evening the Engineering Institute held a dinner at the Old Colony Club in honour of the distinguished visitors. The members of the Wives Club joined their husbands for the occasion. The dinner was preceded by a reception and followed by dancing at the Club. The presidential party left by plane for Halifax on Saturday, September 24.



Additions to the Institute Library

Reviews — Book Notes — Abstracts

BOOK REVIEW

Diesel engine principles and practice. C. C Pounder, ed. Toronto, British Book Service, 1955. Various paging, illus., $14.45.

All types of diesel engine from those for tractors to those for marine engines are covered in this volume which was compiled under the editorship of Mr. C. C. Pounder who has been responsible for the machinery designs for over a thousand vessels.

Each of the twenty-six chapters is written by an expert, and each is complete in itself, although each fits into the general scheme of the work.

The first chapters deal with the theory of compression-ignition engines, fuels, scavenge and exhaust systems, transmission gears, governors, bearings, etc. The middle section of seven chapters discusses the various types of engine, whilst the last chapters are devoted to vibration, testing and maintenance.

This is a very comprehensive work which should be in every technical library and which will be most useful to both practising engineers and students. There are many illustrations and diagrams, a detailed index, and bibliographies are found at the ends of most chapters. This is both a text book and a work of reference. S.C.

BOOK NOTES*

Prepared by the Library

The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

Abstracts of the literature on semiconducting and luminescent materials and their applications, 1954 issue. Battelle Memorial Institute. New York, Wiley, 1955. 200 pp., $5.00.

This compilation of abstracted articles is the second issue and contains over 750 items, taken from various journals and, where possible, from oral papers. Both foreign and American abstracts are included and an attempt has been made to give the most important experimental results or conclusions.

The articles are grouped under the following subjects: germanium, silicon, carbon, boron, and other semiconductors, selenium, and tellurium, selenides and tellurides, intermetalics, oxides, sulfides, halides, organics, fluorescence and phosphorescence, and theory. There are subject and author indices.

Aerodynamics: selected topics in the light of their historical development. Theodore Von Kàrmàn. Ithaca, Cornell University press, 1954. 203 pp., illus., $4.75 (U.S.).

The history of man's efforts to fly has often been spectacular but the behind-the-scenes contributions of engineers and physicists are sometimes overlooked. This book is an account of aerodynamics since Newton's time and particularly during the last fifty years.

The problems of lift, drag, skin friction, stability, aero-elasticity and supersonic aerodynamics are all discussed and reveal the manner in which engineers have met and overcome seemingly unsurmountable obstacles. An interesting aspect of the book is the account of the difficulties which must be met before space travel will become a reality.

The author has been closely connected with the field of aerodynamics, so that his writing has authority as well as high literary quality.

American aviation world-wide directory, v. 16, No. 2, 1955-56. Washington, American aviation publications, 1955. 794 pp., $7.50 U.S.).

The main part of this directory naturally covers aviation companies and officials in the United States, but Canada, Europe, Central and South America, Africa, Australasia and Asia are also represented.

The book is divided into sections covering certificated, intrastate and irregular U.S. air carriers, indirect air carriers, air taxi operators, holders of U.S. foreign air carriers permits, U.S offices of foreign air carriers and air carriers in foreign countries.

The information given on each company includes the address, names of executive officials and managers and a description of the equipment operated by the company.

There are also buyers' guides, and lists of aircraft manufacturers in the countries covered.

Analysis of symmetric cylindrical shells. John McNamee. Ottawa, United Kingdom Information Office, 1955. 84 pp., 12/6.

The lectures which form the text of this book were originally given at Liverpool University and in it the author outlines the theory of thin cylindrical shells for those who are not familiar with the subject. He has also attempted to carry the analysis to the point where it can be used to determine numerical values of the stresses in shell roofs.

In the three lectures unfamiliar mathematical techniques have been avoided if possible. The first deals with elementary analysis and concludes with a short historical account of the theory. In the second chapter matrix analysis is explained while the last is devoted to computations.

***An annotated bibliography on noise, its measurement, effects and control.** Pittsburgh. Industrial hygiene foundation of America, 1955. 364 pp., $7.50 (U.S.).

Over 2,000 references are arranged chronologically under subject subdivision of four major sections: noise measurement, effects of noise, measurement of hearing loss, and noise reduction and control. Most of the references are from the period 1927 to 1953 and include foreign titles as well as English. Representative articles are annotated or abstracted, and subject and author indexes are included.

Basic mathematics for science and engineering. P. G. Andres, H. J. Miser and Haim Reingold. New York, Wiley, 1955. 846 pp., $6.75.

This textbook could serve equally well as an introduction to the mathematics needed for science and engineering courses and as a refresher manual for practising scientists and engineers. It is a revision of an earlier volume published in 1944 under the title "Basic mathematics for engineers".

Topics from algebra, trigonometry, analytic geometry and introductory calculus are dealt with and the material in each chapter is placed in its mathematical and scientific setting. Mathematical principles are illustrated with engineering applications and a great number of exercises are included.

Some of the more useful features are the early explanation of the slide rule, the stress placed on graphical methods, the sections on trigonometric functions, vectors, and the Doolittle method of solving simultaneous linear equations.

Design in British industry. Michael Farr. Toronto, Macmillan, 1955. 332 pp., 87 plates, $11.75.

Because the author condemns a great deal of contemporary British design in industry, with frequent comments on American design as well, this book will be both interesting and controversial. In this survey he includes not only those who conceive and design the pro-

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ducts, but also those who manufacture, market, buy and use them.

The first part of the book deals with specific products such as furniture, metalwork, jewellery, appliances, pottery, and cars. It also discusses the place of the craftsman in industry and includes chapters on consultant designers, the retail trade and art schools. The publicity and propaganda used by design organization form the subject of the second section. The last two sections will create the greatest interest, and arguments, for in them Mr. Farr discusses such questions as design standards and mass production, the taste of the public, snob appeal, etc., and makes many pointed suggestions for improvement in the whole field of industry.

Dichtungen im Stahlwasserbau. C. F. Kollbrunner and Lothar Streuli. Zurich, Leemann, 1955. 34 pp., diagrs.

The subject matter of this German book on seals for steel watertight structures is divided into seven sections Following the introduction various types of seals are described. Within this section the authors deal with the mounting of packings relative to water pressure, the accessibility of packing at low water level, resilience of packing elements, material for packing and static and moving seals. Two chapters are devoted to older and modern sealing systems, followed by one on mountings. The last part of the book discusses guideways of locks compared to types of seals and measuring water to ascertain the water loss by weirs.

***Electric power stations. Vol. II,** 4th ed. T. H. Carr. Toronto, British Book Service, 1955. 832 pp., diagrs., $12.85.

This second volume of a two-volume treatise on the design, construction, and operation of electric power stations deals especially with the electrical side of the subject—alternators, transformers, reactors, switchgear, cabling, and protective equipment. Three chapters deal with hydro-electric, diesel-electric, and gas turbine plants, and there is a chapter on wind, atomic, and other power plants. Also covered are lubricating, indulating, and fuel oils; auxiliaries; station organization; and costs.

***Gear design and production.** Reginald Trautschold. Columbia, Conn., Columbia graphs, 1955. 204 pp., $4.50 (U.S.).

A restatement of basic principles accompanied by proofs of rules and formulas for critical computations. Each of the various standard classes of gears —spur, bevel, spiral, etc.—are taken up separately, and chapters on methods of production, materials, and inspection are included.

***Hawley's technical speller.** G. G. Hawley and A. W. Hawley, comps New York, Reinhold, 1955. 146 pp., $2.95 (U.S.).

This book contains over 8,000 technical words selected from the vocabularies of chemistry, physics, electronics, biology, medicine, engineering, and other fields of science and technology. Recommended word divisions are indicated. A separate list gives the correct prepositions for use after certain words.

Industrial management, 5th ed. W. R. Spriegel and R. H. Lansburgh. New York, Wiley, 1955. Various pagings, illus., $6.75.

In this edition much of the material has been rewritten and rearranged for better use in study and reference. There are new chapters on job evaluation and statistical quality control.

As in previous editions both theory and practice in management are discussed, with policies and principles forming a background for methods of putting them into successful operation. The book is divided into nine sections, beginning with a history of the managerial movement and going on to organization structure, problems concerning the product, the plant and equipment, motion and time study, wages and basic relations between employers and employees, buying, selling and cost controls, material and production control, and finally, personnel administration and management.

The text is generally geared to the point of view of the medium-sized plant with frequent references made to the large and small enterprise. Examples and illustrations have been chosen from a diverse group of industries.

Industrial power systems handbook. Donald Beeman, ed. Toronto, McGraw-Hill, 1955. 971 pp., diagrs., $15.50.

Because of the vast amount of commercial and industrial building going on today this book will answer a wide demand for an authoritative aid to designing electric power distribution systems. The editor has contributed helpful data from General Electric Company experience and the sixteen specialists cover all major phases of power system design.

The first part of the book contains technical information while the latter part is devoted to economic or system design information. There are chapters on short circuit calculations and protective devices, methods of voltage regulation and on system and equipment grounding. Various angles of economy are discussed, ranging from the cycles and economies of methods of generating by-product power from waste fuel or process steam, to cost load and cost estimating data for systems and commonly used equipment components.

One interesting section describes methods of modernizing and expanding existing power systems and suggests ways of applying modern power principles to commercial and office buildings, with many examples and case histories of such power system practices.

Many of the application data are in condensed tabular and curve form to aid in the practical solution of problems.

Introduction to TV servicing. H. L. Swaluw and J. Van Der Woerd. Eindhoven, Philips, 1955. 264 pp., illus., $5.50.

Although this manual refers to the European 625-line system, the theory, description of the TV receivers and the service information which it contains may be applied to the American 525-line system.

To make full use of this book radio service technicians should have a sound knowledge of circuit fundamentals. There is a theoretical introduction before the practical problems are presented and in it we find a short explanation of the scanning system, the working of the picture tube and the waveform of the TV signal. Several chapters then describe a modern TV receiver with separate sound channel and a section is devoted to intercarrier sound and the turret tuner with cascode amplifier.

The larger part of the book describes measuring instruments and the tracing of faults in the defective receiver. The illustrations include a series of photographs of screen pictures as they appear on incorrectly adjusted or faulty receivers.

Municipal organization in Canada. T. J. Plunkett. Montreal, Canadian federation of mayors and municipalities, 1955. 157 pp.

While this book was not written especially for the engineering profession it is, nevertheless, a valuable addition to an engineering library. Many administrators, sales engineers, contractors, etc., must deal with municipal government bodies and this up-to-date volume on local governments in Canada will greatly assist them.

The means by which municipal government is carried out differs greatly from province to province as well as between municipalities in the same province. The author has analyzed these different forms and discusses the various systems used to administer local community services.

Following a general chapter on the purpose and elements of municipal government Mr. Plunkett describes the council committee system, the council-manager system, the council-city commissioner system and the board of control plan. He also discusses the problems of these bodies.

The appendices form a valuable addition to the main text, describing the forms of government in the main cities of Canada. These are followed by municipal organization charts of the same cities.

Principles of farm machinery. Roy Bainer, R. A. Kepner and E. L. Barger. New York, Wiley, 1955. 571 pp., illus., $8.75.

In an attempt to present the subject of farm machinery from the engineering viewpoint the authors have included a minimum amount of descriptive material. Their book is intended for agricultural engineering students with a previous knowledge of static mechanics, who are also familiar with the common types of farm machinery. General discussions of materials, power transmission, economics, and hydraulic controls are included.

Where possible, machines for a particular practice such as planting, are treated on the basis of the unit operations performed by the functional elements of the machine.

Among the specific types of machinery discussed are those employed for earth-moving, soil tillage, crop planting and cultivation, application of fertilizers, hay harvesting, seed cleaning and harvesting, corn picking, spraying and dusting, and farm transport.

• Library Notes

***Principles of nuclear reactor engineering.** Samuel Glasstone. Toronto, Van Nostrand, 1955. 861 pp., illus., $8.75.

This is a broad, over-all review of fundamental scientific principles, prepared for engineers who wish to know something of the impact of nuclear energy on their professional activities. It may also serve as a text for senior and graduate students. The separate chapters cover essentials of nuclear physics, reactor theory, instrumentation and control, fuels and materials, and various associated problems of reactor design. A number of existing reactors are briefly described in the last chapter.

Principles of technical electricity, 2nd ed. M. Nelkon. London, Blackie, 1955. 250 pp., illus. 10/6.

Written for students, this is a general presentation of the fundamental principles of electricity with reference to its technical applications.

The book deals with two main topics: d.c. and a.c. theory. In the former section are described the heating, chemical, and magnetic effects of current, electrical measurements and instruments, and the principles of condensers. The a.c. circuit theory deals with series and parallel circuits of coils, condensers and resistors and applications of this theory to typical radio circuits is stressed.

In this second edition an appendix has been added on the M.K.S. system of units and some changes have been made in the main text.

***Problems and control of air pollution; proceedings of the First International Congress on air pollution.** F. S. Mallette, ed. New York, Reinhold, 1955. 272 pp., $7.50 (U.S.).

These proceedings papers, presented by experts from seven countries, provide new and authoritative information on a wide range of subjects of interest to engineers, municipal officials, management, and others concerned with reducing or eliminating air contamination. Two papers review the British smog problem and public relations aspect of air pollution control; the remaining twenty-three cover specific topics relating to gaps in available knowledge, current research findings, the treatment and recovery of sulfur dioxide, and experiences abroad. Bibliographies accompany many of the papers.

***Proceedings of the American power conference, volume XVII, 1955.** Chicago, Illinois institute of technology, 1955. 722 pp., $6.00 (U.S.).

As in previous years the papers in these proceedings emphasize the practical rather than the theoretical view and range from the technical to the economic and social aspects of power generation, transmission, and distributions. Grouped by sessions — general interest, nuclear energy, mechanical, water technology, and electrical — the individual papers deal with such subjects as scientific manpower, sodium graphite reactor power plants, power plant stacks under wind loading, small gas turbines, the St. Lawrence Seaway, computing devices, and many others.

Productivity measurement, v. I: Concepts. European productivity agency. Toronto, Ryerson, 1955. 143 pp., $1.00.

The first volume of this work discusses the various concepts of productivity measurement. Their practical application will be the subject of the two volumes to follow.

In this volume each of the contributions is an attempt to define the meaning of productivity and the problems involved in the measurement of production are discussed at length. The role of official statistics in measuring productivity is the subject of one chapter while another deals with the correlation between productivity, efficiency and wages.

The appendices contain studies by experts on the relationship between the ideas of "labour productivity" and "integrated labour" and on the possibility of making international comparisons in terms of man-hour purchasing power.

Review of current research and directory of member institutions, 1955. New York, American society for engineering education. Engineering college research council. 1955. 352 pp., $2.00 (U.S.).

Although none of the 105 engineering schools included in this review is in Canada it will, nevertheless, be of value

• Library Notes

and interest to faculty members and students of the universities in this country.

The institutions are listed alphabetically and under each there is information on the names of responsible administrative officers, policies governing research projects and contracts, personnel engaged in research activities, annual expenditures and sources of income for research, as well as the 5,000 entries of research project subjects.

Single-enterprise communities in Canada. Queen's university. Institute of local government. Ottawa, Central mortgage and housing corporation, 1953. 312 pp.

This is a "first of its kind" and extremely interesting report on Canadian communities established by government or industrial concerns. The rapid expansion in our northland and in other previously unsettled sections of the country has focused attention on living conditions which exist in these communities, especially as they might differ from the general situation.

The report describes the founding of single - enterprise communities, their local government, town planning, company housing, recreation, community institutions, utilities and services, and social problems. The final chapter contains a series of conclusions and recommendations.

An appendix lists these communities, giving the names of each townsite, founder, economic activity, population, year established, number of company-owned housing units and the percentage of these in relation to total housing, and type of local retail outlet, whether operated by the company or by independent enterprise.

Symposium on sinter. London, Iron and steel institute, 1955. 200 pp., illus., 37/-. (Special report No. 53.)

The seventeen papers contained in this report describe the process of sintering and reveal the extent of industrial research which has been directed toward increasing the productivity of sinter plants. The last three papers, published since the Symposium was held in 1953, discuss the practice of sintering.

The papers dealing with the physics and chemistry of sintering include discussions of the mechanism of reduction of iron oxides, the softening of iron ores at high temperatures, and radiographic studies of the process of sintering iron ores.

The next seven papers describe the production of sinter in terms of permeability of sinter beds, permeability tests on blast-furnace raw materials, faster sintering of ironstone, rating of sinter plants for economic output, and ironmaking from high-sinter burdens.

Theory of machines. W. G. Green. London, Blackie , 1955. 1,034 pp., diagrs., 40/-.

This is primarily a textbook and contains many worked examples. The author's aim has been to preserve a logical sequence throughout the seventeen chapters of the book. These begin with the kinematics and kinetics of a particle then go on to treat rigid bodies and the kinematics of machines. There are sections on the direct-acting engine mechanism, the balancing of machines, governors, valves, friction and lubrication, brakes and dynamometers and the motion of vehicles, higher pairing, cams and cam motions, vibrations of mechanical systems and motion in three dimensions.

World airline record, 5th edition, 1955. Chicago, Roadcap, 1955. 500 pp., illus., $17.50 (U.S.).

This edition has been expanded to include discussion of 269 regularly scheduled airlines which, it is claimed, represents 100% coverage of the world. Additional space has been given to explanations of individual airline problems and route maps have been brought up-to-date.

The book is arranged alphabetically by continent then by country. The data for each airline is arranged under systematic headings including route map, history and development, management, traffic analysis, seasonal chart, income account and historical statistical summary. An effort has been made to present comparable statistical data for all airlines although the difficulties of doing so, especially in the field of financial accounts, is apparent.

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

Concrete

The durability of concrete under frost action. E. G. Swenson. (Canada. NRC. Div. of bldg. res. Tech. pa. 26) 25 cents.

Practical method of concrete mix design. L. B. Mercer.

Electrical engineering

Automatic noise-factor meter. Henry Wallman. (Chalmers tekniska hogskolas. Handlingar, n. 161.)

A direct-indicating phase meter. A. van Weel. (Philips' Separaat No. 2255.)

Electrical plant for power generation. General Electric Co. Ltd. of England.

General Electric Co. Ltd. 55th annual general meeting. The chairman's speech, by Sir Harry Railing.

The present . . . the future . . . General Electric Co. Ltd. of England.

On the noise of fluorescent lighting installations. E. W. van Heuven. (Philips' Separaat no. 2275.)

Engineers

A criticism of the technical education of recently qualified engineers. P. P. Love. (I. Mech. E. Advance pa.)

The engineer's contribution to the conservation of natural resources. Sir Harold Hartley (I.C.E. The Graham Clark Lecture, 1955).

Patent law. United States

Patent information. Gustave Miller.

Roads and streets

The Washo road test—Part 2: test data, analyses, findings. (U.S. Highway research board. Special report 22.)

Television

TV field service manual, v. 5. Harold Alsberg, ed. (Rider pub. n. 155-5.)

TV repair questions and answers; sync and sweep circuits. Sidney Platt. (Rider pub. n. 173-3.)

Waves, water

Laboratory and field tests of sounding leads. G. M. Watts. (U.S. Beach erosion board. Tech. mem. 54.)

Laboratory data on wave run-up and over topping on shore structures. Thorndike Saville. (U.S. Beach erosion board. Tech. mem. 64.)

Laboratory study of wind tides in shallow water. O. Sibul. (U.S. Beach erosion board. Tech. mem. 61.)

A study of sediment sorting by waves shoaling on a plane beach. A. T. Ippen and P. S. Eagleson. (U.S. Beach erosion board. Tech. mem. 63.)

Miscellaneous

Alfred P. Sloan, Jr., Fifteenth Hoover Medalist. (New York. ASME. Hoover Medal board of award.)

Gunite; durability, economy, flexibility, specifications, and recommended practice. (Gunite contractors assoc. Brochure G-55.)

The impact of the development of atomic and thermo-nuclear weapons on the Royal Navy. J. R. H. Bull, (N.E.C.I.E.S. Advance pa.)

Influence of propeller clearance and rudder upon the propulsive characteristics. H. Lindgren, ed. (Swedish state shipbuilding experimental tank. Pub. n. 33, 1955.)

Progress reports of investigation of railroad rails and joint bars. R. E. Cramer and R. S. Jensen. (Illinois. Univ. Eng. exp. station. Reprint series, n. 54.)

Seventh international conference on ship hydrodynamics. H. F. Nordstrom and Hans Edstrand, eds. (Swedish state shipbuilding experimental tank. Pub. n. 34, 1955.)

Tentative calendar of evening lectures on science and technology to be held in Ottawa for the season 1955-56, v. 1, n. 1.

The following publications have also been received by the library.

Annual reports, proceedings, etc.

British electricity authority. Annual report and accounts, 1954-5.

Canadian electrical association. Sixty-fifth annual convention, 1955, proceedings.

Quebec 1954, a report from the Quebec bureau of statistics.

Montreal. Civil service commission. Tenth annual report for the fiscal year ending April 30th, 1955.

Massachusetts institute of technology. The reports of the president and of the deans of the schools for the year ending October 1, 1955.

Smithsonian institution. Annual report, 1954.

Bibliographies

A preliminary annotated bibliography on muskeg. I. C. MacFarlane, comp. (Canada. NRC. Div. of bldg. res. Bib. n. 11.)

Seaway bibliography and supplement. (Saint Lawrence seaway development corp. Office of information. SLSDC-28 and SLSDC-28-A.)

Supplemental unemployment benefits. (Princeton Univ. Industrial relations section. Selected references, n. 66.)

The writings of David Barnard Steinman; a bibliography. (Rensselaer polytechnic inst. lib. Eng. and science series, n. 67.)

ENGINEERING CAREERS

The Royal Canadian Air Force

Today, more than ever, engineering services play a prominent and essential part in the efficiency of a modern air force. The highly complex nature of aircraft and their ancillary equipment demands a wide range of technical knowledge and skill.

Canada as a nation emerged from the second world war in a leading position in aviation. Within her borders she had built vast facilities to accommodate the British Commonwealth Air Training Plan, and in military operations on both coasts and overseas, the RCAF made a remarkable contribution to victory and established an enviable record of achievement. In the five years following 1939, the RCAF expanded from a peacetime nucleus of some 4,000 personnel and a few aircraft to a wartime force of nearly 250,000 personnel and several thousand aircraft.

All this was made possible because of the teamwork that was developed between the scientist and the engineer who conceived and designed the fighting equipment, the employer and factory-worker who manufactured it, and the aircrew and groundcrew who maintained and operated it effectively against the enemy. The part played by the service and civilian engineers through all stages, from drafting board to active operation was vital.

In the RCAF today, the engineer, or technical officer as he is known, plays an even more prominent and increasingly important role in the design, development, testing, modification, construction, and utilization of Air Force facilities and equipment.

The primary responsibility of the RCAF is air defence, and, therefore, a large proportion of its resources are devoted to this task. To meet this responsibility Canada has built up her CF 100 all-weather-fighter-interceptor squadrons and her vast network of early warning radar units. These squadrons and radar units form the backbone of the RCAF's Air Defence Command.

To the North Atlantic Treaty Organization, the RCAF contributes an air division in Europe of 12 F86 fighter-interceptor squadrons, their equipment and personnel and land-based maritime aircraft for the protection of coastal and sea-lane communications. NATO aircrew training, air transport, search and rescue, survival training, air photographic and tactical air operations are other active and important roles of the RCAF. With the advent of new operational concepts and techniques, it is obvious that today's RCAF must keep at least one step ahead of any potential enemy. This can only be done if the force is provided with the finest and most advanced equipment available. The responsibility of the service engineer in making this equipment available when it is needed is paramount to the whole Air Force effort.

THE ENGINEERING BRANCHES

Engineers in the RCAF are grouped in the aeronautical, armament, construction, telecommunications, mobile equipment and photography branches. Nearly 1,500 technical officers are required to man these branches. This number will probably increase as further technological advances are made.

To qualify for entry into one of the engineering branches of the RCAF, an applicant must hold a degree from a recognized University in pure or applied science. Once he is enrolled he is given specialized training to adapt him to the specific requirements of the branch in which he wishes to serve. However, professional knowledge alone is not enough since in the Air Force the engineer must also possess qualifications of leadership and management so that he is able to supervise and handle men as expertly as he can materiel. During his career he will be required to fill a staff engineer position at a Command or Headquarters level and to take charge of men and equipment in the field.

Each of the engineering branches maintains its identity, but all are part of a closely knit team whose function is to discharge the Air Force's responsibility as efficiently and effectively as possible. A discussion of each branch's specific task and responsibility follows.

Aeronautical Engineering

Officers of the Aeronautical Engineering Branch of the RCAF participate in the formulation of policy and plans pertaining to the maintenance of service aircraft and associated equipment. Their responsibilities include the drafting of designs and specifications, the conducting of tests and development programmes, the supervising of engineering aspects of production, quality control and technical training. Duties also include the managing of aircraft maintenance organizations which involve responsibility for the servicing, inspection, repair, modification, preservation and service evaluation of aircraft and associated equipment.

Armament

The Armament Branch of the RCAF is responsible for the procurement, installation and maintenance of the airborne and ground armament systems which give the RCAF its striking and defensive power. Officers of this branch participate in policy and programme formulation with regard to the maintenance of armament equipment, armament sections and units and the operation of armament training facilities. Their duties include the preparing of equipment designs and specifications, estimating requirements, advising on the development and use of armament equipment, service trials and testing, quality control and technical training. Duties concerning the management of armament organizations involve technical and supervisory responsibility for the inspection, servicing, fault analysis, repair, modification, storage, demolition, salvage, re-conditioning and preservation testing and development of armament equipment.

Armament equipment consists of such weapon systems as guided missiles, homing torpedoes, drone targets and their guidance and control mechanisms, launching equipment and test equipment; explosive stores, electrical and mechanical fuses; pyrotechnic compositions and components; special weapons (atomic, biological and chemical) and flame warfare agents; guns and unguided rockets, turrets and launching gear; armament range facilities which include telemetering equipment, photo theodolites, electronic-optical analyzers, timing systems and calibrators; aircraft fire control systems and weapon directing radar devices.

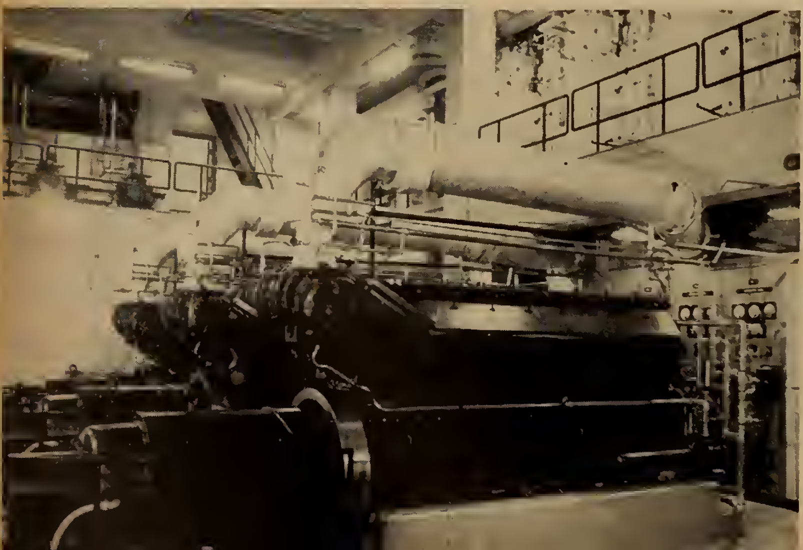
An R.C.A.F snowblower keeping an aircraft parking area clear at R.C.A.F. Detachment Resolute Bay, Cornwallis Island, N.W.T.; the responsibility of the mobile equipment engineer. (*National Defence Photo*)

Construction Engineering

The duties of officers of this branch cover a wide scope of activities in construction, and the operation and maintenance of structures and facilities. Officers of this branch participate in the formulation of construction and maintenance policies, programmes and procedures, prepare construction specifications, standards and estimates of costs, exercise administrative control of construction and maintenance funds and material, recommend acquisition and disposal of Air Force real property, maintain liaison with agencies involved in Air Force construction projects and inspect completed projects as a basis for acceptance, control fire-fighting, fire prevention and aircraft crash rescue services, provide trade training and manage Air Force construction projects and unit construction engineering sections.

This branch has two specialties: (*a*) Construction and Maintenance; and (*b*) Fire Protection.

Entry requirement for the Construction and Maintenance specialty of this branch is a Bachelor's degree in pure or applied science. For the Fire Protection division, senior matriculation, the equivalent or higher, combined with five years' experience (full-time duty) in fire prevention activities in either a municipal, industrial or other recognized fire prevention organization is needed for entry.



Diesel power plant at an R.C.A.F. radar station, providing heat and power for the operations centre, is part of the equipment under the construction engineering branch. (*National Defence Photo*)

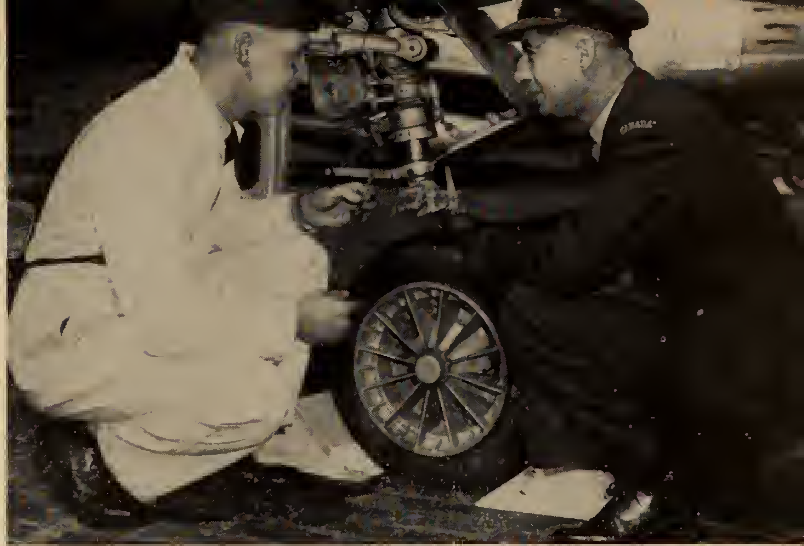
Mobile Equipment Engineering

This branch is responsible for the operation and maintenance of mobile land and marine craft, and the administration of RCAF road transport services. Officers of this branch advise on equipment selection and employment, prepare specifications and cost estimates for equipment procurement and maintenance, conduct accident prevention studies and give technical advice in accident investigations involving mobile equipment, and provide technical training. They are also responsible for the management of unit mobile equipment organizations which involves the administration of road transport services and the inspection, repair, modification, salvage, reconditioning and preservation of mobile equipment and marine craft.

Telecommunications

The Telecommunications Branch of the RCAF involves the installation and maintenance of RCAF telecommunications equipment and the operation of surface communication facilities. Officers of this branch participate in the functions of policy and programme formulation, preparation of equipment specifications, estimation of requirements, advising on the use and development of telecommunications facilities, design and development, provision of trade training and management of telecommunications organizations. It involves immediate supervisory and technical responsibility for the operation of service communication facilities as well as the installation, servicing, inspection, modification, salvaging and preservation of communications and radar equipment.

Officers may be employed in assignments for which special qualifications are required. Included in these are: Radar (Ground Search), Communications Operation, Electronic Counter-Measures.



An aeronautical engineer discusses a maintenance point with an aero-engine technician beside the nose wheel of an R.C.A.F. F86 Sabrejet at Volkel, Holland, before the Fifth International Air Show, Ypenburg.
(National Defence Photo)

Photography

Duties of the Photography Branch cover the installation, operation and maintenance of RCAF photographic equipment. Officers of this branch participate in planning air photography operations, formulate photography policies, programmes and procedures, prepare specifications and standards for photographic procedures and equipment and provide technical training. They also assume responsibility for still and moving picture photography, photographic production, materiel maintenance and the test and development of photographic processes and material.

CONDITIONS OF ENTRY

An engineering graduate, interested in an Air Force career, may apply at any of the 22 RCAF Recruiting Units across Canada or write directly to Air Force Headquarters, Ottawa. Successful candidates are posted to Officers' School at London, Ontario, for a nine-week course of basic officer training. Upon graduation from this course they are commissioned in the rank of Pilot Officer. The first year is devoted to specialized training after which the officer is promoted to the rank of Flying Officer. The RCAF may supplement basic professional qualifications by sending the officer for special courses in the United States or United Kingdom and post-graduate courses are arranged at universities in the United States and Canada. Many officers have attained a Master's degree in various sciences and some have obtained their Ph.D.

The maintenance, servicing and repair of such complicated equipment as this jet flight-simulator is the joint responsibility of the aeronautical engineering officer and the telecommunications officer. *(National Defence Photo)*

Undergraduates

The University Reserve Training Plan (URTP) allows selected undergraduates to be enrolled for training with the RCAF during their university years. In this way, as Flight Cadets, they receive training in the form of two-hour-a-week lectures during the academic year and officer training, engineering training, and employment at an RCAF station during the summer months. Upon graduation they may join the Reserve or enter the Regular Force as Flying Officers.

University undergraduates may also apply for subsidization through their four years of college under the Regular Officers' Training Plan (ROTP). Under this plan, students receive their lodging, books and tuition fees and an allowance of $55 per month. These cadets may attend one of the Canadian service colleges or a Canadian university. In the latter case, an additional allowance of $65 per month is granted in lieu of lodging. Uniforms are issued free of charge.

The ROTP cadet may also be granted a subsidization for a further year of study after graduation from the service college so that he may obtain his degree. On graduation, he is granted a permanent commission as a Flying Officer in the RCAF branch in which he has received his training. He has also the option of release after three years' service.

CAREER OPPORTUNITIES

Once the officer in the Regular Force has completed his basic training and other training courses, he will normally be posted to a unit in the field. The aim at this time is to permit him to consolidate and apply the extensive training undertaken at the University and in the RCAF. He may be charged with the supervision of many men and much complex equipment, including aircraft. Within his own sphere of responsibility he has great scope for exercising his personal initiative and ingenuity. He learns to be part of a highly effective team, including aircrew, groundcrew, and specialist personnel.

In the RCAF there is such a wide variety of employment for the engineer, that during his career he will be called upon to exercise his abilities in many areas. The manner in which he applies himself and handles his subordinates determines his rate of promotion. As he gains experience, he progresses to more responsible positions and receives recognition in accordance with his demonstrated ability.

MONTHLY RATES OF PAY

Monthly rates of pay are shown in the accompanying table.

An officer also receives an allowance of $375 for his uniform when he first enters the RCAF. He will receive substantial pension benefits, free medical and dental care and a $5,000 insurance policy for $2.00 per month as well as other fringe benefits.

Monthly Rates of Pay

Rank	Basic Pay	After 3 Years in Rank	After 6 Years in Rank	After 9 Years in Rank	*Marriage Allowance	†Subsistence Allowance (S) Single (M) Married	Total
Pilot Officer or Flight Cadet	$185	....	....	....	....	$65 (S)	$250
					$40	$91 (M)	$316
Flying Officer	$230	....	....	....	....	$89 (S)	$319
					$40	$110 (M)	$380
	....	$245	....	....	....	$89 (S)	$334
					$40	$110 (M)	$395
			$260	....	....	$89 (S)	$349
					$40	$110 (M)	$410
Flight Lieutenant	$290	....	....	....	....	$94 (S)	$384
					$40	$110 (M)	$440
		$315	....	....	....	$94 (S)	$409
					$40	$110 (M)	$465
			$340	....	....	$94 (S)	$434
					$40	$110 (M)	$490
				$365	....	$94 (S)	$459
					$40	$110 (M)	$515
Squadron Leader	$370	....	....	....	....	$113 (S)	$483
					$40	(M)	$523
		$395	....	....	....	$113 (S)	$508
					$40	(M)	$548
			$420	....	....	$113 (S)	$533
					$40	(M)	$573
Wing Commander	$460	....	....	....	....	$126 (S)	$586
					$40	(M)	$626
		$495	....	....	....	$126 (S)	$621
					$40	(M)	$661
			$530	....	....	$126 (S)	$656
					$40	(M)	$696
Group Captain	$615	....	....	....	....	$139 (S)	$754
					$40	(M)	$794
		$650	....	....	....	$139 (S)	$789
					$40	(M)	$829
			$685	....	....	$139 (S)	$824
					$40	(M)	$864
Air Commodore	$827	....	....	....	....	(S)	$980
					$40	(M)	$1020

* An officer eligible for marriage allowance receives $40 per month if living off the unit and $30 per month if occupying Government married quarters.

† Subsistence allowance is provided when rations and quarters are not available.

FUTURE OUTLOOK

As Canadian military aviation continues its rapid progress, the need for greater numbers of highly qualified engineers increases. According to Secretary of Defence Wilson, "half of the scientists and engineers [in the United States] work directly or indirectly for the defense effort." Although a similar statement cannot yet be made for Canada, RCAF experience alone underlines the growing need for engineers that is developing throughout the Department of National Defence.

Each of the technical branches of the RCAF has its own requirements and areas of responsibility, but they are interdependent. Each officer becomes a specialist in his own branch but he is expected to have a working knowledge of the activities of other branches and an appreciation of their problems. Only in this way can the branches work together as an effective team. Policy planning demands co-ordination within the branch and with those concerned in other branches. The planning must be integrated with specifications of aircraft design and development of new and better weapons and modern electronic devices to be installed in the aircraft. Management of projects involved in the construction of runways, hangars, control towers and personnel housing is closely allied with the operations of the Mobile Equipment Engineering Branch which provides the tractors, bull-dozers, cranes and trucks as well as general transportation vehicles. There must be a constant interchange of ideas between the officers of these various branches. Only by this close integration can an effective fighting system be developed and the maintenance of that system be kept at peak operating efficiency.

A primary factor of modern military superiority is technology. At this time when aviation is on the threshold of vertical flight, atomic powered aircraft and space travel, the scope for engineers in the service is particularly challenging.

A career in the RCAF is interesting and rewarding for a graduate engineer. Apart from its professional advantages, there is the personal satisfaction of service with a team designed for the maintenance of peace and the security of the people of Canada.

Bus. and Ind. Briefs

New Epoxy Manufacturing Company.—The Bate Chemical Corporation, Ltd., Toronto, Ont., and Houghton Laboratories, Inc., Olean, N.Y., have formed a joint company in Canada to manufacture and market Hysol products, which consist of epoxy electrical insulating materials, adhesives and tooling compounds. G. H. Clifford Smith of Bate Chemical Corp., Ltd., is president of the new Canadian company to be known as Hysol (Canada) Ltd., and Russell H. W. Smith, an electrical engineer of Toronto, is sales manager. Offices of Hysol (Canada) Ltd., are at 184 Laird Drive, Leaside, Toronto 17, Ont.

●

German Industries Fair.—The 1956 German Industries Fair covering industrial and consumer goods is to be held at Hanover from April 29 to May 8. Mechanical and electrical engineering industries are prominent among the exhibitors, according to a comprehensive brochure which is available, together with all other information on the Fair, from the Canadian representative, The Trimont Corporation Ltd., 1170 Drummond St., P.O. Box 25, Montreal, Que.

●

Avro Anniversary.—A. V. Roe Canada Limited recently celebrated their 10th Anniversary. The winter, 1955, issue of *Jet Age* attractively presents the story, written by Scott Young, of the achievements of the company during these ten years.

●

Refrigeration Show.—The 2nd Canadian Refrigeration and Air-Conditioning Show, will be held in the Coliseum in Toronto, on February 1, 2 and 3. Sponsored by the Canadian Refrigeration Manufacturers Association, this all-industry show contains over half a mile of exhibits displaying the latest developments in the fields of refrigeration and air-conditioning, plus the finest equipment for commercial, industrial and domestic application. During the first two days (Feb. 1 and 2) admission is by ticket only. The show will be open to the public on the final day. Businessmen desiring to attend the show are asked to write for free tickets to: Sec'y-Manager, 2nd Canadian Refrigeration and Air Conditioning Show, Room 1209, 137 Wellington St., West, Toronto, Ontario.

●

Canadian Contributions to Geophysics.—Roy L. Adams is to supervise production engineering on the type T609 auroral recorder, one of Canada's contributions to the International Geophysical Year which starts in 1957. This was made known by J. M. Bridgman, managing director of PSC Applied Research Limited in announcing Mr. Adams' appointment as production coordinator of the Toronto company. The auroral recorder, which measures the light intensity of the Aurora Borealis was developed by a group under Dr. Donald Hunten at the University of Saskatchewan with the aid of the National Research Council and the Defence Research Board. PSC Applied Research Limited has been given a contract by the Canadian Government to build the first unit.

The company also announce that their Canadian-developed and produced magnetometer has been used to discover more than one hundred million tons of good quality ilmenite in South West Norway. This valuable ore is used in the making of jet engines, paints and other products. The find has been christened the Tellnes deposit.

Publications

Industrial or trade publications received recently cover many fields of interest to engineers. For copies of those mentioned below, please apply to the issuing company (mentioning *The Engineering Journal*).

Bathurst Packaging Handbook.—A comprehensive, illustrated loose-leaf book covering many aspects of packaging, such as design, construction, testing, freight regulations. Bathurst Power & Paper Co. Ltd., Container Division, Sun Life Building, Montreal 2, Que.

●

Barometric Condensers.—A bulletin, Form 9012-A, describing barometric condensers of the disc-flow and ejector-jet types. Canadian Ingersoll-Rand Co. Ltd., 620 Cathcart St., Montreal, Que.

●

Rock Bolts.—Brochure describing types and applications of rock bolts. The Steel Company of Canada Ltd., Hamilton, Ont.

●

Liquid Level Transmitter.—Bulletin 13-22, describing closed tank liquid level measurement and control with Type 13 LA d/p cell liquid level transmitter. (The Foxboro Company.) Peacock Brothers, P.O. Box 1040, Montreal, Que.

Safeguarding Construction.—Well illustrated booklet describing the inspection of construction from site to finished project as part of the services offered by the company. (Publication No. 102.) The Warnock Hersey Co. Ltd., 128 Elmslie St., Montreal 32, Que.

●

Diamond Anniversary. — Illustrated booklet marking 75th anniversary and describing services of J. T. Donald & Co. Ltd., 1181 Guy St., Montreal, Que.

●

Bishop Signs.—Catalogue No. 60, summarizing metal letter and allied product data. H. B. Tompkins & Son, 733 Versailles St., Montreal, Que.

●

Carboloy Blanks and Tools.—Catalogue SBT-17 covers grades, styles, and specifications of "throw-away" insert blanks; new pricing information on Carboloy standard tools and blanks is given in bulletins 54CT and SBT-7B. Carboloy Section, Canadian General Electric Co. Ltd., 1025 Lansdowne Ave., Toronto, Ont.

●

Power Generation Equipment.—Publication No. 2404 deals with large steam turbines; No. P-2560 deals with large generators used with the turbines, also details of other equipment. (The General Electric Company Ltd., of England.) Fraser & Chalmers of Canada Ltd., 1411 Crescent Street, Montreal 25, Que.

●

Shellcast Brochure.—Esco Shellcast Brochure No. 205 covers the shell-moulding process, showing some of its applications and advantages. Esco Limited, 146 East 1st Ave., Vancouver 10, B.C., or 2480 Dufferin St., Toronto, Ont.

News of the Associations and Corporation

(*Continued from page 52*)

on Friday night, and the convention culminated with the annual dinner dance which overflowed the Empress ballroom on Saturday.

Engineers in the News

Charles Bentall, chairman of the board of directors of the Dominion Construction Co. Ltd., recently announced the appointment of **H. C. Bentall** as president and **R. G. Bentall** as vice-president of the Dominion Construction Co. Ltd., Bentall Construction Co. Ltd., and their associated companies.

D. D. Morris has been appointed to the newly-created position of assistant to the general manager of the Consolidated Mining and Smelting Company. He had served as administrative assistant since January, 1954, and had previously been manager of the research and development division.

J. M. Bezer has opened new Calgary offices for Eric Ackland and Associates Ltd., from which he will handle mechanical and electrical lines throughout southern Alberta. Mr. Bezer is a 1950 mechanical graduate of the University of British Columbia.

M. J. Shelley, a University of British Columbia civil graduate of 1955 has won the first Engineering News Record Fellowship for graduate study in the field of public works engineering and administration. The award was based partly on a paper on the design and operation characteristics of the City of Vernon's sewage treatment plant.

Mr. Shelley worked this summer under **F. G. deWolf,** city engineer of Vernon, and has now returned to the University of British Columbia to take his master's degree.

R. N. Gordon, division engineer with the Department of Fisheries in Ottawa, has been transferred to Vancouver where he will continue his work with the Department. Mr. Gordon is a graduate of the University of British Columbia and had previously been with the Department of Fisheries in Vancouver from 1949 to 1954.

D. A. Pirttinen has resigned from the process department of Foundation of Canada Engineering Corp. Ltd., Toronto, and is now associated as project engineer with Catalytic of Canada Construction Co. Ltd., of Sarnia.

J. M. Fitzsimmons has accepted a position with H. A. Simons Ltd. He was previously employed by Canadian Forest Products at Port Mellon.

A. R. M. Stewart has accepted a position with Sandwell and Co. Ltd. in Vancouver. He was previously plant engineer at Powell River and was with the Powell River Company for the past 15 years.

R. G. Foxall has joined Northern Construction and J. W. Stewart Ltd. and will be engaged on work in connection with the expansion program of the Powell River Company. He was with Canadian Forest Products at Port Mellon.

J. H. Eastman has been transferred from Canadian Exploration Ltd., Salmo, B.C., to Pato Consolidated Gold Dredging Ltd., Barranquilla, Colombia, S. America, where he expects to stay for at least two years.

G. H. MacKay, formerly with the Department of Public Works of Canada in New Westminster is now in Winnipeg working for the P.F.R.A.

J. R. Wallis, who recently obtained his master's degree in forest engineering from Oregon State College, has accepted a position teaching at the Montana State University School of Forestry.

J. Moroney is now with Dawson, Wade and Macco engaged in hydro work in the Upper Campbell Lake district. Mr. Moroney was previously assistant to the municipal engineer of Esquimalt.

L. Dotto has accepted a position with the Canadian Western Lumber Co. at New Westminster. He had previously been with H. A. Simons Ltd.

D. J. Turland, of the apparatus division of Canadian General Electric Co. Ltd., has been transferred from Vancouver to Trail where he will be apparatus sales engineer for that district.

R. H. Ferguson has accepted a position with H. A. Simons Ltd. He was previously with Vancouver Iron Works Ltd.

W. T. Harrower, of Dominion Bridge Co. Ltd., was recently elected chairman of the Vancouver chapter of the Canadian Welding Society.

D. I. Cameron is now with the B.C. Electric Co. Ltd. as a protection test engineer. He had been employed by Barvic Engineering Ltd.

R. H. Elfstrom was recently re-elected president of the Greater Vancouver Health League. Mr. Elfstrom is supervisor of industrial safety for B.C. Electric Co. Ltd.

H. Matthews was recently appointed chief engineer of the Victoria Machinery Depot Co. Mr. Matthews had been chief engineer and plant manager of Vancouver Iron Works Ltd. and Vancouver Engineering Works Ltd. and had been employed by that firm since 1928.

H. T. Ramsden has been appointed to the position of district engineer, Water Resources Division, Department of Northern Affairs and National Resources. He is a native of British Columbia and a graduate of the University of British Columbia.

Mr. Ramsden served with the R.C.E. Corps during the late war, and returned to service with the Water Resources Division, where he has held the post of assistant district engineer for six years. He succeeds **W. C. Warren,** the retiring district engineer.

D. C. Gough has accepted a position with Swan, Wooster and Partners, as resident engineer on the Kelowna bridge. He will leave his former position of construction engineer with the Pacific Great Eastern Railway at the beginning of the year.

D. C. Codville, who has been with Giant Yellowknife, recently accepted a position with Northern Construction Co. and J. W. Stewart Ltd., and will be engaged in work on the removal of Ripple Rock.

J. A. Wallace, formerly with Mobil Oil of Canada Ltd. in Canada and more recently district geologist for that company in Edmonton, has been transferred to the head office of the parent company, Socony Mobil Oil Company, Inc., at 26 Broadway, New York 4. In his new assignment, Mr. Wallace will be concerned with the company's Canadian operations.

D. A. Duguid has accepted a position with Bumstead-Woolford Ltd. of Vancouver and Seattle and will take over his new duties in Vancouver at the first of the New Year. Mr. Duguid was previously in the marketing division of the Imperial Oil Company.

Cyril Jones will officially retire from his position as city engineer at Victoria at the end of December.

A. R. Luck has left his position with the electric department of the Vancouver City Hall to join the staff of Canadian Westinghouse Co. Ltd. in Vancouver.

E. A. Bianco, a '52 civil graduate of the University of British Columbia, is now attending Stanford University at Stanford, California. He is working towards his master's degree in engineering administration.

T. L. Horsley has accepted a position with Granby Mining, Smelting and Power Company at Copper Mountain, B.C. He was previously with Taiga Mines.

J. W. Lee has been promoted to the position of senior geologist with Kaiser Aluminum and Chemical Corp. He has been in Jamaica with the Kaiser Bauxite Company.

D. H. Rutherford of Stone and Webster Engineering Corp. has been transferred from Concrete, Washington, to Seattle.

C. H. Morrison, a '55 mechanical graduate of the University of British Columbia, has taken a position with A. L. Swanson and Co. in Vancouver. He was previously with the B.C. Power Commission in Victoria.

W. C. Sellens has left the traffic engineering department of the B.C. Telephone Company to take a position with the engineering branch of the marketing department of the Imperial Oil Company in Vancouver.

G. R. Hilchey has accepted the position of mine engineer at Canadian Refractories Ltd., at Kilmar, Que. He was previously at the Levack Mine in Ontario.

R. T. Lisset, formerly with Vancouver Iron Works Ltd., is now on the engineering staff of H. A. Simons Ltd.

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

17,300 copies of this issue printed

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Indexed in The Engineering Index

SWITCHING . . .

of Shunt Capacitors and Reactors

Some of the more troublesome problems associated with the application of shunt capacitors and reactors to high-voltage lines are indicated in this paper, which deals mainly with the question of switching.

G. W. Clayton,
Apparatus Division,
Canadian General Electric Company Limited,
Peterborough, Ont.

The year 1954 has been called the Diamond Jubilee of Light. The development of the first practical light bulb required that power be made available to both residential and industrial areas. During the past 75 years, the demand for power has been increasing at a phenomenal rate. In order to meet this demand, electric utilities have been forced to transmit more power, greater distances than ever before. This continual battle between the supply and demand of electrical energy has not been confined to kilowatts alone. Increased transmission distances and heavy line loadings coupled with the increased motor load of the industrial and residential consumer has increased the demand for both leading and lagging kilovars.

For many years, power companies were able to supply the necessary system kilovars from available generation. In fact, quite a few of the smaller utilities still supply their entire kilovar requirements in this manner. However, most companies are rapidly realizing that, generally, it is neither practical nor economical to transmit kilovars any great distance. Reduced line and transformer capacity, generator instability, field heating and decreased generator kilowatt capacity have shown that it is better practice to install kilovar sources as close to the load as possible. In order to accomplish this, a large number of utilities are installing synchronous condensers, shunt capacitors and reactors at the load end of their transmission, sub-transmission and distribution lines.

Presented to the Winnipeg Branch of The Engineering Institute of Canada, 2 December 1954.

The installation of these devices on power systems has presented some unique problems. It is the purpose of this paper to point out a few of the more troublesome problems associated with the application of shunt capacitors and reactors to high voltage lines. Possibly, one of the most pertinent problems today is the question of capacitor and reactor switching. Because of this, I have decided to devote most of this paper to the switching question.

General

Many electric utilities have found that repetitive capacitor switching has produced severe transient system disturbances and caused extensive damage to switching devices. The difficulties involved in capacitor switching can be resolved into two separate problems. The first problem deals with the high momentary duty imposed on the switching device by the high inrush currents produced when a capacitor bank is first energized. The second problem concerns the production of overvoltages due to repetitive restriking in the switching device when a capacitor bank is being de-energized.

As will be pointed out later, the switching of a shunt reactor will not produce the effects just mentioned.

Causes of Inrush Currents

In order to fully appreciate the difficulties associated with capacitor and reactor switching, it is necessary that a few of the concepts underlying the production of inrush currents, be reviewed.

Figures 1A and 1B show, respectively, the equivalent circuit of a shunt reactor and capacitor bank which have been connected to a predominately inductive (i.e., resistance neglected) power system. The waveshape of the inrush current for switch closures at various points on the voltage wave, is also shown.

For a start let us consider the magnitude of the inrush current that is likely to occur when a shunt reactor is initially energized. From Fig. 1B, it can be seen that closing the switch at a voltage zero will result in an asymmetrical inrush current whose magnitude is twice normal. On the other hand, closing the switch at a voltage peak will produce a current inrush whose maximum transient value is equal to the final steady state value. In other words, switch closure at a voltage peak will produce a symmetrical inrush current. The reason that the current inrush is in one case symmetrical and in the other case asymmetrical can be attributed to the fact that it is essential that the current lag the voltage by 90 degrees. Therefore, closing the switch at a voltage zero necessitates that the inrush current wave be offset in order that the requirement mentioned above be satisfied. Of course, if the switch is closed at a voltage peak, the inrush current to the reactor can obtain the required phase angle displacement without any offset.

Now, let us consider the magnitude of the inrush current that is likely to occur when a capacitor bank is energized (Fig. 1A). If the switch is closed at a voltage peak, the ensuing voltage "shock" will initiate a transient oscillation, the magnitude and frequency of

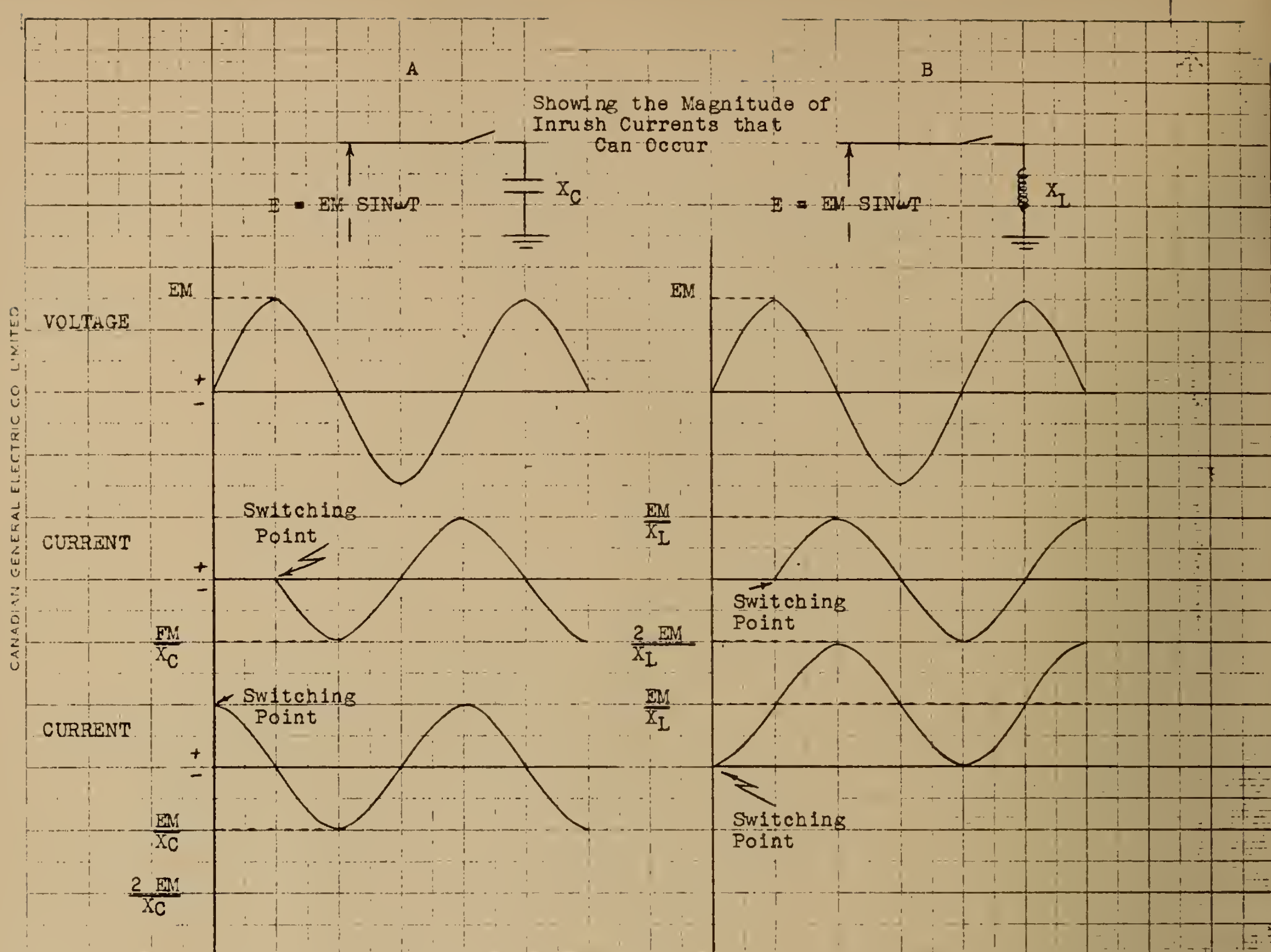


Fig. 1. Showing the magnitude of inrush currents that can occur.

which will be proportional to $\sqrt{\frac{X_C}{X_L}}$. Since the capacitor bank X_C is usually much larger than the system reactance X_L, both the magnitude and frequency of the inrush current will be high. However, if the switch is closed at a voltage zero, the magnitude of the transient component of the inrush current equals the fundamental frequency component. This indicates that even in the best case, the current inrush to a capacitor bank will be twice normal. For switch closures at points intermediate on the voltage wave, the magnitude of the inrush current will depend on the instantaneous value of voltage at the instant of switch closure and the ratio of $\sqrt{\frac{X_C}{X_L}}$.

From the above discussion, it can be seen that the magnitude of the inrush current to a capacitor bank can theoretically be equal to any value between the limits of twice normal and infinity. However, the magnitude of the inrush current to a shunt reactor will be, in the worst case, only twice normal, which leads to the conclusion that capacitor switching presents a more severe duty to the switching device than does reactor switching.

Effect of Resistance on Inrush Currents

Resistance in the lines leading to the reactor or capacitor bank will effect the inrush current in two ways. Firstly, it will reduce slightly the magnitude of the inrush current and secondly, resistance will determine the rate at which the initial value of inrush current decays to the normal current rating of the bank (Fig. 2). However, since we are normally interested in the current magnitude during the first quarter cycle and since resistance does not affect this magnitude appreciably, it is normal to neglect its effect completely. The reason for considering the first quarter cycle only, is that the momentary ratings of circuit breakers are based on the maximum value of current that can occur during this period.

Energizing a Single Capacitor or Reactor Bank

The circuits that have been considered so far have illustrated the fundamental concepts underlying the production of inrush currents. However, it would be of interest to consider the magnitude of inrush

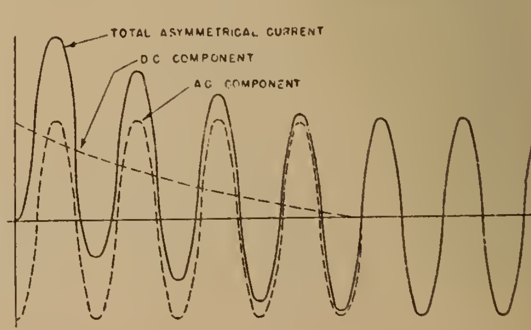


Fig. 2. Oscillogram showing decay of d.c. component and effect of asymmetry of current.

current that can occur in a practical power system. For reasons explained previously, all resistance will be neglected.

With the above thought in mind, let us consider what value of inrush currents can be expected when:

(1) A 13.8 kv. 5400 kvar. capacitor bank is energized.

(2) A 13.8 kv. 5400 kvar. shunt reactor is energized.

In both cases, it will be assumed that the system has an available short circuit capacity of 250 mva.

Case (1)

Figure 3 shows the system diagram and inrush current for the case where a 5400 kvar. 13.8 kv. capacitor bank is being energized. From the curves it can be seen that the inrush current is composed of two components. One component is the normal frequency (60 cps) current to the bank, while the second is the high frequency (410 cps) transient current. The magnitude of the normal fundamental frequency current is approximately 250 amperes and is given by $Em/(X_C - X_L)$. The magnitude of the transient component is 1580 amp. and can be found by multiplying the fundamental component by the ratio $\sqrt{\frac{X_C}{X_L}}$. The total inrush current is the sum of the two component waves and in this particular example will reach a maximum of 1830 amp. It is this total value of inrush current that determines the severity of the duty on the switching device. For this reason, it is customary to consider the maximum value of inrush current that is likely to occur. The curves shown in Fig. 3 have been prepared for the condition where the voltage is a maximum at the instant of switch closure and consequently, the inrush current is likely to be a maximum, depending on the ratio $\sqrt{\frac{X_C}{X_L}}$.

It was stated previously that the normal frequency current is 250 amp. However, the full load current of a 5400 kvar. 13.8 kv. capacitor bank is 226 amp. The difference in the two currents is due to the fact that the terminal voltage of the bank is unregulated. Thus, when the bank is first energized, the terminal voltage increases and the bank draws more than normal current. In order to prevent excessive voltage at the terminals of the bank, it is customary to regulate the terminal voltage by using multistep capacitor switching initiated by voltage control.

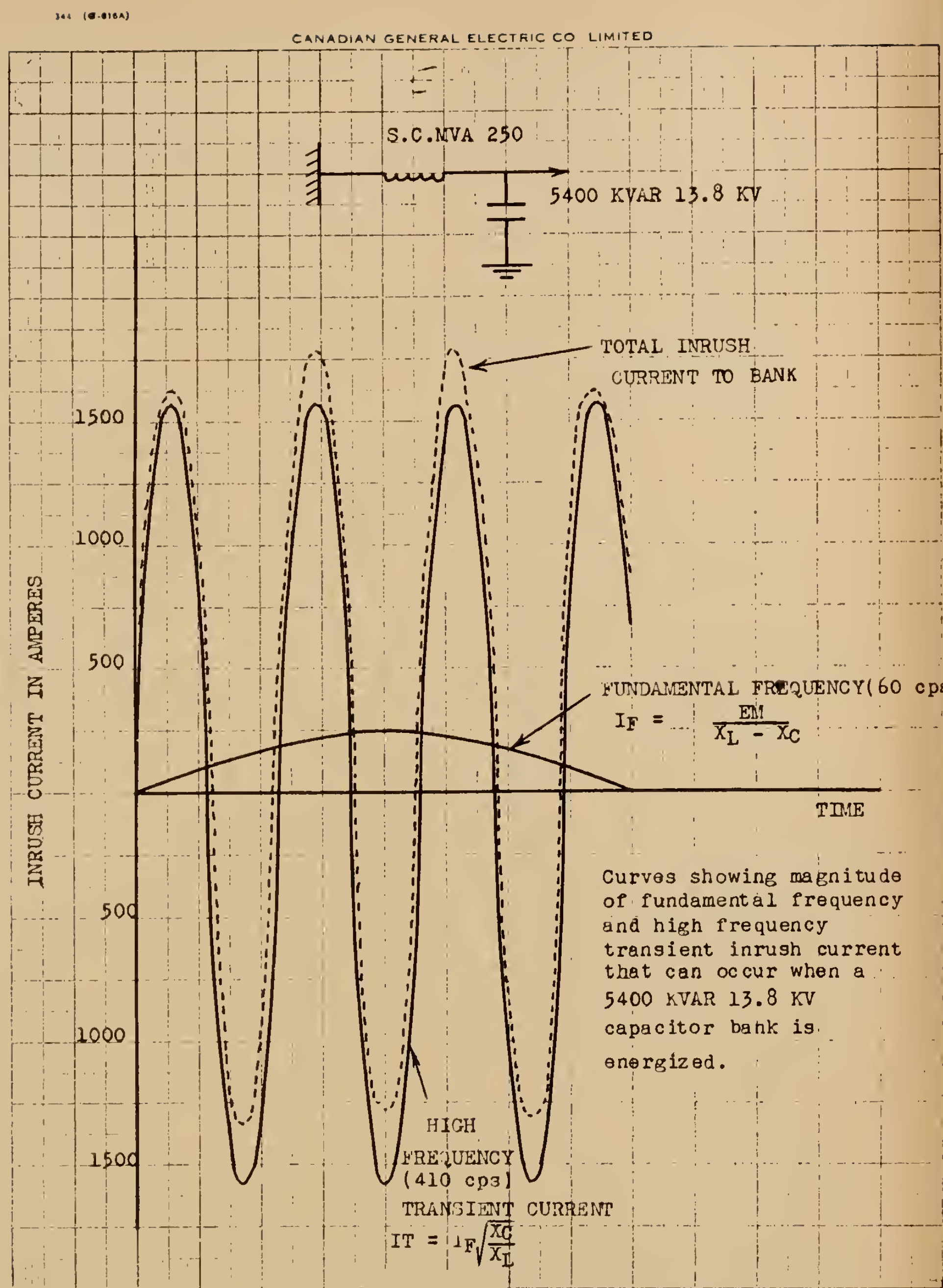


Fig. 3. Curves showing magnitude of fundamental frequency and high-frequency transient inrush current that can occur when a 5400 kvar. 13.8 kv. capacitor bank is energized.

The equation from which these inrush currents can be calculated is quite simple and will give the maximum value that is to be expected when switching a single bank. Figure 4 shows this equation and the type of circuit to which it can be applied. If the equation is expressed in per unit, using as base quantities the line to neutral mva., kv., X and I of the bank in question, it is possible to obtain a universal curve which will give the value of inrush current for a given system reactance. Figure 5 shows such a curve. It should be noted that the curve swings sharply upward at $X_L = 1.0$ p.u. This is, of course, the resonant point. It should also be noticed that it is impossible to limit the inrush current to less than four times normal unless the current limiting reactor is made exceptionally large. That is, the ohmic value of the reactor must be larger than that of the bank.

Case (2)

This next case investigates the

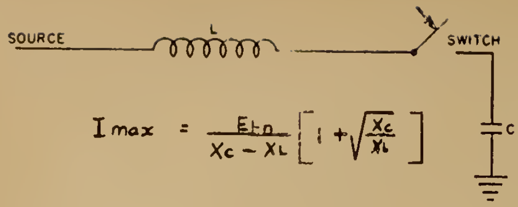
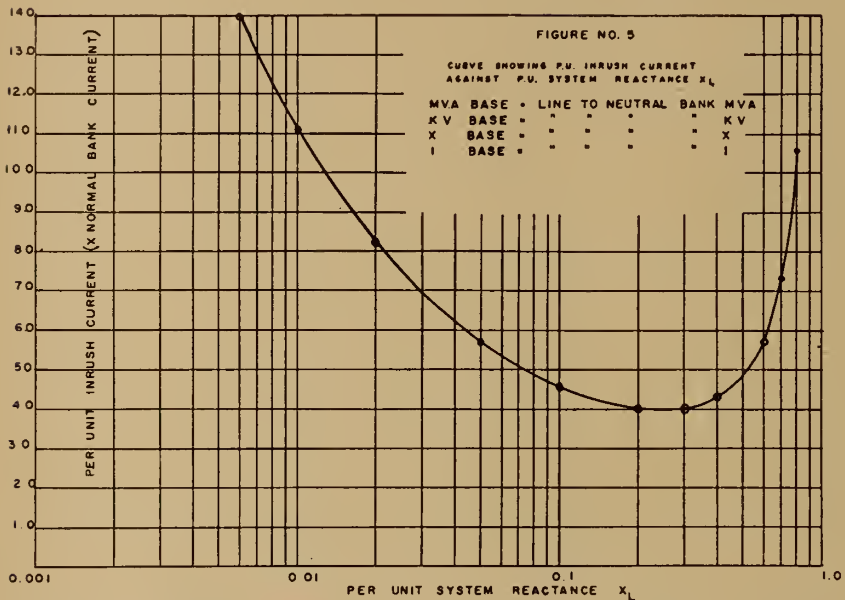


Fig. 4. Circuit diagram representing a capacitor being energized through an inductance.

Fig. 5 (below). Curve of p.u. inrush current against p.u. system reactance X_L.



magnitude of inrush currents associated with switching a 5400 kvar. 13.8 kv. shunt reactor. Actually, this phenomenon has already been discussed under the heading Causes of Inrush Currents. Figure 1B illustrates the maximum magnitude of inrush current that can occur. It can readily be seen from this figure that the worst case will only produce a twice normal inrush, (500 amp.) at the fundamental frequency. This confirms the previously drawn conclusion that energizing a shunt reactor does not impose a very great duty on the switching device. If the switching device has an interrupting rating, then no trouble should be experienced, since the inrush current will be considerably less than the fault current at the same location.

There have been a few isolated cases where the switching of a shunt reactor has proved troublesome. This difficulty has been attributed to rapid rates of rise of recovery voltage causing restriking in the switching device. Normally, this condition can be remedied by using a circuit breaker rather than a load break switch as the controlling device.

Energizing Parallel Banks of Capacitors

The inrush current associated with multistep switching is invariably higher than the inrush current to a single bank. This statement becomes fairly obvious if we consider the circuit of Fig. 6. In the circuit shown, the inductance between parallel banks will be very low compared to the system if the banks are close-coupled physically. Consequently, the majority of the inrush current will come from the two parallel banks rather than from the system. Since we are primarily interested in the maximum inrush current that is likely to occur, it is assumed that the energized banks are charged to a maximum at the instant the switch energizing the last bank is closed. Since the inductance between the banks is small, the inrush current will be correspondingly high.

The maximum value of inrush current to be expected when switching parallel banks can be calculated from the equation shown in Fig. 6. The values of C_t and L_t are, respectively, the equivalent capacitance in microfarads and the equivalent inductance in microhenries of the circuit in question.

By way of comparison, it would be interesting to note how much the inrush will increase if a 5400 kvar. 13.8 kv. bank is energized in parallel with two other 5400 kvar. banks. Using the equation of Fig. 6, the inrush current is found to be 20,600 amp. at 5820 cps. It can be seen that this value of current is more than 11 times the value of inrush current for a single bank and the frequency of oscillation is more than 14 times greater than the frequency associated with the energizing of a single bank.

Although the equations themselves are relatively easy to use, it is sometimes difficult to determine accurately the inductance between the parallel banks. A good rule of thumb is to neglect the inductance of the capacitor leads and buswork and to use 0.5 microhenries per foot as the inductance of open conductor runs, including the length through the circuit breakers. This figure will give a value of inductance which is low, thus the calculated inrush current will be high and on the conservative side.

It should be noted that the formulae previously mentioned are based on the energization of an uncharged bank. If the bank happens to be charged at the instant the switch is closed, it is possible that the inrush current will be much higher than calculated. This can be attributed to the difference between the system voltage and the voltage trapped on the capacitor bank being, at a maximum, twice the normal system voltage. Consequently, at the instant of

$$C_t = \frac{(C_1 + C_2)(C_3)}{(C_1 + C_2 + C_3)}$$

$$L_t = \frac{(L_1)(L_2)}{L_1 + L_2} + L_3$$

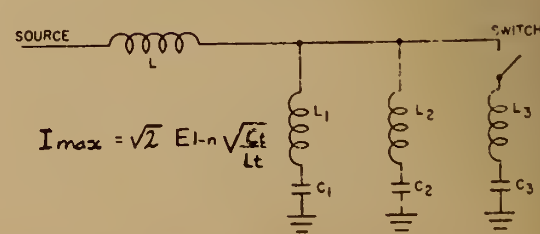


Fig. 6. Circuit diagram representing the energizing of the third step of a multi-step capacitor bank.

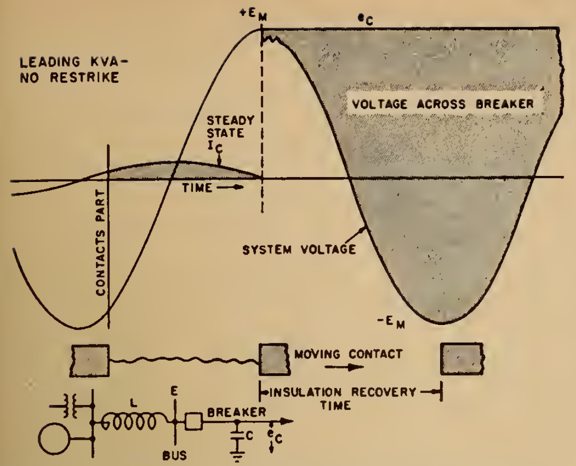


Fig. 7. Diagram representing voltage across contacts of breaker when interrupting capacitive current with no restriking.

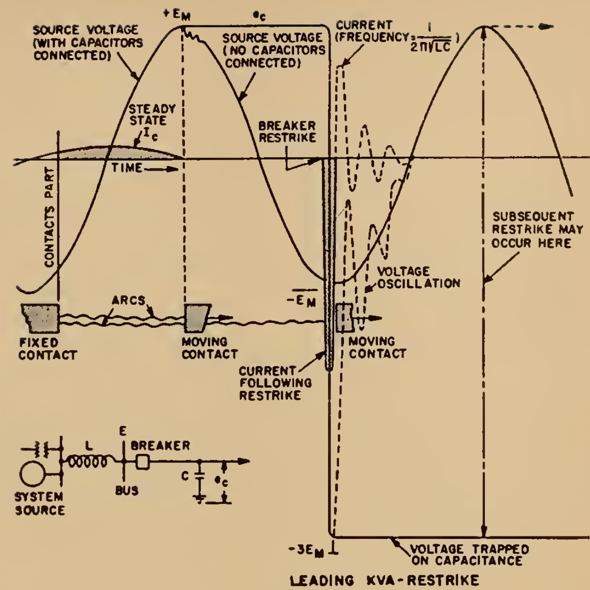


Fig. 8 (right). Diagram representing restrike in a breaker when interrupting capacitive current.

switch closure, the voltage imposed across the bank will be twice normal and the inrush current will also be twice normal. For this reason, it is best to have the bank de-energized for 30 seconds before attempting a reclosure. Likewise, the time delay of the automatic controls that are used to initiate the switching should be set for at least 30 seconds. This time delay will allow the internal resistor in each unit to discharge the capacitor to a relatively low voltage.

Transient Voltages

So far, we have been concerned with the inrush currents associated with energizing either single or parallel banks of capacitors. Before discussing the effect of the inrush currents on switching devices, it might be of interest to study briefly the transient overvoltages that can occur when a bank of capacitors is being de-energized.

Figure 7 illustrates the voltage across the contacts of a breaker when interrupting capacitive current with no restrike. The contacts part at some point during the voltage and current wave. The shaded part of the current wave represents arcing current. At the first current zero, the arc will be extinguished, and the voltage will be a maximum. The capacitor bank will be left charged at the instantaneous value of system voltage. At the instant of current zero the system voltage will drop slightly since the voltage rise due to the capacitor bank is no longer present. There will be a few small oscillations as the system voltage recovers to the no-load value. In the next half cycle the system voltage will go negative and the total voltage stress across the breaker contacts will be twice normal system voltage. If the rate of build-up of dielectric strength across the breaker contacts is sufficiently rapid, then no restrike will occur and the circuit can be considered cleared.

On the other hand, the dielectric strength across the contacts may not build up fast enough to prevent a breaker restrike. If such a restrike should occur when the source voltage is a maximum in the negative direction as shown in Fig. 8, a high frequency equalizing current is then established due to the reversal of potential on the capacitor. The frequency of the current is determined by the capacitance and inductance of the circuit and may be of the order of 1,000 to 10,000 cycles. This oscillating current would pass through many current zeros if it were not that the breaker usually interrupts this current at an early current zero.

The high frequency voltage associated with the high frequency current has the same frequency as the current but bears a phase relation to the current of 90°. Thus, if the high frequency current is interrupted at first current zero, the high frequency voltage, which is at a maximum, is trapped on the capacitor. This voltage may be as high as three times normal crest depending upon the instant at which restrike occurs.

A half cycle following the first restrike, the voltage across the open breaker is four times normal crest depending upon the instant at which restrike occurs. Should a second restrike occur at this point, the voltage on the capacitor may be theoretically as high as five times normal crest. However, extensive field tests have seldom shown overvoltages due to restriking that exceed three times normal value. This would indicate that cumulative build up due to restriking is rarely encountered in practice.

Figure 9 illustrates the type of random restriking that can be obtained when a large bank of capacitors or long high voltage line is being de-energized. The maximum value of overvoltage that occurred in this particular test did not exceed three times normal crest. The voltage trapped on the line after the breaker finally cleared does not exceed $1\frac{1}{2}$ times the normal crest value. It is apparent that if restriking is not limited, the voltage stresses may cause failure of the capacitors and other apparatus such as lightning arresters and transformers.

Effect of Inrush Currents and Restriking on Switching Devices

Having studied the theory behind inrush currents and restriking, it would follow logically if we were to determine how these phenomena affect the operation of switching devices. The stress imposed on any piece of electrical apparatus by high transient currents is mechanical rather than thermal. The inrush currents associated with capacitor switching are of such short duration that the thermal capabilities of the switching device are not severely stressed. However, the electromechanical forces on the switching

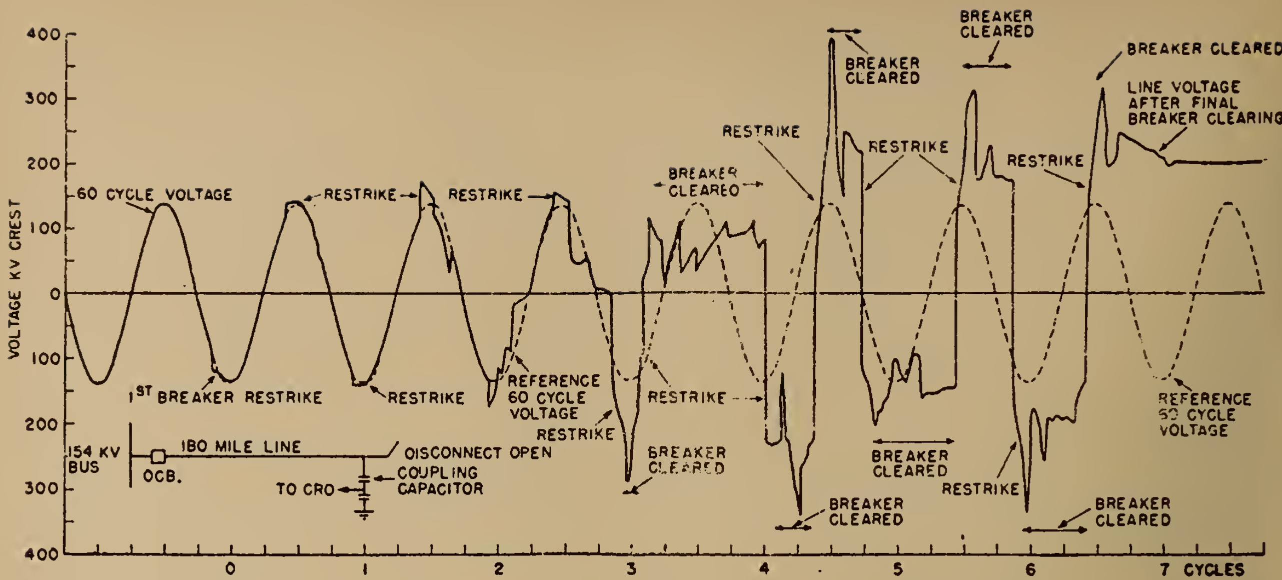


Fig. 9. **Oscillogram from interruption of charging current of 180 miles of 154-kv. overhead transmission line, showing random restriking of circuit breaker having interrupters unmodified for capacitive switching.**

device will vary with the square of the current. Consequently, if the inrush currents are high the mechanical forces on the switching device may be large enough to cause mechanical failure. Restrikes, on the other hand, may burn the contacts of the switching device and produce large overvoltages that might damage other apparatus.

How to Select a Switching Device

From the previous discussion, it can be seen that the switching device should be selected carefully if it is to perform satisfactorily. All switching devices have standard ratings as far as voltage, continuous current carrying capacity, interrupting capacity etc., are concerned. When selecting a switching device for duty with capacitor banks, each of the following ratings should be examined to insure that the device will be operating within its design limits.

(a) Voltage Rating.—The voltage rating of the switching device must be equal to or greater than the maximum operating voltage of the circuit to which the switch is connected.

(b) Continuous Current Rating.—The continuous current rating of the switch should be at least 135 per cent of the capacitor bank current in accordance with Nema standards. This margin is necessary since the capacitor current may exceed the name-plate value because of manufacturing tolerances of the individual units and because of the possibility of overvoltages and harmonic current flow.

(c) Interrupting Rating.—If the switching device is used as a means of short circuit protection in addition to its duty as a capacitor switch, it must have an interrupting rating adequate to handle short circuits occurring on the bank side of the switch. Even if the switch is not used for short circuit protection, it must be able to interrupt normal capacitor current without excessive overvoltages due to restriking. If the switching device has no interrupting rating, fault protection must be provided by backup breakers or fuses.

(d) Momentary Rating. — The switching device must be capable of withstanding the momentary duty due to fault current. In addition, the device must have a momentary rating greater than the maximum inrush current to the capacitor bank.

(e) Frequency of Operation.—The mechanical and electrical design of the switching device must be capable of withstanding repetitive operations.

Table I. Oil Switch Characteristics and Capacitor Switching Capabilities

Type	Rated Volts	Rated Amp.	Phase	Moment Amp Asym.	BIL Kv	Contact Life (No. of Operations)	Max 3-phase Capacitor Banks to be Switched: Volts	Kvar.
NR	15,000	200	1	9,000	95	6,000 at rating	2,400	600
							4,160 delta	1,080
							4,160 grd Y	1,080
							4,800	1,215
							7,200	1,845
							12,470	3,240
							13,800	3,555
B-1	15,000	150	3	40,000*	95	45,000 at 100 amp. 20,000 at rating	2,400	450
							4,160 delta	800
							4,160 grd Y	800
							4,800	900
							7,200	1,350
							12,470	2,400
							13,800	2,700

*40,000 amp. asym. applies only to 60-cycle currents. High-frequency inrush currents should not exceed 10,000 amp.

Capacitor Switching Capabilities of Load Break Switches and Circuit Breakers

Another point of interest deals with the amount of capacitor kvar. that can be handled by various types of switching devices. Table I shows the capacitor switching capabilities of two typical load break devices. It should be noticed that the B-1 switch has been derated to 10,000 amp. momentary when high frequency currents are being considered. It should also be noticed that none of these switches has an interrupting rating other than the nominal current rating. Hence, short circuit protection should be

Table IIA. Maximum Single-bank Three-phase KVAR to be Switched with Magneblast Breakers

Rated Circuit Voltage	Breaker Continuous Rating 1200 Amp.	2000 Amp.
2,400	3,700	6,200
4,160	6,400*	10,700
4,800	7,400	12,300
7,200	11,100	18,500
12,470	19,200	32,000
13,800	21,500	35,400

Table IIB. Maximum Single-bank Three-phase KVAR to be switched with Outdoor Breakers

Breaker Rating Kv	Single-bank Three-phase Kvar
14.4	30,000
23	30,000
34.5	30,000
46.0	22,000
69.0 – 1,500 mva	30,000
69.0 – 2,500 mva	30,000
69.0 – 3,500 mva	30,000
115.0 – 3,500 mva	50,000
138.0 – 5,000 mva	50,000
138.0 – 10,000 mva	50,000
161 – 5,000 mva	50,000
230 – 5,000 mva	50,000
230 – 10,000 mva	50,000

provided by backup breakers or fuses. Both switches will interrupt their rated capacitor current at rated voltage without restrikes.

Table IIA shows the amount of three-phase single-bank kvar. that can be switched with magneblast breakers. The interruption principle of the magneblast breaker is such that it is particularly suitable for switching capacitor banks. That is, the lengthening of the arc in the arc chutes tends to bring the current more in phase with the voltage thus reducing the possibility of restrike.

Table IIB will give some idea of the three-phase single-bank kvar. that can be switched by a large high voltage outdoor oil breaker. In order to switch successfully the amount of kvar. shown, it is necessary that the breaker be equipped with either an impulse or resistor type of interruptor. The principle of interruption of both devices is quite different although one does as good a job as the other.

On high values of fault current, the impulse interruptor relies on a self-generated oil blast to extinguish the arc. Under light current duty and reduced gas pressures, the spring-actuated impulse piston assists arc extinction by forcing cool oil across the arc.

On the other hand, the interruptor equipped with resistors achieves successful interruption by reducing the rate of rise of recovery voltages and equalizing the potential stress across the interruptor. The resistor also permits the capacitor bank to discharge into the system, thereby lowering the magnitude of the voltage trapped on the bank. These two features, combined with reduction of the phase angle between the voltage and current, decrease the possibility of restrike.

The values of capacitor kvar. shown in Tables IIA and IIB are standards which have been set by the electrical manufacturers. In general, most manufacturer's breakers can switch considerably more kvar. than the table would indicate.

Summary of Capacitor Switching Phenomena

The previous section illustrated the amount of capacitive kvar. that can be switched in a single step by various load break switches and circuit breakers. As mentioned previously, these values are conservative. The only way in which the performance of a switching device can be predicted accurately, is by actual field and laboratory tests. Such tests have enabled the following observations and conclusions to be drawn.

(1) The switching of shunt reactors does not present any problem since the maximum inrush current that is likely to occur is only twice normal. In general, the duty on a circuit breaker is much less when switching shunt reactors than when clearing a three-phase fault located on the reactor side of the breaker.

(2) Circuit breakers that are not designed for capacitor switching service may produce random restriking. This restriking will cause overvoltages which may damage the capacitor units, lightning arresters and other connected electrical apparatus.

(3) If a bank of capacitors is switched in parallel with a second bank of energized capacitors, the inrush current will be greater and the transient voltages less than if the energized capacitance were not present.

(4) By using properly designed shunting resistors across the breaker contacts, it is possible to reduce markedly the magnitude of the transient voltages and currents that are likely to occur if the switching device should restrike.

(5) A second effective means of controlling restriking is mechanically to force the dielectric between the parting contacts of the switching device. Since this principle is independent of the arc energy, low values of leading current can be interrupted successfully.

Although it is possible to design and build a restrike-free circuit breaker, it is felt that the economics involved would be prohibitive. This is especially apparent when it is realized that the maximum transient overvoltages, occurring from one restrike, will not usually be of sufficient magnitude to cause any damage to the system. Furthermore, on energizing an uncharged capacitor bank, it is possible to obtain twice normal crest line to ground voltage. Consequently, there is little point in attempting to limit the voltage due to restriking to less than twice normal crest. Because of this, it has been proposed that the following criteria should apply when determining the capabilities of circuit breakers for capacitor switching service.

(a) The transient voltages to ground resulting from possible restrikes when switching capacitor banks should not exceed twice normal line to neutral crest voltage.

(b) It should be demonstrated that the circuit breaker is so designed that not more than one restrike per phase will occur when interrupting capacitive current.

(c) The circuit breaker should be capable of successfully opening and closing the maximum transient currents as determined by (a) or (b) providing these currents do not exceed the momentary rating of the circuit breaker. √

Is Effective TOWN PLANNING Possible?

S. D. Lash, M.E.I.C.

Head of the Department of Civil Engineering,
Queen's University,
Kingston, Ont.

When I speak of town planning I mean a *process* aimed at creating the best possible urban environment with the available resources. It follows therefore that town planning is concerned particularly with health and safety, economic opportunity and efficiency, aesthetic and cultural satisfactions. I wish to consider whether such planning is in fact possible within the framework of democratic government. I am primarily concerned with planning as applied to existing towns for I am sure that all will concede that new towns such as Kitimat cannot come into existence without most careful planning.

Town Planning and Civil Engineering

Although planning activities of one kind or another are as old as cities themselves, the sort of planning that we are doing today is largely based upon the experience of the past fifty years. Most practical town planners have been trained either as architects, land surveyors or civil engineers and relatively few have had much university training in planning. There is necessarily a very close relation between civil engineering and urban planning and it is not surprising therefore to find that many of the most significant contributions to planning have been made by civil engineers. I believe that this will continue to be true.

Presented to the Kingston Branch of The Engineering Institute of Canada, April 19th, 1955.

At the same time it is important that we appreciate the differences between town planning and engineering design. We are all familiar with the latter and it may be illustrated by the following simplified example.

Suppose that an engineer is asked to design a bridge. He first surveys the site in order to determine the span and the foundation conditions. He then finds out what loads the bridge must support and how wide it must be in order to carry the traffic. With this basic information he can prepare alternative designs and estimate their costs. One of these designs is selected, working drawings are prepared and the bridge is built in accordance with the drawings. Our engineer can have the satisfaction of visiting the site and seeing his ideas take concrete form.

His colleague the town planner has a very much more difficult task. To begin with, the objectives of planning are seldom defined. The planner can survey the site but he cannot determine the size of the structure—he can only guess at what it may become. Most cities seem to feel that growth is all important—if only Kingston could be like Toronto all would be well—or would it? Chambers of Commerce believe that industry is all important—machines to make more machines. The planner is not so sure, perhaps because he has looked more critically at some of our large industrial cities.

Our engineer was dealing primarily with things; our planner is mostly concerned with people, and people are much more complex than things. Our engineer has learned effective techniques of design and construction. We say he has the know-how; but our planner is working in a field where technique is still in a rudimentary stage. The planner may draw up excellent plans but he is usually unable to do much about their realization. This will be the task of others. And finally even if the plans are followed it is unlikely that the planner will live to see their completion. Rome was not built in a day.

The Ineffectiveness of Planning

When we consider these differences we are not surprised to find that, so far, planning in Ontario and elsewhere has been relatively ineffective. If we study the matter a little further we will find additional reasons for ineffectiveness. These may be summarized as follows:

(a) lack of public understanding concerning the objectives and procedures of planning,

(b) uncertainty concerning the proper place of planning in the structure of local government,

(c) unsatisfactory administrative procedures,

(d) lack of properly trained personnel especially senior men,

(e) lack of money,

(f) vagueness of planning proposals.

Is town planning, particularly as it is concerned with health and safety, economic opportunity and efficiency, and aesthetic and cultural satisfactions, possible within the framework of democratic government? Dr. Lash considers that it is, but only if it has clearly defined objectives that are approached rationally.

Planning Objectives

May I examine these in a little more detail and at the same time suggest some remedies. Firstly, in this matter of objectives. I believe that town planning should have the following specific aims:

(i) The proper planning of town extensions.

(ii) The preservation of vitality in existing urban areas and especially in the central areas.

(iii) The improvement of means of communication.

(iv) The expression and encouragement of civic spirit.

The proper planning of town extensions involves the selection of land to be developed, the control of land use, the location of streets, the location of parks, schools and other public or semi-public uses of land.

The preservation of vitality in existing urban areas involves slum clearance, the reconditioning of obsolete properties, the remedying of deficiencies in open space, the creation of amenity, the improvement of traffic conditions including the development of off-street parking, the development of centres or precincts for specific purposes.

The improvement of communications involves the planning of by-pass or internal relief roads, road widening, the improvement of intersections, control over parking, control over the kinds of vehicles permitted on roads, traffic control devices, mass transportation facilities, the location of air, rail, and bus terminals.

The expression and encouragement of civic spirit is a rather intangible aim but it is of paramount importance. In 1915 Patrick Geddes wrote "the true town plan, the only one worth having, is the outcome and flower of the whole civilization of a community of an age". A more recent writer has said "Cities have personalities and characters as men have and the planner must try to catch the personality and character of the place he is planning before he can begin to formulate his plans". Nearly all successful town planning schemes in the past have commanded public support because of their visual appeal. Town planning will always be more of an art than a science. One of its primary aims must be the revival of the lost art of civic design.

The preceding summary of planning objectives may sound too ambitious and certainly not all these activities are likely to be carried on at one time and place. Nevertheless, all are practical and in fact all are being done successfully in various parts of the western world.

Planning and Local Government

May I consider next the place of planning in the structure of local government I believe that wherever possible the planning agency should be an integral part of local government. At the same time it must not be associated too closely with any particular department. It is the function of a planning agency to discover the public interest, to balance conflicting claims on the public purse and to co-ordinate development, both public and private, so as to produce a harmonious result. To do this effectively requires that the planning agency be very close to the normal machinery of local government but that it have a vitality and continuity of its own. Two systems have worked well—in one the planning agency is itself an independent department, in the other it forms part of the staff of the mayor or chief executive. What has not worked well is the North American system of a semi-independent planning board or commission. Planning boards may be useful if they function only as advisory committees on policy but they cannot deal effectively with the implementation of planning policy.

Size of a Planning Area

The size of a planning area is a matter of fundamental importance. It has become usual in North America to regard planning as being primarily a municipal concern. Unfortunately the municipality as presently constituted is seldom a suitable administrative planning unit. Either it is too small in terms of total population or it is too small geographically. Effective planning requires the planning staff consisting of a leader of high calibre assisted by a technical staff competent in a wide range of different fields. These might consist for example of a civil engineer, an architect, a sociologist and a real estate specialist. Obviously a small municipality cannot afford a planning staff of this size and it follows therefore that small municipalities should be grouped together for planning purposes. As a rough guide it is suggested that the population of a planning area should not be less than from 75,000-100,000 but further studies of this problem are clearly needed.

Many towns in Canada are overspilling their municipal boundaries with the consequence that there is often a multiplicity of government within a single urban area. The remedy is obvious but difficult to achieve — to extend municipal boundaries so as to include all existing and potential urban land. Where two or more towns are tending to coalesce, a single municipality should be formed. In many places this has been done with great success but little has been accomplished in Ontario except the creation of Metropolitan Toronto. It would seem that planning cannot wait for local government reform. In Ontario we are stuck with a municipal act of the horse and buggy era and there seems little chance of replacing it with more modern legislation. An interim solution is to form joint planning authorities such for example as the Kingston Area Planning Board. But experience has shown that such bodies are relatively ineffective and this is particularly true when they are supplemented by a number of subsidiary planning boards. Planning is accomplished not by setting up a large number of planning agencies, but by giving adequate authority to appropriate agencies. Effective planning therefore requires the establishment of regional planning authorities. This has already been done to a limited extent in Alberta and British Columbia. I have no time to discuss in detail the organization of such a planning system, but one feature should be mentioned. I would expect a regional planning authority to delegate some of its powers to local municipalities within its jurisdiction and thus retain local interest and experience.

May I remind you that I started out by describing planning as a process. This process consists essentially of three steps which are repeated cyclically—survey or the collection of information, the preparation of plans, and the control of development in accordance with approved plans. The approval, rejection or modification of plans must be the responsibility of elected governments.

We are fortunate that in Canada the general pattern of planning has been that of local action subject to approval at the provincial level. This is basically sound. In large measure this must be a local responsibility but there are circumstances in which local approval or disapproval may be irrelevant or unimportant in comparison with the wider interests of the public. Thus it should not be within the competence of a local municipality to prevent the extension of a much needed limited-access road. In such circumstances approval by the provincial Minister of Planning should be all that is required.

Appeals

It should be possible for all parties affected by local planning decisions, whether they be private citizens, or corporate bodies, to appeal such decisions to a level higher than that of purely local government. Such appeals should be decided by the Minister of Planning usually on the basis of evidence given at a local inquiry.

May I return for a moment to the subject of public relations. Experience shows that the public will support planning provided they understand its basic aims and are convinced that they are being dealt with in a fair manner. They are opposed to pernickety regulations and they are quite properly indignant when planning machinery causes lengthy delays to legitimate development. In the early stages of development of planning systems public participation is of great importance. It often provides the drive required to get the machinery established and working and it is a good method of educating both politicians and the public. However the public participation is likely to dwindle once an effective system has been established. Planning then tends to be accepted as a necessary feature of democratic government.

Compensation

Any effective planning system must come to grips sooner or later with the problem of compensation if it is to receive continued public support. There are really two questions—firstly, in what circumstances are property owners entitled to compensation if the value of their property is depreciated by planning action, secondly, in what circumstances should land be acquired for planning purposes and how much should be paid for it. All countries that take planning seriously have given a great deal of thought to these matters but I can find little evidence of even any thought in Canada. Unfortunately nobody seems to have arrived at any solutions of general acceptability. My own views are briefly as follows.

Compensation should be paid whenever planning actions cause undue loss or hardship to a property owner but it should not be paid where the loss is of a speculative nature. This is a much less radical point of view than that expressed by the Supreme Court of New Jersey in 1938 when they stated "the public welfare is of prime importance; and the correlative restrictions upon individual rights—either of person or of property are incidents of the social order, considered a negligible loss compared with the resultant advantages to the community as a whole". In my opinion a farmer should not be paid compensation if he is prevented from selling lots along the highway provided it is clearly in the public interest to prohibit such development. The value of his farm as a farm is not lessened by such a prohibition, what he loses is the possibility of an unearned increment of value and to lose this is not a hardship.

On the other hand a man who has bought a parcel of land from the same farmer for the purpose of building a service station and then discovers that this use is not permitted might be entitled to compensation. To obtain compensation he would have to show that at the time he bought it there was no reason to anticipate any objection to its use for a service station and that he had paid a price well in excess of its value as agricultural land. Whilst the difficulties of administering such a system may appear insuperable, in practice I believe it can be made to work and the difficulties diminish as planning becomes more effective. But the system will not work if the municipality has to pay the bill. The costs must be met to a very large extent by provincial government grants.

Public Acquisition

Many difficult problems of compensation can be avoided altogether by public acquisition of land and I am strongly of the opinion that this is a good thing, not because I am a doctrinaire socialist, for I am not, but because it solves so many planning problems. In support of this view I would like to read three quotations; the first two are by distinguished European planners, the third is from a recent judgment by the United States Supreme Court.

S. E. Rasmussen, "Towns and Buildings", Liverpool, 1951. — "A survey of town-planning will show that there have been well-planned cities since the earliest times but only in places where all the land was in one hand, whether a state, a town or a private landlord. But from the moment in which the ownership of the land is shared by many small landlords with all their egoistic interests, total planning and control of development are almost impossible".

H. Bernoulli, "Die Stadt und ihr Boden," Zurich, 1949.—"Where a radical solution by a single stroke proves impossible, the community should keep to the following rules: The community should never sell any of the land held by it. The community buys private land whenever possible. The community allows land held by it to be used for private enterprise by granting building rights. Repurchase of land, whether carried through in a day or in the course of years should however never be regarded as an end in itself, but as an indispensable stepping stone: it forms a first elementary basis upon which the city of the future can be built and a constant organic regeneration made possible".

United States Supreme Court, November 1954. — The judgment by the Supreme Court concerned the right of the District of Columbia Redevelopment Land Agency to acquire by compulsory purchase a small department store located in a blighted area which it is proposed to redevelop. "If those who govern the District of Columbia decide that the Nation's Capital should be beautiful as well as sanitary, there is nothing in the Fifth Amendment that stands in the way".

It is becoming increasingly evident that public acquisition of land is often an essential first step to effective planning. There are no fundamental difficulties in doing this for town extensions—though those who have followed the attempts to establish a land assembly project in Kingston will agree that there may be practical difficulties—but there are fundamental difficulties in acquiring land for redevelopment within existing urban areas. These difficulties arise from the very high values of land that are characteristic of large cities. These high land values are caused essentially by congestion or over-development and since planning actions aim at relieving this congestion there is frequently a loss in land value. In a recent redevelopment project in New York it cost $9,000,000 to acquire a site of 10.6 acres which it is estimated will have a value of only $3,000,000 when redeveloped. Few cities can afford much redevelopment at such a price even though the Federal government may absorb two-thirds of the cost as it is prepared to do under the U.S. Housing Act of 1954. I have no solution of this problem but I do know that it can be avoided if the central areas of cities remain in public or quasi-public ownership.

On the question of the price that should be paid for land acquired by compulsory procedures I am of the opinion that this should be the fair market value. If the price is less than this it is unfair to the owner and if it is more it is unfair to the public.

Thus I believe that an effective planning system requires the wide use of powers of acquisition of land by agreement or by compulsory purchase plus a readiness to pay compensation in special circumstances. Actions of this kind will cost money and it helps very little to say that good planning will save money in the long run. In the meantime we should be prepared to spend money in order to see that the right kind of development occurs in the right places at the right time. The experience of other countries, notably the United States and Great Britain, indicates that most of this money must come from central governments.

Next may I say a few words about the planners. They are a pretty motley crew and effective planning is only possible if there are well trained planners. In a recent report Professor Adams of M.I.T. has recommended that the university training for a planner should consist of three years of general education followed by three years of studies in the field of planning. In Canada today most people who have pursued any formal studies in planning have taken a one year course following graduation in some allied field and relatively few have done even that.

"Effective town planning is possible, but only if it has clearly defined objectives and only if we are prepared to proceed in a rational way . . ."

Much of the good planning that has been done in Canada during the post-war years has been done by immigrants who have brought with them a considerable breadth of knowledge and experience. If planning is to become effective it must acquire the status of a profession. This means that not only must there be adequate training for those wishing to enter this profession but also there must be continuing programs of advanced study and research. Many strange things are being done today in the name of planning and the growth of technical knowledge is slow. May I give one example—a slum area is to be cleared and redeveloped for housing. What density should be adopted in the new site —20 persons to the acre or 200 persons to the acre? What percentage of the land should be covered with buildings? How much land should be reserved for schools, shops and other ancillary uses? Some valuable studies have been made on these points by the British Ministry of Housing and Local Government but in spite of these the answer is basically that we do not know and we know comparatively little about the principles that should guide us in seeking answers.

In no field is the need for research greater than in the matter of transportation facilities. The average American citizen believes that he has a natural right to be able to drive in his own automobile to within a few feet of his destination and to leave it there until he is ready to use it again. It is becoming clearer each day that this is a physical impossibility in a city of considerable size and yet immense sums of money are cheerfully being spent on improving those facilities that cause congestion. As Lewis Mumford has recently pointed out our thinking about these problems is largely superficial. Much research is needed to discover the kinds of towns that are best suited to the age of the automobile. The very few experiments that have already been made in this field have paid off most handsomely.

Any extended discussion of planning technique would obviously be inappropriate in a paper of this kind but I would like to mention just one feature which I believe to be of basic importance to effective planning. I refer to the price tag. As engineers, we are always conscious of the importance of dollars and cents. Planners should be equally conscious but too frequently the public is asked to approve or disapprove of planning proposals without being told how much they will cost. It is not surprising that many planning schemes are gathering dust on the top shelf.

We are now in a position to answer the question posed in my title. Effective town planning is possible but only if it has clearly defined objectives and only if we are prepared to proceed in a rational way towards those objectives. This involves a recognition of the place of the planning function in democratic government, sound administrative procedures, properly qualified technical personnel and a willingness to spend money on preventing mistakes. Having said this, may I add that in my judgment planning should be compulsory in all areas where any substantial amount of development is taking place for it is only in this way that we have any chance of building the kind of cities in which we and our children will want to live. √

to November or December. The duration and intensity of this period of non-replenishment of ground water increases as we move in a southwesterly direction in the region.

It is easily seen from Fig. 4 why the farmers are becoming interested in irrigation with lake water. At Harrow, for instance from Fig. 3, it can be seen that there is a total moisture deficiency of 6.8 inches of rainfall during a period lasting from the last week of June to the first of October. National Research Council experiments have proved that calculations of the amount of irrigation water needed, based on these moisture deficiency calculations, are quite reliable and if excess water is used in irrigation above the calculated need, ponding will result.

It is evident that the water which moves laterally through ground water aquifers to be intercepted and carried away by a surface stream, or any water removed by pumping during the summer and fall months, represents a lowering of the water tables because there is no replenishment from above during this period. This lowering of the table is merely seasonal unless the pumpage represents more inches of water on the recharge area than will fall as rain following the time when the soil moisture has been replaced in November or December until the need again exceeds the rainfall in May or April.

Ground water levels rise during the period of recharge to reach a maximum elevation in the spring. A program of observing the fluctuations in the elevation of the ground water table was started in 1946 by the Ontario Department of Mines. Figure 5 shows hydrographs of water levels obtained from observation wells at Forest and London between 1946 and 1950.

There are about 22 wells in the region now under observation by the Department of Mines, but none, according to the information available, in the counties of Essex, Elgin, Huron, Bruce, Grey, Dufferin, Brant, Norfolk, Wentworth and Lincoln. It is very desirable that additional observation wells be established to enable the tabulation of this important information in all areas dependent on ground water. Several municipalities conduct their own level

Fig. 2. Map of bedrock geology (courtesy Ont. Research Foundation).

recording program and there may be some wells under observation in the counties listed by local authorities. It might be remarked in passing that once the opportunity for making a hydrological measurement has gone by nothing can be done to fill the gap in the statistical data. Increasing emphasis is being placed on statistical analysis of such data as experience accumulates proof of its value in forecasting future conditions. It is equally true of surface water resources as well as of ground water that a continuing study should be set up to capture irreplaceable data which would prove so valuable in future studies.

In the absence of information regarding the history of water table elevations it is very difficult and often impossible to know whether an aquifer is being overpumped. Evidence that wells have had to be deepened is not a reliable indication. As pumpage increases the drawdown will increase and result in a general lowering of the table so that where water once reached a shallow dug well it may no longer do so with higher pumpages from the aquifer. However, recharge may still be adequate to balance pumping plus the discharge to streams from the aquifer. The discharge to surface streams from the aquifer would be reduced in this case because of the lower hydraulic head available.

There are some areas where overpumping has occurred in the region. One known example is at Dresden where screens were placed at about 133 feet below surface. Now the water level is down to 133 feet below surface and air is entering the pumps. In this case it has been necessary to use the water of the Sydenham River.

Well drillers have been required to report to the Department of Mines on each new well drilled since 1946. Much valuable information has now been published in two reports of the Department, the latest being Bulletin 145, published in 1953, which records that in the three year period from 1948 to 1950 nearly 4,000 wells were drilled in the region, 23.7 per cent were in overburden and 66.6 per cent were in bedrock. About 4 per cent were not indicated and 5.8 per cent were abandoned or dry. Fresh water was reported in three-quarters of the wells. There are probably around 100,000 wells in total in the region divided about evenly between dug and drilled wells. It is interesting to note that in replying to a questionnaire asking their opinion as to the adequacy of farm water supplies, County Agricultural Representatives nearly all expressed themselves as satisfied with the supply.

except for short periods during the year. Haldimand County reported satisfactory quantity but unsatisfactory quality. The eastern part of Brant County was also classed as poor in this regard. Waterloo County was classified as fair in this questionnaire survey.

Use of Ground Water

Figure 6 shows some of the municipalities dependent, at least partially, on ground water supplies. There are about 70 indicated and there are at least 114 more communities, some very small, which are also ground water users. Table I shows that there are nearly 447,000 people living in these 184 communities and that there are nearly 640,000 more living on farms. Thus there are about 1,086,000 people dependent upon ground water supplies or about 60.5 per cent of the total population of the region. When the large populations of Hamilton and Windsor are excluded the percentage of the remainder using ground water rises to 75 per cent. If the rate of consumption of water by the farm population is assumed to be 30 gallons per capita per day (g.c.d.) the total consumption would be about 66.9 millions of gallons per day (M.g.d.). This is an average rate of 61.6 g.c.d. The rate for those living in the 184 communities averages 107 g.c.d. It will be noted from Table I that six counties are over 90 per cent dependent on ground water supplies. The rate of consumption

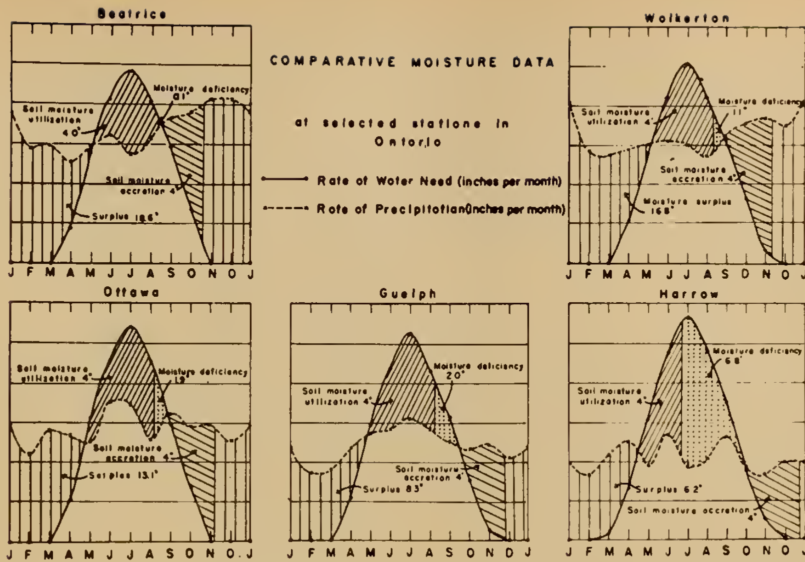


Fig. 3. Comparative moisture data (courtesy Ont. Research Foundation).

in farm areas at 30 g.c.d. does not include any water used for stock or irrigation.

Difficulties With Underground Supplies

Several municipalities in the region are experiencing difficulty in finding enough water. Frequently there is a fairly adequate supply but the quality is poor. The main cities which are concerned about getting enough water are London and Kitchener-Waterloo.

In each case there is a surface supply available. The water of the north branch of the Thames is of satisfactory quality and the use of the water impounded behind the Fanshawe Dam was envisaged by the designers of the dam. The 1953 report of the consultants on London's water supply recommended the installation of a treatment plant to treat this water.

Kitchener - Waterloo, on the Grand River, are reluctant to use this water which is polluted by upstream municipalities. Both the Thames and the Grand have waters of greater hardness than might be expected of surface supplies due to the limestone common in their watersheds.

Some of these problems are shown on Fig. 6. Among communities having quantity problems could be listed London, Kitchener, Waterloo, Aylmer, Dresden, Stratford, Leamington. The ground waters are generally hard. Cayuga has one of the hardest waters, 1900 p.p.m. (parts per million). A desirable limit is around 100 p.p.m., but 150 p.p.m. is not very hard. However, most of the communities shown on Fig. 6 have waters much harder than this. The London supply has a hardness of around 300 p.p.m. and Kitchener's supply is about 350 p.p.m.

Future Growth and Water Consumption

The principal areas of future growth for centres dependent on ground water are expected to be around London (population now 98,700), Kitchener-Waterloo (now 69,700), Guelph (now 31,000), Galt (now 22,200), St. Thomas (now 19,200), Woodstock (now 16,900) and many others. These are all manufacturing or commercial centres and are expected to continue their recent rapid devel-

Fig. 4. Average annual water deficiency in Southern Ontario (courtesy Ontario Research Foundation).

Table I. Distribution of Ground Water Consumption in South Western Ontario.

1	2	3	4	5	6	7	8	9
County	Population of County in 1954	Est. Urban Population Using Ground Water	Est. Daily Consumption of Ground Water by Urban Pop. G.P.D.	Est. Rural Population Using Ground Water	Est. Daily* Consumption of Ground Water by Rural Pop. G.P.D.	Total Population Using Ground Water	Est. Total Daily Consumption of Ground Water G.P.D.	Percentage of Total Population Using Ground Water %
1. Brant	71,633	7,505	569,000	14,272	428,000	21,777	997,000	30.4
2. Bruce	40,665	13,279	1,648,800	21,982	660,000	35,261	2,309,000	26.6
3. Dufferin	15,031	5,539	426,700	9,492	285,000	15,031	712,000	100.0
4. Elgin	53,947	7,373	601,200	25,028	751,000	32,411	1,351,000	60.0
5. Essex	238,471	14,727	1,115,800	70,712	2,120,000	85,439	3,236,000	35.8
6. Grey	60,300	14,810	1,420,600	28,370	850,000	43,180	2,271,000	71.6
7. Haldimand	24,562	5,451	144,800	14,308	429,000	19,759	574,000	80.5
8. Huron	46,984	14,985	1,234,900	26,031	781,000	41,016	2,016,000	87.4
9. Kent	84,439	9,060	636,800	40,900	1,226,000	49,960	1,863,000	59.2
10. Lambton	81,795	6,768	170,000	29,389	381,000	36,157	1,271,000	44.2
11. Lincoln	103,628	2,249	212,200	47,710	1,430,000	49,959	1,642,000	48.2
12. Middlesex	172,474	109,900	10,337,700	61,980	1,860,000	171,880	12,198,000	99.6
13. Norfolk	43,375	10,724	790,700	28,081	842,000	38,805	1,633,000	89.4
14. Oxford	60,660	34,198	3,951,100	26,462	794,000	60,660	4,745,000	100.0
15. Perth	53,130	29,479	3,889,800	22,571	667,000	52,050	4,557,000	98.0
16. Waterloo	139,047	113,352	13,221,600	25,695	770,000	139,047	13,992,000	100.0
17. Welland	144,532	2,294	200,600	66,287	1,998,000	65,581	2,199,000	47.5
18. Wellington	71,088	42,931	6,820,900	26,570	796,000	69,501	7,616,000	97.8
19. Wentworth	289,664	2,128	93,100	53,704	1,610,000	55,832	1,703,000	19.3
Totals	1,705,425	446,752	47,706,300 107 gcd.	639,544	19,178,000 * Assumed 30 gcd.	1,086,306	66,885,000 61.6 gcd.	60.5

opment. However, there is the danger that an unsatisfactory water supply might prove a limiting factor because so many industries require ample supplies of water and often have fairly stringent quality requirements for their process water. Cooling water for industry and for some types of air conditioning is becoming very important and it is likely that considerable water will be used in the future for irrigation if water is made available.

It is also expected that the rate of consumption will increase on a *per capita* basis from all causes. In the United States, the President's Materials Policy Commission estimated that between 1950 and 1975 the growth in water production would be 50 per cent for municipal supply, 170 per cent for industrial, and 25 per cent for irrigation. The *per capita* rate is expected to increase from the 1950 figure of 140 g.c.d. to 155 g.c.d. in 1975. According to the December, 1953 issue of "Willing Water" from which these figures are quoted, this can be interpreted to mean that the average city can expect a growth in population and consumer rate of use that will require it to provide 142 per cent of today's supply for tomorrow's city on an average day and possibly 235 per cent of the average 1950 day on a peak day in 1975.

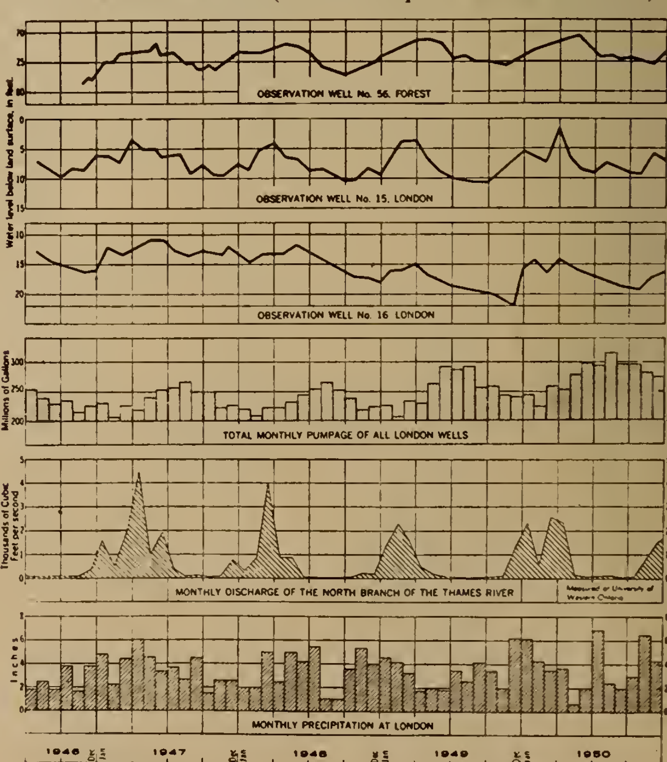
These estimates are probably quite conservative for much of southwestern Ontario. A report made in 1953 for the Metropolitan Area of London indicates a 25 year rate of growth of about 59 per cent. The daily *per capita* rate of water consumption is expected to increase from the 1953 value of 98 g.c.d. to a value in 1974 of 125 g.c.d. Consumption is expected to rise from about 12.5 M.g.d. in 1953 to 22.5 M.g.d. on an average day in 1974, which is an increase of 80 per cent in 21 years. The city is entirely metered. London is the commercial and educational centre of the region and probably reflects the growth of the rest of the region. It is likely therefore, that greatly increased demands for water can be expected from the most of south western Ontario.

In London's case the consultants found that there was no evidence of overpumping since ground water levels seemed to reflect rainfall and river flows. This was shown on the hydrographs for London in Fig. 5. They concluded that the gravel deposits in which the wells are located could be expected to supply an additional 15 M.g.d. However, the report warned that while ground water reservoir would probably meet average day demands for some time to come it would not be adequate during protracted periods of low rainfall and hot weather. At these periods the demand is higher than usual and ground water levels are declining temporarily.

Possible Solutions

London has two ways of obtaining increased water supply over and above the 15 M.g.d. mentioned above. One is by water spreading in an attempt to increase the quantity available as ground water. Another way is to treat the water impounded at the Fanshawe reservoir and pipe it to the city. Both have been recom-

Fig. 5. Hydrographs of water levels in observation wells at Forest and London (Ontario Dept. of Mines Bull. 145).



Hydrographs of Water Levels in Observation Wells at Forest and London

Fig. 6.

Treatment problems encountered in well waters in South Western Ontario.

Symbol and Meaning		Desirable Limit (p.p.m.)
H	Hardness	100
FE	Iron	0.3 (incl. MN)
T.S.	Total solids	500
CL	Chlorides	250
SO_4	Sulphates	250
MN	Manganese	0.3 (incl. FE)
	Fluoride	1.5
	Nitrate	10
H_2S	Hydrogen sulphide odour.	

mended and water spreading has already been started.

Kitchener has found four good wells about five miles out of the city. A continuous exploration program has been necessary to meet increasing demands for water despite very effective conservation measures to discourage waste.

Water spreading has also been practised at Catfish Creek in an attempt to improve the water supply for Aylmer.

The 1950 report of the Select Committee of the Ontario Legislature on Conservation made a recommendation that "a detailed survey should be made to ascertain the feasibility and costs of piping water from the Great Lakes system to be distributed as a public utility for the benefit of participating municipalities." A committee has been set up to carry out this recommended study. Such a system would ensure adequate supplies to this very important part of the Province and it seems very desirable to make a thorough study now to determine the merits of the proposal.

The 98-mile aqueduct at Winnipeg is an example from Canadian practice of a long pipeline to supply a city. A more modern example is the pipeline built in Michigan between 1946 and 1948 to serve the cities of Saginaw and Midland with water taken from Lake Huron. Before the new system was put into operation in 1948 the two cities obtained their raw water supply from the Saginaw River system.

The cities of Saginaw and Midland have populations of about 98,000 and 17,000 respectively. The total length of pipe is 78 miles. The pipe is of prestressed reinforced concrete manufactured in 16-foot lengths and hauled by truck to the site.

The common supply from the intake to the junction pumping station and reservoir is a 48-inch diameter pipe 48 miles long; this cost $20.91 per foot to supply and lay. From this junction pumping station the line branches into two 36-inch lines having a combined length of 27 miles. The junction is about equi-distant from the two cities. The 36-inch line cost $15.39 per foot to supply and lay. The total cost exceeded $10,000,000. This cost included a 2-mile long 66-inch diameter steel intake and crib, a 70 M.g.d. pumping station at the intake end, the 78-mile pipeline, another 70 M.g.d. pumping station and a five-million gallon reservoir at the junction point, plus blow-off connections, air valves, access manholes, line valves, and river crossings. Present capacity of the line is 43 M.g.d. The greatest difference in elevation over the 48 miles of 48-inch pipe is 30 feet, and over the 78 miles does not exceed 80 feet. Comparative studies led to the selection of a 48-inch pipe designed for a 300-foot head for the main line and 36-inch pipe for a 300-foot head for the branches. Most of the head results from friction losses in the pipe. The pipelines generally follow the contours of the ground with an average cover of three to four feet. The line uses county road right-of-ways for about 25 miles and state highway right-of-ways for about 40 miles. It was not found necessary to expropriate any property forcibly. Rights-of-way across numerous pieces of privately-owned land were purchased by agreement on price with the owners.

Small communities along the line have the privilege of connecting to outlets provided for them and service connections were provided for in front of all homes and business establishments along the highways. At the end of 1954 there were over 600 such connections, 200 of which are on the 48-inch line. The raw Lake Huron water contains about 5 grains or about 86 p.p.m. hardness. The water is chlorinated at the Whitestone station at the intake end of the line and is conditioned in the existing plants in Saginaw and Midland. Even though the water may be in the pipe for 24 hours or more before reaching the customer there is very little change in its temperature.

This is quite a different problem from that facing pipeline planners in southwestern Ontario. The main difference is that there is a high lift required to reach many of the inland cities. Lakes Huron and Erie have elevations of about 580 and 572 ft. respectively. The elevation at Kitchener-Waterloo is about 1,100 feet, at Stratford nearly 1,200 feet. Galt, Preston and Woodstock are around the 1,000-foot contour and London is around 800 feet. Static lifts, therefore, are quite high ranging from around 225 for London to over 500 feet for some of the cities on the high ground in the interior of the peninsula.

There will probably be much discussion of the relative merits of treating the water at the source or of treating it in local treatment plants. Water treated before it enters the pipeline would make it possible to service consumers along the right-of-way through pressure reducing valves. A single plant would be more economical than a number of small plants. On the other hand, a single large plant is more vulnerable to damage, accidental or due to enemy action, than a large number of well dispersed small plants would be. Also in the event of a breakdown in the raw water supply due to either mechanical breakdown or contamination of the lake water by some weapon releasing radioactivity the small local plants could treat local supplies until the emergency had passed. An additional advantage of pumping raw water might be the saving in treatment costs for water not used for human consumption. This might apply to water for many industrial purposes and for irrigation.

The question of reliability of supply is a prime consideration and perhaps at a later stage a system of pipes will be in service linking the two lakes so that the main centres can receive water from either lake. In the event of a break in one main line it would then be possible to obtain enough water from the single line to serve during the emergency. Numerous reservoirs would also provide protection against interruption of supply.

Conclusion

In conclusion it may be said that there is a critical situation as regards ground water supply in the region. Problems exist in regard to both the quantity and the quality of the water. There is no evidence of overpumping except in very small areas. Many important cities whose welfare is a matter of vital concern to the province as a whole are dependent on supplies which at best are uncertain. Because of the poor quality of the ground water in many cases it does not seem advisable to look for a long term solution to the problem in terms of ground water.

The appointment of a provincial committee to study means of distributing lake water to the inland cities is a welcome development.

It is to be hoped that existing legislation in the western states, applicable to the use of ground water, will be reviewed to determine whether or not changes are needed in our own legislation to obtain the best use of ground water resources. If the pipeline plan does become a reality there may be a tendency on the part of the public to take less interest in stream sanitation. A program of public education on the value of clean streams will help to prevent this attitude arising.

Careful consideration should also be given to the benefits to be derived from the use of multiple purpose storage reservoirs at strategic positions along our inland watercourses. These would increase the elevation of the water table and conserve water by reducing excess run-off. They would also have many conservation and recreational advantages which do not enter into the ground water problem except in so far as they represent competing interests in the facilities provided by the reservoir.

I would like to express my grateful acknowledgement to the many people who have supplied information for this paper. The diagrams dealing with moisture relationships and the physiography of the region were supplied by L. G. Chapman of the Ontario Research Foundation. Dr. A. E. Berry and G. M. Galinbert of the Department of Health for Ontario were most kind in supplying advice and data. Much of the data on water use and quality came from the records of the Water Resources Survey of Ontario which was carried out by the Department of Health. A. K. Watt of the Department of Mines was most helpful personally and considerable use was made of his published work including the diagram of water level fluctuations at Forest and London. James F. MacLaren Associates very kindly aided in the production of some of the diagrams and in the typing.

THE DESIGN OF

COMPRESSED BEAMS

The paper presents a method of design for compressed beams; that is, beam-columns. The author's solution is based on a rigorous theoretical analysis and has been confirmed by tests. Intended for plastic design, the solution is also applicable to conventional elastic design.

D.T. Wright

Department of Civil Engineering,
Queen's University,
Kingston, Ont.

Conventional methods of designing steel skeletons for buildings are based upon elastic theory. These methods, or rather the philosophy behind them, evolved before the nature of steel as a structural material was fully understood. Although materials such as cast iron are brittle and must be designed to behave elastically, structural steel is ductile — it can deform without either fracturing or losing strength. This quality sets steel apart from most other materials, and provides a basis for more realistic design methods.

The work of the Steel Structures Research Committee[1] some 20 years ago showed conclusively that real stresses in steel skeletons bear virtually no resemblance to stresses predicted by elastic theory. If, as the elastic theory postulates, a structure failed when the elastic limit was reached anywhere in it, then virtually every structure standing can be said to have failed. That steel structures do not really fail, or collapse, depends upon the ability of mild steel to yield, to suffer large deformation past the elastic limit with no decrease in strength.

The simple plastic theory of structures which has been developed in Cambridge by Professor Baker and his associates attempts to provide a rational basis for the design of steel frames. The theory is based upon a consideration of the actual mechanics of failure of structures made of ductile material[2, 3]. The design methods derived by the plastic theory are different from conventional design methods in that they are based upon conditions of collapse rather than on the attainment of stresses equal to the elastic limit. That is, plastic theory applies a safety factor on load to prevent collapse, whereas elastic theory applies a safety factor on stress to prevent yielding. The significance of the difference is that for complex structures, loads considerably greater than those required to produce local yielding are required to cause undesirable deformations and collapse. Conventional elastic design neglects an appreciable part of the strength of redundant structures. However, the most important advantage offered by plastic theory is that it is realistic. Whereas stresses predicted by elastic theory are different generally from those measured in real structures, collapse loads predicted by the plastic theory give an accurate estimate of failure conditions.

In its present state of development the plastic theory provides for the analysis and design of flexural members and structures made up of flexural members. Compression members have also been studied, but general methods for their design are not yet available.

In fact, very few structural members are subjected to either pure flexure or pure compression. In building frames, most members are subjected to some combination of flexure, shear and axial load. Shear effects on beams have been determined[4]. The present work is concerned with the effects of axial compressive forces on flexural members.

Because of space limitations only an outline of the work can be presented. What follows is a discussion of conventional design methods for beam-columns, an outline of the plastic theory analyses, and a proposed design method which can be used either for conventional design, or for plastic design.

Elastic Analysis and Design

Members subjected to combined flexure and axial compression are known as beam-columns. Such members are common in most structures particularly so, perhaps, in rigid frames where the elimination of trussing induces moments in members. The design of beam-columns is customarily based on approximate formulae because of the difficulty of exact analyses. To be complete an analysis of beam-columns must take into account three effects: the axial load, the bending due to the transverse load, and the bending due to the eccentricity of the deflected member from the line of the axial compression. It is this last which introduces most of the difficulty.

Maximum stresses in members subjected to combined loading may be determined by means of the familiar formula

$$f = \frac{P}{A} + \frac{M}{S} \quad \text{..............} (1)$$

where f is the stress, P the axial load, A the cross-sectional area, M the bending moment, and S the section modulus. Equation (1) leads to correct values of maximum stress only if M is taken as the total moment

$$M = M_W + P\delta \quad \text{...........} (2)$$

where M_W is the moment due to the transverse load, W, and δ is the deflection. The deflection depends upon the magnitude and arrangement of the transverse load as well as upon the magnitude of the axial load, the moment of inertia of the section, and the length of the member. No simple way of determining δ is available. For a few cases formulas are known and have been tabulated[5], but because of complexity these are not often used. Only in the design of aircraft structures are accurate stress analyses generally made for beam-columns.

For ordinary structural design a simpler approach is required. Most standard specifications and building codes in Canada, Britain and the United States suggest that beam-

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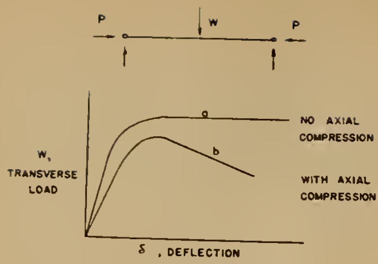

Fig. 1 (left). The behaviour of a compressed beam.

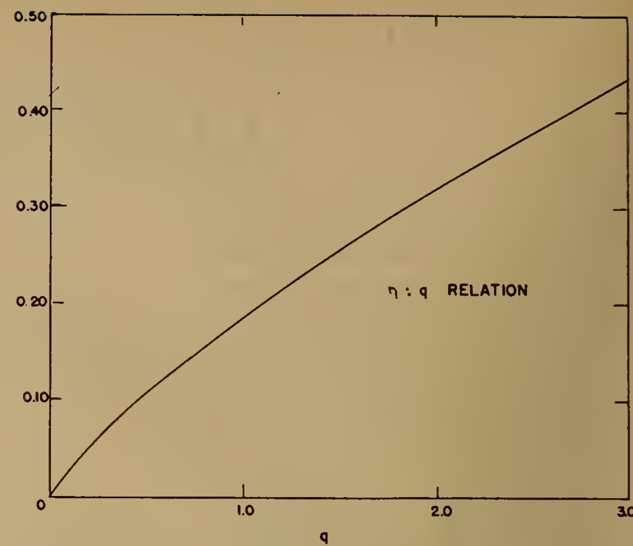

Fig. 2. Relation between η and q for a simply-supported beam of rectangular cross-section carrying a uniformly distributed transverse load (see equation 7).

columns be proportioned to meet the condition

$$\frac{f_a}{F_a} + \frac{f_b}{F_b} \ngtr 1 \quad \ldots\ldots\ldots\ldots (3)$$

where f_a and f_b are the simple axial and bending stresses in the member, and F_a and F_b are the permissible column and beam stresses. Equation (3) is generally known as the "interaction" formula although in fact it only expresses an interpolation between the conditions

$$\frac{f_a}{F_a} \ngtr 1 \quad \ldots\ldots\ldots\ldots (4)$$

and

$$\frac{f_b}{F_b} \ngtr 1 \quad \ldots\ldots\ldots\ldots (5)$$

according to which simple beams and columns are designed. As equation (3) is ordinarily used, interacting effects are actually *neglected.* The value of f_b is taken as M_W/S and the flexural stress due to the additional moment $P\delta$ (see equation 2) is not considered. Further, no account is taken of whether the axis of bending for M_W coincides with the axis about which column instability is expected. That is, in equation (3), F_a is always determined from the maximum slenderness ratio of the member even though this may not be the same axis as that about which the transverse load causes bending. Consider a member subjected to an axial load; surely deflections will be greater and failure nearer at hand if a bending stress f_b is applied about the column's "weak" axis than if it is applied about the column's "strong" axis. Yet the method of equation (3) does not distinguish between these cases.

The most important virtue of equation (3) is that it provides a smooth interpolation between the simpler cases of pure compression and pure flexure (equations 4 and 5). This alone does not appear to be reason enough for its acceptance. Neither is the fact that the formula has been used extensively and has not led to failures. The factors of safety provided by standard specifications both by specified working loads and specified maximum stresses are large enough to prevent failures even when design methods are grossly inaccurate. The most desirable criterion for a design method is that it provide a truly uniform factor of safety. It is obvious that equation (3) does not meet this requirement.

Plastic Analysis

Just as an accurate elastic analysis of beam-columns is found to be complex so plastic theory analyses are also found to be complex. For convenience the problem can be divided into two parts, depending on whether beam or column action is dominant. The present discussion is concerned only with the strength of compressed beams, where axial loads are small enough that beam behaviour defines the mode of failure.

The effect of axial compression on a beam made of an ideally plastic material is shown in Fig. 1. The upper curve, (a), is for a beam with no axial load: as the transverse load, W, increases the central deflection increases, proportionately at first up to W_y, the yield load, and then more rapidly as yielding increases. When the fully plastic load, W_p, is reached deflections increase indefinitely. This is characteristic of the flexural behaviour of any beam under any arrangement of transverse load, provided that lateral instability is prevented. The lower curve, (b), indicates the effect of a constant axial compression on the behaviour of a beam. As the transverse load increases elastic deflections are somewhat larger than in the previous instance, but the same pattern is repeated until a point is reached in the partially plastic state where the rate of increase in moment due to the increasing eccentricity of the beam from the axis of the compression load is greater than the rate of increase in bending resistance offered by increased deflection. At this point the beam becomes unstable and is said to have buckled. The maximum transverse load carried by a compressed beam is called the critical load, W_{cr}.

To determine critical loads it is necessary to study beam deflections in order to find the critical deflection, Y_{cr}, and the extent of yielding corresponding to Y_{cr}. For the cases which have been studied it was found most convenient to express the result, W_{cr}, in terms of W_p, the load that a beam could carry in the absence of axial compression. All the results obtained so far have been in the form

$$\frac{W_p - W_{cr}}{W_p} = \eta + \left(\frac{f_a}{f_y}\right)^2 \quad \ldots (6)$$

where f_a is the average axial stress (as in equation 3), f_y is the lower yield stress, and η is a function depending upon the particular details of beam section and transverse load arrangement.

Values of η have been determined for beams of rectangular- and I-section, for uniformly distributed and concentrated transverse loads, and for simple and restrained ends. In each case a general expression for deflection was first found by integrating curvature functions, then critical deflections were solved. The results are in the form of power series which though cumbersome are reasonably accurate. Certain minor simplifying assumptions made in the analyses have been shown to have no serious effect on accuracy by means of both separate special analyses and experimental verifications.

The solution for a typical case — a simply supported beam of rectangular cross-section carrying a uniformly distributed transverse load — is outlined in the appendix. The result for this case is

$$\eta = -0.0504\, q \log q + 0.170 q + 0.0161\, q^{3/2} + 0.0006\, q^2 \quad \ldots (7)$$

where

$$q = \frac{f_a}{E}\left(\frac{l}{r}\right)^2 \quad \ldots\ldots\ldots\ldots (8)$$

and E is Young's modulus, l the length, and r the radius of gyration about the axis of bending. From equation (7) it is seen that η is a function of a single parameter, q, which in one term expresses all the significant variables. It should be noted that

$$q = \left(\frac{f_a}{f_e}\right) \quad \ldots\ldots\ldots\ldots (9)$$

where f_e is the Euler stress.

For other cases involving beams of rectangular section expressions similar to (7) were found. For beams of I-section, however, two additional variables expressing shape characteristics entered the expressions for η. The effect of two extra variables on expressions already more complicated than (7) would appear to render the solutions useless because of excessive complexity. Fortunately, the first of these shape factors was found to be virtually constant for standard rolled sections, and the second shape factor, though having a marked effect on critical deflections, had an insignificant effect on the η:q relation. For all problems of practical interest then, critical loads could be expressed as in equation (6), with η as a function of only the one variable, q.

Figure 2 shows the η:q relation corresponding to equation (7). Similar curves were obtained for each case studied. Although useful in this form, simpler presentations are preferable for design. It was found that the η:q relation could be approximated with reasonable accuracy as

$$\eta = 0.19\, q^{3/4} \quad \ldots\ldots\ldots\ldots (10)$$

for all the cases studied. Using equation (10) it is possible to rewrite equation (6) as

$$\frac{W_p - W_{cr}}{W_p} = 0.19 \left\{ \frac{f_a}{E} \left(\frac{l}{r}\right)^2 \right\}^{3/4} + \left(\frac{f_a}{f_y}\right)^2 \quad \ldots\ldots\ldots\ldots (11)$$

Because of the approximations introduced by using equation (10) rather than the accurate η:q formulae, equation (11) is not exact. The errors are small however, and the advantage gained by having a single expression for the effect of axial loads on beam strength is important. It should be noted that equation (11) is in terms of ultimate and critical loads rather than working loads.

As a check some 16 tests were performed on beams of rectangular- and I-section. Figure 3 shows the testing frame that was used for the purpose. Loads were applied by hydraulic jacks and measured by standard load capsules. The variables included axial compression, slenderness ratio, and end fixity. As control, eight other beams were tested with zero axial load. The results verified the analyses satisfactorily. Of the 16 test beams, three suffered failure due to lack of lateral restraint, and three more exhibited strain hardening which tended to obscure critical load peaks. For the remainder the maximum difference between predicted and measured values of W_{cr} was 6 per cent, and the standard deviation for all the tests was 3 per cent.

Fig. 3. Test arrangement.

Design

As it stands, equation (11) is suitable for use in design by the plastic method where structures are proportioned so that collapse is about to occur when loads reach values equal to the product of load factor and working load. Equation (11) may also be applied to conventional "elastic" design, even though it is based on failure conditions rather than on elastic stress analysis. It may be noted that such common structural components as columns and riveted joints are designed not on the basis of exact elastic analysis but rather on the basis of simple average stresses with specified limits based on interpretations of ultimate load tests.

The factor of safety against collapse which is provided by conventional elastic beam design is

$$\frac{f_y}{f_b} \times \frac{Z}{S} = \frac{33}{20} \times 1.15 = 1.90$$

where f_y is the yield stress, f_b the allowable bending stress, and Z and S are plastic and elastic section moduli respectively. If a factor of safety of 2 is applied to equation (11), the result will provide greater safety than is ordinarily provided by simple beams. Using

$$\frac{W}{W_p} = \frac{S\, f_b}{Z\, f_y}$$

and a load factor of 2, equation (11) in design form is

$$\frac{f_b}{F_b} + \left(\frac{f_a}{F}\right)^2 + 0.30\left(\frac{f_a}{E}\frac{l^2}{r^2}\right)^{3/4} \not> 1 \quad \ldots (12)$$

where F is the permissible axial stress F_a corresponding to zero slenderness ratio, and the other terms are as have been defined previously. In the last term the slender-

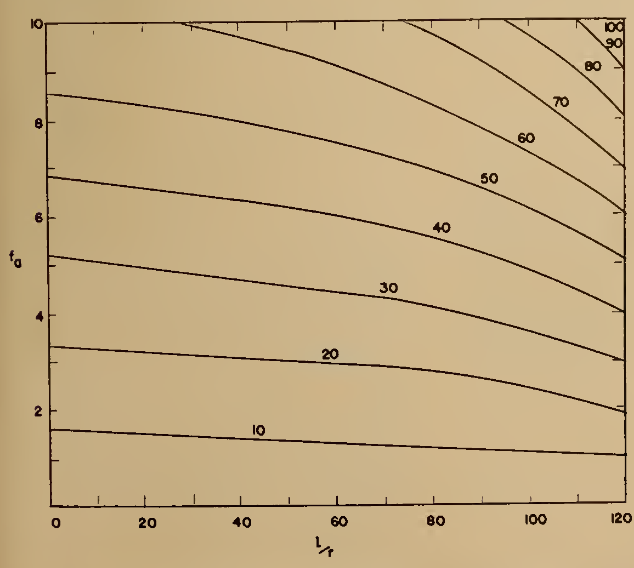

Fig. 4. Graphical solution of equation (3) showing percentage reduction in beam strength in terms of axial stress (f_a in ksi.) and slenderness ratio (l/r).

ness ratio, l/r, must be calculated for the axis about which flexure occurs due to the transverse load.

It is of interest to compare equation (3) with equation (12). Figs. 4 and 5 show the effects of axial stress and slenderness ratio on beam strength according to the two equations. For Fig. 4 the values of F_a have been taken from the AISC column formula. The lines in the figures are contours of effect: for instance, at any point along the line marked 30, the beam strength has been reduced by 30 per cent — that is, the permissible flexural stress, f_b, is 70 per cent of F_b. Comparing Figs. 4 and 5 it may be seen that equation (3) is much less sensitive to slenderness ratio than to axial stress; this is in contrast with the effect of equation (12). For values of l/r less than about 70, the true factor of safety using equation (3) and the AISC column formula is greater than 2. (For $l/r=20$ and $f_a=10$ ksi, the true factor of safety against collapse is 2.30). But for l/r greater than 70 conventional design becomes unsafe. (For $l/r=120$ and $f_a=8$ ksi, the factor of safety is 1.50.)

Although equation (12) appears much more formidable than equation (3), it should be noted that for (3), F_a must first be calculated from the slenderness ratio according to the applicable column formula whereas no such extra step is necessary with (12). Considering this there would seem to be little extra effort involved in using (12) rather than (3). Time may also be saved by using graphical solutions in the form of Figs. 4 and 5.

Limitations

Equation (12) is intended to apply to only a part of the beam-column problem. For axial stresses greater than about 12 ksi equation (12) becomes inaccurate. The present work is not applicable either to cases where transverse load causes flexure about one axis and failure occurs by buckling or twisting about the other axis, as for instance due to lateral instability.

Acknowledgments

The work described in this paper was carried out by the author at the Engineering Laboratory, Cambridge University, under the direction of Professor J. F. Baker and Dr. M. R. Horne. The work was supported by the British Welding Research Association and the author held an Athlone Fellowship at the time.

Appendix

Consider a simply supported beam of rectangular cross-section, breadth b and depth $2d$ with a span of length $2l$ subjected to a uniformly distributed transverse load w and an axial load $P=2\,pbd$, where p is the average axial stress. Taking coordinate axes such that the origin is at midspan on the axis of the undeflected beam, the moment can be written as

$$M = \frac{wl^2}{2}\left(1-\frac{x^2}{l^2}\right)+P\delta \quad \ldots (a)$$

where δ is the deflection. If δ is assumed to have a parabolic form (the actual form is not important, only the magnitude of the central deflection is important), (a) can be rewritten as

$$M=r^2M_p\left(1-\frac{x^2}{l^2}\right) \quad \ldots\ldots (b)$$

where r is a parameter defined as

$$r^2=\left(\frac{wl^2}{2}+Py_o\right)/M_p \quad \ldots (c)$$

and y_o is the central deflection. As the critical load, W_{cr}, is approached the central portion of the beam will have suffered some yielding, but the ends will still be elastic. In the elastic region ($x_1 \leqslant x \leqslant l$), noting that $I=2bd^3/3$ and $M_p=bd^2f_y$, the curvature is

$$\frac{d^2y}{dx^2}=-\frac{M}{EI}=-\frac{3f_yr^2}{2Ed}\left(1-\frac{x^2}{l^2}\right) \quad . (d)$$

In the partially plastic region ($o \leqslant x \leqslant x_1$), where the depth of the elastic core is $2t$, the moment of resistance is

$$M=M_p\left(1-\frac{t^2}{3d^2}\right) \quad \ldots\ldots (e)$$

for small values of p, and the curvature is

$$\frac{d^2y}{dx^2}=-\frac{f_y}{Et}=$$

$$-\frac{f_y}{\sqrt{3}\,Ed}\cdot\frac{1}{\sqrt{1-r^2+\frac{r^2x^2}{l^2}}} \quad (f)$$

Integrating (d) and (f) gives the central deflection

$$y_o=\frac{f_yl^2}{Ed}\left\{\frac{1}{\sqrt{3}\,r}\sinh^{-1}\frac{\sqrt{r^2-2/3}}{\sqrt{1-r^2}}+\right.$$

$$\frac{\sqrt{1-r^2}}{\sqrt{3}\,r^2}-\frac{\sqrt{r^2-2/3}}{3r}(3r^2+1)$$

$$\left.+r^2-\frac{1}{2r^2}\right\} \quad \ldots\ldots\ldots\ldots (g)$$

in terms of the parameter r. Differentiating equation (c) and noting that $dw=0$ when $W=W_{cr}$ gives

$$\frac{dy_o}{dr}=\frac{2M_p}{P}r \quad \ldots\ldots\ldots\ldots (h)$$

Expanding equations (g) and (h) in powers of $(1-r^2)$ permits r_{cr} to be determined in terms of q (see equation 8)

$$r^2_{cr}=1-0.0481q-0.0089q^{3/2}+0.0079q^2 \quad \ldots (j)$$

The reduction in strength is

$$\left(1-r^2_{cr}+\frac{Py_{ocr}}{M_p}\right) \quad \ldots\ldots\ldots (k)$$

Using (j) and (k) the expression given as equation (7) is found.

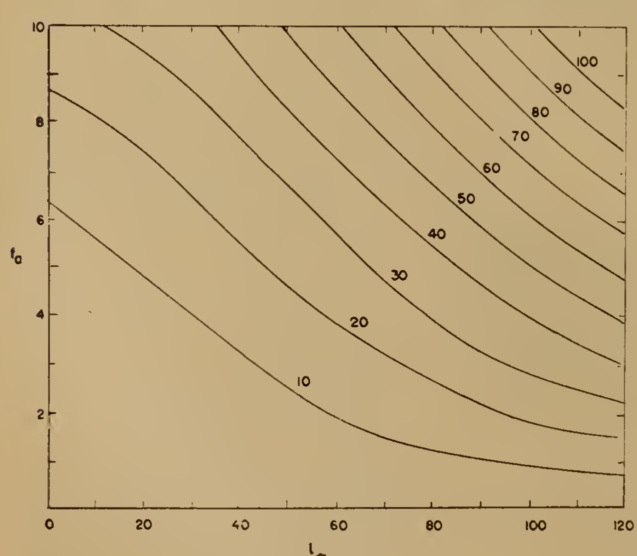

Fig. 5. Graphical solution of equation (12) showing percentage reduction in beam strength in terms of axial stress (f_a in ksi.) and slenderness ratio (l/r).

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The Professional School in the University

C. T. Bissell,
Vice-President,
University of Toronto.

> **Dr. Bissell was the dinner speaker at the 23rd annual meeting of the Engineers' Council for Professional Development, held in Toronto in October 1955. A somewhat condensed version of his remarks is presented here. This we think will be of interest to all engineers, but particularly to those not long out of college or who have recent graduates under their direction.**

I bid welcome to our American guests with the sense of gratitude that those of us in university work feel towards American universities for the unquestioning generosity that they have always extended both to our students and to the members of our staffs. Between Canadian and American universities there is no problem of communication. There is such an unimpeded interchange between them that no danger of misunderstanding from ignorance ever arises. Many Canadian university teachers were trained in American graduate schools, and some have taught in American universities before returning to their native country. I think of Cornell as my second alma mater, and I take pride in her this evening, for I gather that she is not totally without distinction in the field of engineering. With the development of our own graduate schools, we are attracting an increasing number of students from American universities, so that the academic traffic between the two countries will soon be more evenly balanced. In one respect the balance has already been redressed, since a good many of your engineering graduates are coming to us for 'postgraduate work' of a remunerative variety in Canadian industry, in the oil fields of the west and in the immense mining development to the north.

The Engineers Council for Professional Development is, as I see it, a synthesis and concentration of the work of eight influential professional engineering bodies. It constitutes a formidable witness to the powers of intelligent organization that inhere in your profession. I doubt if any profession has so many professional societies, all firmly established and some, by the standards of this continent, ancient and venerable. The aims of the Engineers Council, as set out in your charter, are not narrowly directed towards the preservation of status and the circumscribing of the profession with rigid rules and regulations. The Council 'looks before and after, although it does not pine for what is not'.

You are concerned with the young man who is about to make his choice of a career—with placing before him a clear and yet imaginative picture of the role of the engineer as he leaves university and enters upon his work. You represent engineering bodies concerned about engineering bodies. Rightly, you are intensely interested in the educational bodies that train the engineering bodies—I mean the universities—since in Canada and in the United States the university is the custodian of professional training for the engineer. I am sure I speak for all universities when I say that we welcome your interest and your support. You represent in your council a healthy union of the theoretician and the practitioner. We can learn much from those who in the daily discharge of their duties see the product of a university course in action, and observe him as he is tested by practical problems and by the mysterious dynamics of human situations.

Yet I think that I am also speaking for the universities when I observe that it would be a pity if the centre of educational thought were to shift from the universities themselves to any outside body, no matter how reputable and wise that body might be. The final decision about university policy must be made within the university, by men and women who have devoted their lives to education and who are in a position to see the ramifications throughout the whole university of a policy shift in one of its parts. Most of you here will be aware of one difference in attitude between Canadian and American universities with respect to the ordering of professional education. We are suspicious of the value of the system of accrediting by outside organizations. In most cases there can be no doubt of the wisdom of those who carry out the accrediting of universities, and it is not the bodies concerned with accrediting that we would challenge. It is rather the implications of the system for the university. A university worthy of the name is an organic whole in which the various faculties and schools have vital interrelationships. If two or three of these faculties are subject to a system of accrediting, then they are subject to external pressure that may well disturb the welfare of the whole. As some of you will know, this has been a serious problem for some American universities, where accrediting agencies have attempted to prescribe the curricula and to scrutinize appointments to the staff under the threat of academic excommunication.

Since the university is an organic whole, no one faculty should be sharply marked off from another. Any tendency towards fragmentation, no less common in universities than in other areas of contemporary society, must be resisted. I think we can resist it in the university by constant emphasis upon the aims of higher education common to all departments and divisions, in other words, on the fundamental unity of knowledge. It is unfortunate that there should be such a marked distinction drawn between professional and liberal education . . . 'professional' is not an evil word. All higher education is professional in the sense that it seeks to combine certain general qualities of mind and heart with the mastery of a specific area of knowledge. That area of knowledge, of course, varies from faculty to faculty. But whether it involves a knowledge of the scansion of Greek verse or of the principles of hydraulics, it is still a specialized area of knowledge.

Professionalism

Professionalism has a long and honoured history in the development of the university. There are those who say that professional schools have no place in a university; that their expensive instruction saps the strength of the institution and that their aim of practical proficiency contributes little to the welfare of higher learning. Anyone who speaks in this way betrays a lamentable ignorance of the history and development of higher education. Training for the learned professions has been a responsibility of universities since the twelfth century. Bologna's law school, the medical centre at Salerno and the theological schools of Paris wielded a remarkable influence throughout the later mediaeval period. The professional schools, however, leaned heavily on the faculties of arts. There was established in those early days a primacy of the studies in arts that has been a continuing feature of higher education. In theology, for example, the mediaeval universities related the life of the spirit to that of the intellect and produced the great philosophers of the period. In the same way, the practice of medicine was ennobled by its marriage to liberal education and the medical profession thus attained its status as a learned and respected group. Professionalism in the early universities always involved the close interrelation betwen specialized knowledge and general qualities of mind.

Two Conditions

With this general proposition in mind, I would suggest two conditions that professional schools should try to meet. The first is that they must never lose sight of the importance of the general qualities of mind that should be common to all faculties—incisiveness of expression, powers of organization and of logical thought and willingness to reserve conclusions until the facts are all in, and their correlatives on the side of character — tolerance, humility and empathy. Now it is possible, I think, for these qualities to be developed in the teaching of any subject up to a point. You have all had experience of the vast gap that exists between the methods of two instructors in the same subject, where one is enmeshed in details that seem to have no relation outside of themselves, and the other is exhilarated—and exhilarating—by keeping before him broad relationships and ultimate goals.

The distinction is not between two types of mind, but between two ways in which each person's mind should be used, depending upon the subject-matter he is considering. To learn and to apply the 'law of things,' a man needs what Pascal called *l'esprit géométrique;* to learn and to apply the 'law of men', he needs *l'esprit de finesse.* Problems which are susceptible of systematic treatment, that is, the measurement of mass, or space, or time and the classification and interpretation of results, call on us to use *l'esprit géométrique.* On the other hand, the subtler facets of experience, which cannot be handled with the same rigour and confidence, must be examined in *l'esprit de finesse.* In university work, the subjects which develop in student's *l'esprit de finesse* are the humanities and work in the social sciences. For a number of reasons, the problem of relating specialized knowledge to general qualities of mind is particularly acute on the North American continent.

In all of the reports on engineering education that I have read recently, there is unanimous agreement that the humanities and social sciences should occupy an important place in the curriculum of an engineering student. As I recall, there was agreement that this element should constitute one-fifth of the curriculum; and the mathematical neatness of that conclusion prompts me to pay further tribute to the genius for organization displayed by your profession: twenty percent liberalizing yeast should be adequate to leaven the engineering loaf. Here at the University of Toronto—and I gather the practice is fairly common—we meet this need for general education by including in the curriculum during the four years of professional education a number of courses in the humanities and social sciences. There are some doubts in my mind as to whether this technique of diffusion is really the best way to meet the problem of general education. If courses in the humanities and in the social sciences are squeezed into a day that is otherwise solid with labs and lectures in professional courses, they must of necessity assume a secondary position in the students' mind.

Meeting the Difficulty

There are two possible ways of meeting the difficulty. The first way is one with which many of you are familiar, namely, a pre-engineering year or two, which, in addition to giving instruction in the humanities and social sciences, emphasizes the basic natural sciences. The argument against this is, of course, that the needs of the country for engineers are so urgent that it is uneconomical and wasteful to extend their period of training beyond what is absolutely necessary. The argument in favour of this procedure is that it does give the student the benefit of more continuous exposure to the humanities and to the social sciences, and, although involving a longer undergraduate course, produces professional men who are alive to their responsibilities as thinking members of society.

The second possible approach is one which may sound Utopian and impractical, but which could be given a trial. In brief, it involves bringing graduates in engineering back to the university for a concentrated course in the humanities and social sciences after they have had a few years' experience in the profession. It would, of course, be impossible to make this compulsory, so that my suggestion really applies only to those who have manifested leadership in their calling. My suggestion is not entirely a theoretical one, since it has actually been tried at one American university, though the course was not restricted to the engineering profession. Some of you may have read about it a year ago in *Harper's Magazine*. An Institute of Humanistic Studies was set up at the university for young executives in a large American corporation. Given the trends in modern business, I suspect that the majority of them were engineers. They were subjected for ten months to an intensive course in the humanities, under a curriculum that made unflinching demands upon their powers of concentration and assimilation. Judging by the comments of some of the graduates of this Institute, the course did not induce imaginative flights of impractical speculation. It seems to have contributed to a surprising degree toward the maturing of these men, and certainly towards their efficiency as executives.

One man wrote: "I have been much more efficient in organizing the relevant facts and placing alternative courses of action in sharp focus. Although I now see more angles and am less sure that any particular decision is the right one, I am aided in making it by the realization that there is probably no one right solution to many problems. I am now much less upset, and more able to learn, by mistakes."

I said earlier that there were two conditions that professional schools should try to meet, the first being the interrelation between specialized knowledge and general qualities of mind. The second condition is one that your various committees have also discussed, reaching conclusions that most educational thinkers would endorse. Professional education must emphasize the 'know why' as opposed to the 'know how'; it must be concerned with fundamental principles and not merely with the application of those principles. Although this concept is, I think, generally accepted, we have a tendency in our curricula not to apply it; instruction proceeds with melancholy clock-like precision from one class to another throughout the teaching day. It is easy for administrators, especially if they have been trained in an arts faculty where teaching hours are only a small portion of the day, to make these critical comments. Still I am convinced that unless a professional student has the time in which to absorb, and to reflect upon, basic principles, he cannot emerge either as an intelligent citizen or as a good professional worker.

Discussions of the philosophy of professional education must today be made in the light of the 'painful reassessment' of university policy consequent upon the vast increase in numbers that we all face. Recently there has been great publicity given to what should not be designated a 'bulge' in enrolment—a bulge has an end, as well as a beginning and a middle—but which should more properly be called the reaching of a new plateau. Most of you are familiar with the American statistics which indicate that the present university population of two and a half million may reach five million by 1965. The Canadian statistics are less overwhelming, but none the less challenging. It is estimated that the present percentage of persons of college age who go to college—7.2 per cent—will rise within the next ten years to 9, 10 or 11 per cent; and that this trend, combined with the increasing population, will give us a university population of from 110,600 to 135,200 instead of the present 65,600.

"The melancholy predictions . . . that we would be flooded with engineers have been confounded by the facts of our industrial development."

Our problem is not simply a problem of finding the money for the necessary expansion; it is also a problem of re-examining our human resources so as to make sure that the sums spent on education are spent on those people who are capable of using it to best advantage. Engineering faculties will have to face this problem perhaps sooner than any other faculties in the universities. Is it not our responsibility to examine more critically than we have the different kinds of education that may be necessary for the training of engineers?

In Canada and in the United States we have made engineering education almost entirely a university concern. In Europe and in Great Britain there has been a distinction between engineering training in the universities and engineering training in the technological institutes. I am aware that there is an ambiguity in the use of the designation 'institute of technology', and that some of these institutes are in their own right great universities.

The kind of technological institute to which I refer is one which does not concentrate on general principles, but rather on the application of general principles to particular situations. Is there not a likelihood that many of the students who now find their way into universities should be encouraged to go to such institutes? In this way we may salvage something of the waste which occurs in the first year of our engineering courses as a result of the student's inability to cope with the basic theoretical disciplines. We shall ensure that our universities are concerned with their proper task—the training of keen minds in fundamental principles. And we shall be making a discerning contribution to the problem of 'numbers' and the university. This setting up of two different kinds of institutions for training engineers can be done without suggesting that one is necessarily inferior to the other. We should endorse a recent report on technology in British universities: "The difference between the two types of institution is not in status or grade but in kind."

Of one thing we are sure: there is no possibility in the foreseeable future that the supply of engineers will exceed the needs of this country and of the United States. The melancholy predictions made during the early postwar years that we would be flooded with engineers have been confounded by the facts of our industrial development. The engineering profession has never before occupied a position of such power and influence. It is all the more incumbent upon it to respond adequately to its responsibilities. √

DISCUSSION

of Technical Papers

The Helicopter and the Engineer

by
W. H. D. Hanchet, M.E.I.C., Doman-Fleet Helicopters,
Fort Erie, Ont.
The Engineering Journal, December 1955 issue, page 1643.

T. J. Burgess[1]

In discussing Mr. Hanchet's paper "The Helicopter and the Engineer" I shall present my views as a representative of the Ontario Hydro which as you are aware is an operator of helicopters for transmission line patrol.

With vast sources of hydro-electric energy available to the Province of Ontario, it was only natural that high voltage transmission networks would eventually extend across the province linking the distant sources of generation with power loads in the industrial south of the province. Likewise the rich mining areas and extensive pulp, paper and timber industries extending from one boundary to the other across our extensive northland caused long distance power transmission lines to spread from Hydro developments to wherever industry led.

The Ontario Hydro today has some 8,000 miles of high voltage (115 and 230-kv.) transmission lines. Much of this transmission is over rough and isolated country, and because of its primary importance to the huge power pools of the province requires ever careful inspection and preventive maintenance. The early methods of power line patrol soon proved time consuming and costly, and something more efficient was required. We had some experience with conventional aircraft for this type of inspection and while these had their place, some vehicle of slower motion for more detailed and careful inspection was desirable.

The helicopter was tried on an experimental charter basis during the fall of 1948 and the winter of 1949, and the results appeared promising. In June 1949 we purchased a three place helicopter and commenced power line patrol in a modest manner. Immediate results were gratifying. With slow patrol speeds of 40 to 45 miles per hour, very careful inspection of towers, insulators and conductors could be made, and soon we were locating minor defects hitherto missed on ground patrol. I remember the search for many months by ground patrol over 60 miles of 115-kv. steel tower line from one of our northern plants to explain interruptions every time a heavy wind blew. Conductor loops, dead-ends and clamps were minutely inspected by walking patrol and no explanation found. The first patrol by the new helicopter explained the mystery. Over a long ravine a strand of aluminum cable had broken at the end of a compression joint and had unravelled to such extent that it could touch the adjacent conductor every time the wind blew in the right direction. This small strand of conductor wire could not be seen by walking patrol because the inspector stopped at the last tower and walked around the ravine. I cite this case simply to illustrate the minute imperfections in a high voltage transmission line that may cause trouble and can be readily located from slow-moving aircraft flying at conductor level. I should point out that helicopters like other aircraft are subject to weather conditions for flying and there are times when we have to resort to foot patrol.

Our experience with helicopters on line patrol was excellent from the start, but many problems of operation and maintenance peculiar to the helicopter had to be learned and overcome as we went along. Experienced pilots were scarce so that we selected men with many hours of fixed wing time and had them specially trained in helicopter flight at the Manufacturer's School. Likewise experienced air engineers had to be selected and given helicopter training also at the Manufacturer's Training School. As Mr. Hanchet pointed out, the field of helicopter operations is most certainly one for the professional and there is no place in it for the novice. Our observers, too, have been selected from experienced line maintenance foremen and supervisors. We thus have an experienced team in all patrol flights capable of handling the immediate inspection as well as any power line emergency that may and does arise from time to time.

Spare parts and an adequate maintenance base were early realized as essentials of the highest order. Gasolene caches spread over our patrol routes were also found to be a necessity to extend the machine's range and provide for emergencies. Notwithstanding these problems, our results continued to be excellent so that we gradually expanded the helicopter patrol fleet to a second and a third machine in 1950, a fourth in 1951 and fifth in 1952 to arrive at our present complement of 5 helicopters.

I should like to point out most emphatically that the helicopter is a delicate mechanism to maintain. We have found from experience that rigid and meticulous maintenance is the secret of safe operation. The Department of Transport rigidly controls the licensing of helicopter pilots, air engineers and machines, and rightly so. The manufacturers rigidly specify the frequency of inspections and overhauls. In our kind of operation, for safety reasons, we find it desirable to extend our maintenance over

[1] Hydro Electric Power Commission of Ontario, Toronto.

and beyond the minimums specified.

With the brief outline I have given, I feel that it must be fundamentally apparent that the operation of the helicopter should be thoroughly understood and its capabilities and limits realized before entering seriously into its use. It has no peer in the slow-flying field and its ability to hover for another look and get in and out of inaccessible places is unbeatable by any other type of aircraft. At low level contour flying, 90 to 100 feet above the ground, it is in a class by itself and many are the experiences our pilots have had in riding safely through heavy winds of 45 miles per hour and sometimes greater. If the weather does "close in", the crew can always land and wait it out.

For the Commission's vast network of transmission lines, many of which are over rugged country, the helicopter has proved itself vastly superior to any other method of inspection coverage in shorter time. Its efficiency in this field has to us been quite adequately demonstrated. It has speeded up maintenance when emergencies occur in inaccessible locations. It has also adapted itself to other services associated with the service security of high voltage transmission lines, such as right-of-way spraying and transporting of men and material, whether on construction or maintenance. The helicopters have also been used in Hydro for surveys and preliminary engineering studies and by outside organizations on loan during national emergencies and rescue.

J. D. Hunter[2]

Mr. Hanchet has outlined clearly the role played by the helicopter in the development of our Canadian northland, and how this comparatively new vehicle has enabled our engineers to accomplish modern day miracles in the construction field, with a substantial saving in time and manpower.

The paper has been fairly presented. Shortcomings of the present day helicopter have not been overlooked, and we are aware of the comparatively high operating cost and limited range of this aircraft. Design engineers are fully aware of the requirement to increase operational efficiency and I am confident that the basic factors affecting this requirement will be adequately met in the very near future. Significant progress has been made in component simplification which will increase efficiency and reduce hourly operating costs. The introduction of new structural materials will permit the saving of many pounds of parasitic weight, allow more economical production and reduce daily maintenance. These factors will increase the service life without loss of functional efficiency and play a great part in adding considerably higher pay load to the helicopter.

It is well to remember that the helicopter available today has been developed to military specifications and therefore cannot be expected to embody all the specific characteristics that are desired from a commercial operator's standpoint. We can say, however, that the military and civil requirements are becoming more closely connected, and this liaison in design specification is bound to benefit both users and the industry as a whole.

Mr. Hanchet has dealt briefly with many varied uses of the helicopter in transporting men and supplies to the sites of some of the greatest engineering projects in the north. We have heard how feats have been accomplished in a fraction of the time and with considerably less effort than we would have thought humanly possible a few short years ago. Engineers are in a good position to evaluate this new type of vehicle, and to put it to work in many new fields of exploration and development. The whole history of aviation is a story of continual progress and improvement, as are the techniques in the engineering practices, throughout Canada today.

Rapid advances are being made in helicopter design and I am confident that by continued faith in the transportation team of airplane and helicopter, Canada will lead the world in engineering development, far beyond the scope of our fondest dreams today.

The Author

Since I am indebted to Mr. Burgess and Mr. Hunter for information used in my paper, it would be surprising if I disagreed with any aspect of their discussions. Indeed I am certain their remarks on both usefulness and limitations are endorsed by all the operators in the country.

To us in the newly-formed Canadian helicopter manufacturing industry the challenge to "simplicate and add less weight" is a major one, and gives entirely new meaning to "The Helicopter and the Engineer". I am grateful that Mr. Burgess and Mr. Hunter referred to this challenge directly or indirectly, and can assure them that it is being resolutely met.

[2] Superintendent of Flight Operations, Department of Transport, Ottawa.

The Influence of Tropical and Sub-tropical Factors in the Design of Hydro-Electric Plants

by

J. K. Sexton, M.E.I.C., Chief Civil Engineer,
Montreal Engineering Co. Ltd., Montreal.

The Engineering Journal, October, 1955 issue, page 1363.

A. O. H. Neilson, M.E.I.C.[3]

I read with interest the paper on "The Influence of Tropical and Sub-Tropical Factors in the Design of Hydro-Electric Plants".

Cherrapunji is no longer considered the wettest place in the world. This doubtful honour has now been passed to the small village of Mawsynram in the same area. In the nine months ending September 30, 1954, Mawsynram had 17.5 metres of rain, whereas Cherrapunji only had 16.2.

A number of points occurred to me while reading the paper; although they are not perhaps strictly within the terms of reference, they have some bearing on the subject in general.

Hydro-electric stations in the tropics are frequently sited at considerable distances from the source of supply of their equipment. While this may not directly affect their design, it has a considerable influence upon their construction, and hence upon their cost. For instance, the size of the pieces of equipment is often limited by the handling capacity of the local transport system.

Cement also has sometimes to be brought from abroad. Where a local supply is available, the cement may be of a particular

[3] Project Engineer, Aluminum Company of Canada, General Engineering Department, Montreal.

type, in which case it may be economically desirable to ensure that the criteria used in the design of the concrete structures are such that it may be used.

Another point is that hydro-electric development in tropical countries is not infrequently carried out in under-developed, and consequently relatively poor parts of the world. Although the main design is seldom affected by this, the desire of the client for especially strict economy must always be borne in mind.

A further possible reason for the neglect of the buttress type dam, and of other relatively complicated types, is that usually a higher standard of workmanship is required for such a structure. A consistently high standard of workmanship throughout the job is a difficult thing to achieve in the tropics.

Mr. Sexton mentions that trouble is sometimes caused by small animals. Large ones can be a nuisance too; an over-inquisitive hippopotamus had to be chased out of the main building of the Owen Falls Power Station in Uganda, the very night that the first alternator went on load.

Electrical Equipment in Large Transport Aircraft

by

Clayton Glenn, Engineering Department, Trans-Canada Air Lines, Montreal
***The Engineering Journal*, September 1955, page 1189.**

Elsie G. MacGill, M.E.I.C.[4]

Mr. Glenn mentioned using a small auxiliary gas turbine for generating electrical power for the aircraft on the ground. What about using such a unit for developing electrical power in flight?

He mentioned that electrical power is only one of several power sources. I think when considering it we should keep in mind that electrical failure is usually complete, and rarely is partial, as may be the case in hydraulic failure. Also that damage to an electrical system sometimes has serious secondary effects, like fire.

For anti-icing, using compressed air off the jet engine, or tapping the inter-stage turbine for hot gas and passing the gas through a heat exchanger would seem a more natural source of heat supply, and moreover control of this hot air would be easy over a wide range of flight conditions. Would Mr. Glenn mention the chief arguments offsetting this?

Capt. J. Deane, M.E.I.C.[5]

Mr. Glenn stated that except inside the pressure cabin, 110-volt direct current equipment constitutes a serious problem at high altitudes. I would like to ask what happens if failure of a blower causes loss of pressure in the cabin?

D. C. R. Miller, M.E.I.C.[6]

Has any consideration been given in aircraft wiring, particularly having regard to the miles of wiring in large aircraft, to the possibilities of weight saving through reducing conductor diameters, operating conductors hotter and utilizing the high temperature insulating materials now available? I have in mind the Navy reduced-diameter cable program which has been able to effect considerable savings in space and weight requirement for power and communication cables on ships and the fact that with materials now available it is possible to operate at temperatures up to 200°C continuously. The weight and space savings aspects would be expected to be of much more value on aircraft than on ships.

The Author

Mr. Miller's question pertains to the possibility of increasing the rated conductor temperature of aircraft wire from 100° to 200°C.

Consideration was given several years ago to increasing the continuous copper rating from 100°C to 125° or 150°C, but no mention has been made of 200°C as far as we know. Most of the airframe manufacturers adhere to a set of standards prepared by themselves known as the Air Industries Association Aircraft Electrical Standards, the current issue of which limits conductors to a continuous temperature of 100°C. If up-rating the wire were to produce large weight saving benefits in aircraft they are now producing, then you can rest assured that the airframe manufacturers would pursue this field.

In the low voltage d-c systems used in current large transports, only a small percentage of the wiring would be affected by increasing the allowable temperature limit. Most of the wiring size is limited by mechanical strength, it having been found that No. 20 gauge is about the lightest gauge which will stand up to the strain of pulling through conduits and normal handling. Nearly all of the remaining wiring falling into the above categories could be reduced in size by increasing the allowable conductor temperature. On fighter aircraft, however, where runs are shorter and where voltage drop may not be a factor, there may be some weight advantage by doing so.

Our experience has indicated that the only conductors in the aircraft which are limited by current carrying capacity are the generator and battery feeders. Increasing the copper temperature from 100°C to 200°C for the generator cables would not appear desirable from our point of view since 200°C is approaching the autogeneous ignition temperature of some of our fuels, and these cables invariably pass through areas where there is the possibility of exposure to free fuel. Naturally, we would be concerned about any potential hazard.

The Navy may be able to get away with running their copper at 200°C, but conditions in a surface vessel are much different from those in an airplane, where cables are subjected to higher vibration frequencies and much different ambient air temperature and pressure conditions. If the airframe manufacturers can prove to our satisfaction that an increase in the maximum continuous copper temperature of aircraft cable is justified and introduces no additional hazards, then we would be foolish not to accept their recommendation.

In Answer to Miss MacGill

With respect to using the small auxiliary gas turbine for producing electrical power in flight, I can see several basic objections. First, for large civil transport aircraft we would require several sources of electrical power, so that if one source fails, we can draw

[4] Consulting Engineer (Aeronautical), Toronto.

[5] Assistant chief, Naval Technical Service, Naval Headquarters, Ottawa.

[6] General Manager, Dow Corning Silicones Limited, Toronto, Ontario.

from another. With the small auxiliary turbine drive, it would require, therefore, duplication or preferably triplication. This would increase the weight of the airplane and add to the overhaul cost, since maintaining these auxiliary turbines is no small cost item.

Another important factor is that which I mentioned in my paper, that of fuel consumption. These small gas turbines are notorious for their high fuel consumption, the currently produced units consuming about twice the fuel per unit of work than the engines used for propelling the airplane. This would show up as high operating costs and perhaps a loss of airplane range, if the airplane were already critical.

Fire hazard is another factor. These auxiliary engines would be no less of a fire hazard than the main engines and it may not be convenient to hang them externally. The non-pressurized rear fuselage seems to be the only spot left in the current transport designs for such an installation, it is doubtful if the airlines would accept the additional hazard in this area.

With respect to using engine bleed for anti-icing, I feel that there is more to ice elimination than providing a source of heat at the leading edges of the wings and tails. The run-back and refreezing of free water constitutes a major hazard in these high speed airplanes and tests seem to indicate that unless the surfaces are elevated to a very high degree, all the water will not vaporize to steam. Run-back can be practically eliminated with cyclic de-icing systems, which allows the ice to form and then supply just enough heat to break it loose. The cyclic control of hot gases to the wing, and the concentration of heat, is much more difficult to accomplish than the cyclic control of electric elements. Hot air bleed from the engines is the preferred method today, but I feel that in time, the electrical method will come into its own.

In Answer to Capt. J. Deane

When stating that 110 volt d-c. would constitute a certain hazard at high altitude, except in pressurized areas, I hope I did not imply that airplanes would have 110 volt d.-c. inside the cabin and some other voltage in the non-pressurized area. Naturally one basic system would be used throughout the whole airplane.

In any event, if it were possible to have all the electrical equipment in the pressurized fuselage and if that voltage were 110 volt d.-c., there would be no major high altitude problem since the loss of cabin pressure would necessitate dropping to a lower altitude due to the effect on passengers and crew.

Is Effective Town Planning Possible?

S. D. Lash, M.E.I.C., Head, Department of Civil Engineering, Queen's University, Kingston, Ont.

***The Engineering Journal*, February 1956 issue, page 116.**

A. E. K. Bunnell, M.E.I.C.[7]

Since Professor Lash's paper was originally presented to the Kingston Branch of the Institute I presume that he was speaking primarily of town planning in the Province of Ontario. In any case, my remarks will be based on the situation in Ontario since that is the province of which I have the most intimate personal knowledge.

Professor Lash's approach to planning is that of an engineer and perhaps because my primary training and experience have been in the engineering field, I may be expected to react in much the same manner. Whatever the reason, I find myself in substantial agreement with most of his statements and I consider his paper to be a valuable contribution to the current consideration of this most important subject. There are several matters, however, on which I should like to comment.

First of all, I am pleased to find that Professor Lash recognizes the significant differences between engineering and planning in that planning encompasses the broader field including in greater measure the social and economic aspects of a situation as well as the physical. It is primarily concerned with people and the policies and physical plant required in each community to most adequately serve their needs. It also must have regard to the future and a broader than purely local concept and must therefore have regard to many variables and consequently does not permit of an absolute solution as do most engineering problems.

As Professor Lash states, planning is primarily a function of local government, i.e., of local municipalities and combinations of local municipalities, and its effectiveness will depend to a great extent on its relationship to the local implementing authority. In view of the vital policy-making role of the planning agency it would not seem possible for it to be a normal department of the local government which is constrained to carry out dutifully the policies of the council rather than to initiate new ones. Nor does it seem that it should be denied the benefit of free consultation directly with all elements of the community. Further, it should have a maximum of continuity in its operation in order to study and develop policies over a period of time. Because of these factors, in Ontario where the term of office of elected councils is generally only one year, we have been constrained to operate local planning under the direction of planning boards, the members of which hold office for three years, appointed by the municipal council but consisting for the most part of public spirited citizens not members of council. While Professor Lash suggests that this type of organization does not work well and we are aware of many of its shortcomings, much effective planning is being accomplished under it and, short of a complete reorganization of our municipal institutions in Ontario, no more effective planning organization appears possible.

The organization for town planning has been established in most of the larger urban communities in Ontario. There are now well over two hundred planning boards functioning in areas containing more than three-quarters of the total population of the Province. One of the limiting features of their operation is the dearth of adequately trained and experienced technical staff to serve them. Four universities in Canada are providing a one year post-graduate course in planning which is providing some opportunity for special academic training in this

[7] Consultant to the Ontario Department of Planning and Development, Toronto.

field. The enrolment in these courses is increasing and a great many people in this and associated fields have taken short courses at M.I.T., and our own universities to supplement their knowledge of planning. It will, however, be some time before we have from these sources and elsewhere sufficient fully competent and experienced technical planners to adequately serve the various planning boards now functioning in Ontario.

In support of Professor Lash's suggestion that land in central areas of our cities might be held in public or quasi-public ownership and only building rights granted to private agencies, there is the experience of Stamford University near San Francisco. Stamford has developed for urban and suburban purposes a large part of 9000 acres (with which it was endowed and which by the terms of the endowment it cannot sell) on the basis of long leases, the fee in the land remaining in the University. Also, in the redevelopment proposed recently for a large area in central Toronto, one scheme proposed that the land would be acquired by the city and the redevelopment carried out by private companies on the basis of building rights or a lease for a definite term with the fee remaining in the municipality. There are other successful examples which would indicate the desirability of giving serious consideration to the continuation of this form of land tenure whenever land is acquired by a municipality for redevelopment or other public purpose.

Planning in Ontario under The Planing Act, 1955, is permissive and it is doubtful that compulsory planning is likely to receive public support in this Province. Regardless of the desirability of planning, it is not likely to be competently done or effectively implemented until it has the support and co-operation of at least a goodly number of the local citizens and councillors.

With this possible exception I can agree fully with Professor Lash's conclusions.

In Ontario we have tried to achieve as nearly as possible the conditions indicated as being essential to success. In view of the various difficulties pointed out in Professor Lash's paper and these notes, it is gratifying to be able to report the very great general interest in planning in Ontario and the quite substantial progress that has been made in overcoming these obstacles and obtaining a moderate measure of success. With greater public acceptance, more experience as to procedures, more experienced planning personnel and greater appropriations, we will come nearer to Professor Lash's ideal and, we hope, achieve a correspondingly fuller realization of the tremendous benefits planning can bring to Ontario.

G. Sutton Brown[8]

In commenting on a paper as comprehensive and as excellent as that of Dr. Lash, it is perhaps best to confine oneself to one or two points. The writer states that the objectives of planning are seldom defined, that the planner is mainly concerned with people as compared to things so that his task is made that much more difficult since people do not conform to formulae, that planning technique is still in a rudimentary stage, and that a planner is usually unable to do much about the realization of his plans. For these reasons, he is not surprised to find that so far planning in Ontario and elsewhere has been relatively ineffective.

To state that planning has been relatively ineffective does not do justice to some of the very fine developments which have taken place in recent years, or are being carried out at the moment. To take just one example alone, it is indeed encouraging to find a new town such as Kitimat in British Columbia being designed and developed as a comprehensive entity in accordance with a master plan prepared by some of the most eminent consultants on the continent and being executed under suitable control. This is but one instance, and there are many others, although, perhaps, we would find more reason for congratulation on work being carried out in Europe. I think what Dr. Lash means is that the planning process today has not nearly reached its enormous potential for bringing about major improvements in the efficiency of our urban areas and in our environment.

One of the reasons, as stated by Dr. Lash, is that planning, as we know it today, is in its infancy. Dr. Lash indicates that it is largely based upon experience of the past 50 years. I would suggest that planning, as we understand it today, is based almost entirely in the experience of the post-war years and certainly does not go back beyond 1930. It is not surprising, therefore, to find that techniques are still comparatively crude. It is perhaps significant that today we talk so much about the qualifications and training of planners, since we realize that we are still so deficient in the necessary skills required for practising in this most complex profession.

One of the reasons for relative failure has been the lack of defining our objectives and keeping these objectives within limits. It is now realized that plans of civic development and improvement should be limited to a period of time of say 20 to 25 years. Plans must be related to the financial and other resources of the area concerned. It has come to be realized that grandiose plans which have no possibility of realization cause more harm than good.

Modern planning techniques are now becoming sufficiently advanced to predict with some degree of accuracy the needs of an area for approximately 20 years ahead, assuming no world disturbances such as war intervene. Similarly, it is not too difficult to obtain some idea of the financial resources which a particular municipality or group of municipalities will command. The planner's task is to co-ordinate these two and translate them into a planned program of work. Increasingly, the preparation of integrated programs of capital expenditure are becoming the planner's responsibility and these programs to a considerable degree constitute a town plan or devlopment plan for a particular area.

It becomes necessary to understand these changes in technique because I would wish to endorse strongly Dr. Lash's recommendation that the planning agency should be an integral part of local government. It is perhaps our first concern to see that our administrative arrangements for planning are adequate for the tasks to be undertaken. √

This discussion of S. D. Lash's paper will be concluded in the March issue.

[8] Director of Planning, City Panning Department, Vancouver, B.C.

ABSTRACTS . . .

OF RECENTLY PUBLISHED ENGINEERING LITERATURE

TECHNICAL WRITING

Bulletin of the Institute of Engineers (*India*), v. 4, n. 7, August 1955, p. 1.

Vitruvius, who probably lived between the time of the death of Julius Caesar and the Battle of Actinium, said in his treatise, that an architect should be a good writer also, because an architect is to commit to writing his observations and experiences in order to assist his memory. But he was modest enough to inscribe in the preface, "I beseech you, O Caesar, and those who read this my work, to pardon and overlook grammatical errors; for I write neither as an accomplished philosopher, an eloquent rhetorician, nor an expert grammarian, but as an architect."

Technical writing of any merit or value is admittedly not easy. No writing is easy for that matter. At one time or another most of us try our hand at writing. The toddler's first step should be just to put himself down and write. Whatever the subject, a minimum of vocabulary is called for, and he soon becomes aware of its limitations. But if the brain is alert for new words and for old words in new contexts, slowly and with patience, the lack of skill in the selection of words ought to disappear. And while the engineer may not—indeed is not likely to blossom out into a litterateur of rare ability, he might at least attain that working knowledge to enable him to translate his experiences into interesting words.

The engineer who wants to get ahead finds that a considerable amount of his time is being devoted to writing, for his own benefit to begin with and then for other engineers and for less technical readers. If the writing is not effective and forceful, and if it does not mean what the writer intends, readers who may be specialists in their fields will have little confidence in the authority of the article or its significance. Neither employer nor employee will be persuaded or convinced.

If pursued in the right way, technical writing—as any other writing—can be an interesting pastime. The twin performance—the execution of the work and its expression in words—ought to run parallel, or in close sequence, to enable the author to maintain regularity, uniformity, precision and balance—qualities which, according to Matthew Arnold, should characterise any piece of good writing. In this are, or should be, combined science and art, the one rationalising and the other embellishing, making the organization and presentation of the whole work fascinating.

It is necessary to plan any piece of technical writing. Ideas have to be arranged. The article must start with facts known to the reader and lead to less known fields. A definite attitude towards the reader is necessary — an opinion of how much he is likely to know, and how much he is capable of taking in. A certain workmanlike ability, if not facility, can come fairly quickly if three basic rules are observed. First, simplicity of expression. Second, the writer must mean what he says. Third, the writing must have a head, a body and a tail—a clear announcement of the purpose, a logical development of the subject, and a brief summary, repeating the main points of the article with deductions, if any.

A last word. After the article is written out, the writer should, in every instance, try to edit his written words. And then he will appreciate too the hard task before an editor, that is, an editor who takes his work seriously—for not all editors of technical journals do this. He should check for grammatical correctness, examine his vocabulary, and eliminate verbosity—see if he cannot substitute 'The meter was read' for 'The reading of the meter was taken'.

Unfortunately, the lack of attention paid to training in technical writing in the universities has left the young engineer unconscious of the importance of his written words. He is not made aware that words are necessary to explain his works. He takes pride in his deeds but is not embarrassed at his lack of elementary literary skill.

There is a demand everywhere today for the engineer-writer who can effectively describe technical products and processes not only to the other technical men but also to the layman.

If the engineer approaches his writing as a challenge to his judgment, knowledge and accuracy as well as literary skill, articles will be better and better written.

AIRCRAFT RUNWAY DRYING MACHINE

The Engineer, v. 200, n. 5201, Sept. 30, 1955, pp. 485/86.

Pools of water on aircraft runways are a source of danger to aircraft landing at high speeds, and for this reason a machine for drying runways of aerodromes after rain storms has been developed and built.

The machine consists essentially of a fabricated steel frame mounted on four pneumatic wheels at the rear and three similar wheels on a castor head at the front. It is 13 ft. long overall by 6 ft. 4 in. wide and 3 ft. 10 in. high and is designed for towing by a tractor. Mounted on the frame is a totally enclosed steel tank of 400 gallons capacity, and there is a separate power compartment at the front.

In the power compartment a 3

h.p. engine drives a suction fan to create a vacuum in the tank. Depending from the rear of the tank is a squeegee, which is spring loaded into close contact with the surface of the runway, and runs across the full width of the machine. A slot above the rubbing surface along the front of the squeegee opens into a duct leading into the tank, so that as the machine moves along the water pushed up in front of the squeegee is sucked up into the tank. When the water in the tank reaches a pre-determined level it actuates a cut-out switch to stop the engine and prevents excess liquid being drawn into the fan compartment. Baffle plates are fitted in the tank to prevent water surge as the machine is drawn along.

When it is required to move the machine over dry patches on the runway or take it away after drying is completed a lever at the side is operated to raise the squeegee clear of the ground. The makers state that the machine is capable of removing water at a rate of 100 gallons a minute from a runway under normal conditions.

CANADA'S FUTURE BRIGHT FOR NUCLEAR POWER

Electrical Digest, v. 24, n. 8, August 1955, pp. 42/44.

By 1980 nuclear power plants may account for as much as 10 to 15 per cent of the total electrical generating capacity in Canada. Although by that year water power will still be the principal source of electrical energy in this country, thermal generation will have risen from negligible proportions of a few years ago to at least 30 per cent of the installed capacity.

A third to a half of this thermal generation will be by nuclear plants in spite of the fact that Canada has an abundance of coal that can be strip-mined in certain regions, and large reserves of petroleum and natural gas. Costs of conventionally produced electrical power are expected to rise despite significant improvements in long-distance transmission and further advances in the efficiency of central electric stations burning conventional fuels.

The most attractive feature of nuclear power is low fuel costs. They may be such as to make the economics of future atomic energy plants resemble more closely those of Canada's existing hydro-electric installations rather than those of steam plants burning coal or petroleum.

Nuclear energy will not be competitive anywhere in Canada until its price has fallen below 8 mills ($0.008) per kilowatt-hour. At 7 mills ($0.007), it might be able to compete with hydroelectric or with coal-fired steam power but demands for nuclear power at this price would be limited. The highly-developed power-consuming region of Southern Ontario, where imported coal will soon be the only alternative to hydro, could absorb large blocks of power at 6 mills ($0.006) without creating even a temporary surplus of generating capacity. Various engineering and economic studies under way at Chalk River suggest that nuclear plants capable of such performance will be under construction within the next 10 years.

The average annual rate of growth of total demand for electrical power in Canada is now about six per cent per year. Consumption could be expected to increase threefold to four-fold or more during the next 25 years. Domestic supplies of oil and natural gas are emerging as deterrents to the use of electrical power for steam-generating and other heating purposes. Furthermore, if inexpensive nuclear power becomes available in from 20 to 30 years time, a large part of Canada's established demand for new increase in power would disappear, for there would arise the tendency to locate certain heavy power-using industries, such as the refining of aluminum, close to the principal industrial markets of the world. On the other hand, Canada's increasing population seems likely to be forced to increase its productivity and thus use an increasing amount of power. While the annual rate of growth of consumption may, therefore, decline from its present level of six per cent to about four and a half per cent in the 1970's, annual installations varying between one million and two million kilowatts will still be required throughout the 1960's and 1970's.

The need for heavy water for Canada's nuclear plants will be several times the nation's present production capacity. What would be a sizeable segment of the country's chemical industrial may therefore have to be created simply to satisfy this large and rapidly expanding demand for a new material.

Production of natural uranium for domestic consumption, apparently, would have to run into tens of millions of dollars a year. Even if new methods are discovered for the manufacture of heavy water at appreciably lower costs, the expenditures might reach an annual level of from $40 million to $50 million twenty-five years from now. Outstripping these expenditures would be the outlays on generating plant, machinery and equipment—capital investments that might reach into the $100 million-a-year category by 1980.

JOB TITLES: HOW STEEL CLEANED HOUSE

The Iron Age, v. 176, n. 12, September, 1955, p. 71.

Main purpose of the handbook was to isolate all similar, but not necessarily identical jobs based on the predominant function of the job regardless of the job classification.

Because of the manner in which job titles had been applied over the years, it became a burdensome task to gather information for grievances and to compile and correlate data for establishing job classifications. In the past it had been the custom for the foremen to apply titles of their choosing.

This resulted in a conglomeration of titles for jobs performing the same work within or between plants, divisions and departments. As a result, an attempt at standardization was made in 1947. This initial effort was far from successful; the actual number of titles increased rather than decreased.

In 1951 the industry's cooperative Wage Bureau established The Standard Title and Code Committee to set up a standardized system for salaried, clerical and technical jobs. Successful in this effort, the committee reviewed all production and maintenance (hourly paid) jobs in 1952 and in January 1953 the present handbook was established.

SCIENCE AND THE SCIENTIST

The Engineer, v. 200, n. 5197, September 2, 1955, pp. 323/24.

Science is simply the record, enshrined in the literature, of the system of knowledge and of the conceptions correlating parts of that system.

It is fundamental that such knowledge cannot be based on dogma or authority of any kind, nor on any intuition or revelation, unless indeed it be of the Book of Nature that lies open before our eyes. It is inherent in the philosophy that the record may be imperfect and the conceptions erroneous; the potential fallibility of our science is not only acknowledged but insisted upon.

Where the material can be directly apprehended by our senses, there can be little doubt as to the validity of the record, though it may need some adjustment of errors of observation and of the value of any magnitude that is involved. The uncertainties are then largely concentrated on the conceptions and generalisations which have been based on the ascertained facts.

Justification of scientific theory has been obtained by the success of predictions and by the unanticipated convergence of more than one line of approach. In all the cases the degree of coincidence becomes so great as to carry conviction that we have been vouchsafed, if not the whole truth, at least something very closely related to it.

There is no philosophical line of demarcation that separates one branch of learning from another though the demeanour of many so-called humanists suggests that they perceive one. It is opportune to add another voice of protest against the often repeated assertion, that "culture" is the preserve of students of some particular branches of knowledge, and is denied to others. What is meant by "culture"? If it is the ability to think clearly and to express thoughts in language, what evidence is there that physical and biological scientists lack these qualities?

Before straying too far from actual science I would like to say something about the use of speculation, which should always arise from some correlation which was hitherto unknown or unnoticed, or the significance of which has been underestimated, or thought to have been underestimated. In the early stages it may be discouraging to study the literature; one can always find reasons there for believing that a new idea is not worth pursuing, or for that matter for saving oneself the trouble of doing an experiment. Later, having worked up an internal, self-generated pressure of enthusiasm, it is obligatory to face the hard facts already on record. Then, instead of weakly accepting a rebuff we shall at least put up some fight with "but on the other hand it might be that -----."

An important aspect of science is its universality, and its fully international character only rendered possible by the axiomatic freedom it enjoys from authority and dogma. The brotherhood of scientists is a reality. It is fortunately not unique; there is a similar fraternity among sportsmen, musicians, chess-players, and other categories of enthusiasts, not encumbered by the so-called ideologies.

WATER-ACTIVATED BATTERIES

The Times Review of Industry, September 1955, p. 39.

One of the most interesting advances in storage batteries is the recent utilization of a novel electro-chemical principle in the design of cell units for "one shot" and emergency applications. Such a battery had to be small, light and unfailingly reliable even after years of idleness in all climatic conditions—a requirement which ruled out the use of dry batteries. The new water-activated units achieved this combination of virtues so successfully that they have now been developed for many other related applications. A typical example from the new range of water-activated cells consists of special dry-charged plates of cuprous chloride designed to suit the particular application—which remain completely inert while protected from moisture by sealing tape or some similar means. In an emergency, the tape is ripped off and as soon as the plates come into contact with either salt or fresh water, the battery is energized. Once begun, the discharge then continues until the capacity is exhausted. A battery of this type has outstanding advantages for "one shot" emergency applications. It can be used for high discharge rates for relatively short periods, or for low-rate work over longer periods and has in either instance an outstanding high performance for its weight and volume. Protected from moisture, it remains completely inert under widely varying temperatures and humidities for an unlimited period. A number of water-activated batteries of different sizes and capacities has been developed, most of them employing cuprous chloride and magnesium electrodes.

BRASS-POWDER STRUCTURAL PARTS IN PRODUCT ENGINEERING

Mechanical Engineering, v. 77, n. 9, Sept. 1955, pp. 762/65.

The domestic production of metal parts from powder is not new. Practically all metals can be made into powders, but those most widely used for powder metallurgy today are iron, copper (largely mixed with tin to produce bronze), and brass. Brass was a late starter in the field of powder metallurgy and, consequently, the qualities of this powder for the pressing and sintering of structural parts are not so well known as those of some of the more firmly established metals.

It was not long ago that the production of satisfactory brass-powder parts was considered to be extremely difficult, and few fabricators were willing to tackle the problem. The production procedures have now developed, however, to a point where the majority of fabricators can turn out excellent brass-powder parts, and consequently their fields of application are rapidly expanding.

The fact that a considerable number of new brass-powder ordnance parts are now specified is a further indication that this method of production has become firmly established.

Parts Well-suited to Production:

1. Cylindrical, rectangular, or irregular shapes which are relative-

ly thick (up to 1 in.) and which, in general, do not involve large variations in cross-sectional dimensions and do not have a length-to-diameter ratio exceeding 2½ to 1.

2. Parts with surface indents or projections on tops or bottoms.

3. Parts with simple flanges or projections at one end.

4. Parts with splines, gear teeth, or knurling.

5. Parts with holes, counterbores, slots, or keyways.

It is good practice in designing brass-powder structural parts to avoid the following:

1. Narrow or deep splines.

2. Feather edges.

3. Sharp corners at the junction of the flange and body on flanged parts and other stepped designs.

Brass is exceeded only by the iron-copper alloys from the standpoint of tensile-strength, under comparable production conditions, and brass has much better elongation than the other commercial metals. It might be said that, when compacted and sintered under well-controlled conditions, brass-powder parts are generally comparable in physical and mechanical properties to brass castings. As related to wrought brass, the strength, hardness, and wear resistance of powder parts are more nearly equal to those of dead-soft annealed brass than to those of cold-worked stock. But the properties of parts made from wrought brass may be approached by re-pressing.

As an example of successful application of brass-powder structural parts, consider one which is never far from our finger tips— the dial mechanism of the latest telephone handsets. Three parts perform the important function of controlling the rotational speed of the dial and these vital parts are made from brass powder. They are the matching governor weights and the drive bar, in which close control of both weight and dimensional tolerances are imperative to efficient performance.

The powder-metallurgy process was easily the lowest-cost method of producing these parts. Although the shapes require relatively complicated tooling substantial savings over any alternative method result, because secondary operations are not needed to produce finished parts. Production rates of 1000 per hour per set of tools make for further economies.

CONSUMABLE-ELECTRODE INERT-ARC SPOT WELDING

The Welding Journal, v. 34, n. 9, September 1955, pp. 839/45.

Spot welding with an inert-gas-shielded arc is not a new concept. Spot welding, which utilizes a non-consumable tungsten electrode with inert-gas shielding has proved an extremely valuable production tool. However, it does have limitations. For one thing, it is limited as to the thickness of materials which can be joined. Another limitation is that it can be applied only to clean surfaces. Furthermore, this process adds no filler metal. Consequently, gaps or poor fit-up results in sinks or cavities.

Consumable-electrode inert-arc spot welding has been developed in order to overcome these shortcomings. Basically, the mechanics of this process are the same as those of the consumable-electrode inert-arc welding process, itself. In both, an arc shielded with inert gas is established between the weldment and a consumable filler wire. Here, however, most of the similarity ends. For in the spot-welding process, the ignition and extinction of the arc must be more precisely controlled. Usually the arc current density and voltages used are higher than those in the conventional process. The weld puddle develops and solidifies rapidly. Intense local heat develops instantly; but as the arc exists only briefly, the total heat input is rapidly quenched by the surrounding metal.

Present Limitations

At present, the consumable-electrode inert-arc spot-welding process can be used on carbon steel, stainless steel and copper-bearing alloys. Aluminum is omitted from this list due to some difficulty in obtaining consistency in starting. It is extremely important that starting consistency be obtained if uniformly good results are to be expected. the consumable-electrode spot-welding process can be used on metals up to about ⅛-in. thick in the downhand position. On thicknesses of ⅛ in. or thicker, it is necessary to plug weld.

The fit-up of the materials being welded does not constitute the problem it does in the tungsten electrode welding process. This is because filler metal added in the consumable-electrode spot-welding process can bridge the gap between the pieces. In fact, in many cases, it has been found that higher shear strength occurs with the consumable-electrode process when a slight gap exists. This is probably due to the ease with which the filler metal can flow over the lower plate and thereby effect a larger interface nugget. When larger interface nuggets cannot be obtained with the consumable-electrode process without burning through the lower plate, multiple cycling has been found useful.

Comparison to Other Processes

Generally, consumable-electrode inert-arc spot welding must be regarded as a supplement to other existing spot, plug and stud welding methods. The tungsten-electrode spot-welding process is still to be preferred on very thin materials, where it is cheaper and does not have the buildup or button which occurs with the consumable-electrode process as a rule. However, consumable-electrode spot welding does have advantages in that fit-up is not a problem and in that it can be used over a very wide range of thicknesses.

Manual plug welding may still be preferred in some cases where the plug is extremely large or where it is necessary to get a high degree of manipulation of the puddle in order to eliminate cold shuts or slagging. The consumable-electrode process may supplant some applications in which stud welding is now used. For tack welding, consumable-electrode spot welding offers an extremely valuable tool.

Consumable - electrode inert-arc spot welding can be applied easily and quickly to a variety of production problems. The process is now being used in all positions on carbon, stainless and galvanized steels as well as on copper-bearing alloys.

Its future growth will follow three major paths: First, it will serve more and more as a useful supplement to older methods of spot, plug and tack welding. Second, its inherent quality-control properties will help to make it an adjunct to automation-production operations. Finally, it will very possibly find use in applications which cannot be adequately handled by any other presently known welding method.

Month To Month

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

No Engineers Required

Members of the Institute may have noticed that within the personnel of the Royal Commission on Canada's Economic Prospects there is no engineer. They may have noticed also that the terms of reference for the Commission include a study of the "future developments in natural gas, power . . . the need for more roads, hospitals, schools and universities, a survey of Canada's energy resources and raw materials".

The Council of the Institute also observed this incongruity and instructed the general secretary to draw it to the attention of the Prime Minister, with the suggestion that the work of the Commission would be expedited and increased in value if the Commission were strengthened by the addition of an engineer experienced in such matters. Such a letter was written, but the Prime Minister replied that in his opinion the Commission was already competent to handle the situation satisfactorily.

In his own words Mr. St. Laurent said "the Government endeavoured to choose persons with as comprehensive experience as possible in Canada's development in all areas. . . . It is confidently expected that those who were selected have the qualifications for making a thorough survey of the nation's prospects." Also he stated that one of the commissioners was an engineer.

The Commission is composed of an accountant, three lawyers and a forester. (In Quebec a graduate in forestry from Laval may call himself a forest engineer, but graduation from such a course does not meet the requirements for registration under the engineers act.) One might be excused for wondering how they acquired a "comprehensive experience" in such things as natural gas, power, roads, and raw materials and the energy resources of the country.

The gentlemen of the Commission all enjoy an excellent status. No one would criticize them personally. It is more than likely that they too are puzzled to find that they are supposed to study and report on things so foreign to their experience.

In order to get this thing into proper perspective, suppose the Commission had been established to study and report on the rewriting of the North America Act or the Criminal Code. Is it possible that the government would have appointed a commission consisting of an accountant, a medical doctor and three engineers? And if they had, what would the lawyers and the press have said about it? There is no need to ask.

Or suppose the subject to be studied included the medical care of indigents, or the mentally ill or the study of contagious diseases, would the government have made up a commission of an architect, an engineer and three lawyers? How would the medical doctors and the press have received such a commission? Here again there is no need to ask. Nevertheless the case under discussion has much in common with these hypothetical cases.

Engineers in Engineering Work

It is apparent that there is still much to be done to impress some influential people with the fact that engineers are the ones best qualified to do engineering work. No one would want to belittle the other learned professions. On the contrary it is probably a compliment to them to suggest that they are so well informed, so expert in their own fields that they should not be expected to know anything about some other field which is equally specialized.

It is hoped that in spite of the handicap, the Commission may make a useful report on these subjects, which in the minds of many are the most important of all matters included in the terms of reference.

Cover Picture

The cover picture shows the first Canadian installation of an automatic device that parks locked cars mechanically "untouched by human hand". This unit is situated in Montreal.

Photo courtesy of Automatic Parking Inc.

Library Regulations Changed

Recently Council has approved several changes in the regulations for the Institute library. These changes were submitted by the Library and House Committee at the request of the librarian.

Some of the changes are quite important and all are intended to make the use of the library more simple. Principal among them is the abolition of the $5.00 deposit, which has been required up to now, and the reduction in the penalty for overdue books from 25c to 10c a day.

Here are the regulations as they stand now with the changes incorporated in them:

1. *Hours:* Monday to Friday—
   9 a.m.-5 p.m.
   Saturdays—
   9 a.m.-12 noon
2. Two books, periodicals or pamphlets (or more at the discretion of the librarian) may be borrowed at one time.
3. The loan period is two weeks, but this may be extended, on application, for a further two weeks if the material is not in demand. Out-of-town members may add mailing time.
4. A fine of ten (10) cents a day will be charged on overdue books.
5. Requests for a book must be made in person, by telephone, or by letter, and members are personally responsible for items charged out in their names.
6. No charge is made for the library service and the cost of sending books by mail will be paid by the Institute, but the cost of returning books must be borne by the member.
7. Short subject bibliographies are compiled on request. When placing these requests, please give as much detail and background information as possible.
8. Any book or pamphlet may be ordered through the library, as may subscriptions to periodicals of other engineering societies. *Please make no payments in advance.*
9. Non-members may consult the library, but may not borrow material. Please address all requests to *The Library.*

The Engineering Institute of Canada has one of the finest engineering libraries in North America. It is staffed by a group of four competent people, including professional librarians.

Members outside of Montreal are reminded that the library is just as much for their use as for those living within the city. The same services can be given to non-resident members through the mail as can be given direct to those close to Headquarters. Now that the $5.00 deposit has been abolished, the facilities are even more readily available by mail than they were in the past.

It is believed the library can give to Canadian engineers a better service than they can obtain elsewhere. To those who have not used it previously it is suggested that the solution of many of their problems may lie in the use of this service.

"HELP WANTED"

Due to the retirement this summer of Colonel H. G. Thompson the Institute is seeking an assistant general secretary to be located at Headquarters in Montreal. The position carries excellent prospects for development on a permanent basis.

Applicants should have ability and experience in meeting people, in public speaking, and in writing. Personality is important. Experience in organizing, in conducting meetings and in office routine is essential. Experience in editing can be used to good advantage.

Membership in the Institute is not essential but naturally a preference will be given to members. Persons who have been active in Institute affairs will also have an advantage.

Age requirement is not fixed rigidly but applicants should be over thirty-five and under fifty.

This is a good opening for a person who is ambitious and energetic. Please mail applications with full particulars of education and employment experience to:

The General Secretary
The Engineering Institute of Canada
2050 Mansfield Street, Montreal

Custodian for Memorial

At the November meeting of Council held in Winnipeg, Council agreed that the Ottawa Branch be asked to act as custodians of the recently unveiled monument to Colonel By. A letter has been received recently addressed to the Council in which the Management Committee of the branch have agreed to accept this responsibility.

It is an important thing to have someone or some organization take a special interest in the maintenance of a memorial. Very often such things are erected amidst great enthusiasm and then within a surprisingly short time they are forgotten and neglected. It is the hope of Council that by making this the special responsibility of the Ottawa Branch such a fate will not await Colonel By and his fountain.

Of course the Institute is fortunate in having the Federal District Commission so vitally interested in the memorial. It was erected on F.D.C. territory and in a location selected by them. The task of the Ottawa Branch as custodians will be minimized by virtue of the assistance and the interest of the Commission; nevertheless it is nice to have the double assurance which has now come from the Ottawa executive.

Branch Scholarship

A short time ago word was received from the Vancouver Island Branch that they had awarded their first annual scholarship amounting to $100.00. It has been awarded to Howard A. Grant of Duncan, B.C., who is now a first year student at the University of British Columbia.

It is rather an unusual thing to find an annual scholarship of this amount being given by so small a branch. The funds were not raised specially but were taken from the branch's regular revenue.

The basis upon which the award is made is left to the committee on prizes and scholarships at Victoria College. The only stipulation is that the recipient must be an outstanding student and be proceeding into an engineering course at an approved university. The branch has been informed that the committee has made the selection, not only on the basis of scholarship but as well on character, leadership, conscientiousness and potential in his chosen profession.

Here is a real contribution towards the development of the profession. If other branches are interested in following this good example, there is no doubt but that the executive of the Vancouver Island branch would be very glad to pass on the full details of their thinking and of their experience.

Ontario Association Officers

Merritt W. Hotchkin, Kirkland Lake mining executive is the president of the Association of Professional Engineers of Ontario, succeeding John R. Montague, M.E.I.C., of Toronto.

As chief executive officer of the Association, Mr. Hotchkin, with the new council, will guide the body's policy-making throughout the present year affecting the more than 14,000 members in the province. The new president, well-known in Canadian and U.S. mining circles, is engineer-in-charge, outside exploration, for Wright-Hargreaves Mines Ltd.

Also named to the executive were John H. Fox, M.E.I.C., general sales manager, Minneapolis-Honeywell Regulator Co. Ltd., Toronto, as first vice-president, and C. T. Carson, vice-president and producing manager, Hiram Walker & Sons Ltd., Walkerville.

Serving on council during the year will be two representatives from each of the five branches of engineering. They are:

Civil Branch: Tullis N. Carter, M.E.I.C., Toronto vice-president and general manager, Carter Construction Co., and Joseph H. Irvine, M.E.I.C., Ottawa, of James F. MacLaren Associates;

Chemical and Metallurgical Branch: Gordon W. Ames, M.E.I.C., Sarnia, senior design engineer, Polymer Corp. Ltd., and Patrick E. Cavanagh, director, engineering and metallurgy, Ontario Research Foundation, Toronto;

Electrical Branch: John W. Holmes, design engineer, Canadian General Electric Co. Ltd., Peterborough, and John H. Waghorne, engineer-in-charge, electrical research dept., Ontario Hydro-electric Power Commission;

Mechanical, Aeronautical and Industrial Branch: John H. Ross, M.E.I.C., Toronto, consulting engineer; and William D. Sheldon, Jr., M.E.I.C., president and chief engineer, Sheldons Engineering Ltd., Galt;

Mining Branch: M. S. Fotheringham, M.E.I.C., president and general manager, Steep Rock Iron Mines Ltd., Steep Rock, Ont., and Charles P. Jenney, chief geologist, The American Metal Co. Ltd., Toronto.

The Association's permanent officers are: T. M. Medland, executive director; Murray Muir, secretary-treasurer and registrar, and T. C. Keefer, M.E.I.C., field secretary.

The new president of the Association of Professional Engineers of Ontario, M. W. Hotchkin (right), with three prominent members. From left, they are: John H. Fox, M.E.I.C., Toronto; Richard L. Hearn, M.E.I.C., who was awarded the Association's highest honour, the Professional Engineers' Medal; and James A. Vance, M.E.I.C., Woodstock, Ont.

Two 335-foot transmission towers at Cornwall, Ont., are associated with facilities which will provide interconnection between Canadian and U.S. powerhouses of the St. Lawrence power project.

St. Lawrence Seaway and Power Project

The *Engineering Journal* reviews the progress of the St. Lawrence Project.

Progress by Ontario Hydro

At the end of December, track laying operations had commenced on the relocated section of the CNR double track line which will skirt the flooded area. This eventual 40-mile stretch of track will take the railway line around the headpond area from Iroquois to Cornwall.

Meanwhile significant progress had been made in various sections of the railway relocation project. More than half the grading had been completed, while installation of culverts was well advanced and ditching operations also had been progressing favourably.

Commencement of the track laying operations for the railway line significantly coincided with work on the relocation of No. 2 highway. The highway work had been completed for 7.2 miles between Cornwall and Moulinette area, and the main stream of through traffic had been routed away from the work area. This had aided construction work in general in the vicinity of the power house and the administration area.

Building operations at the St. Lawrence transformer station had been impressive in the past few weeks. The various structures and buildings were taking shape and the whole area showed rapid development. The 115-kv. area which will largely be taking over the function of the Cornwall transformer station was well advanced. The Cornwall transformer station presently is distributing power to the immediate district and that station will be dismantled soon to make way for the new diversion canal.

At the new St. Lawrence transformer station, about 70 per cent of the total first stage work had been completed by Hydro's own forces. In the 115-kv. area of that station, more than 80 per cent of the work had been finished. The relay building was ready for service and two 25,000-kva. transformers had been installed. Most of the bus work had been completed.

Other important installations were being erected for full-scale building operations in connection with Hydro's half of the power dam and power house. The main section of the concrete batching plant had been erected. This plant will provide concrete for the power dam and it is expected that the concrete plant will be in operation in February.

Meantime, excavation on the powerhouse site and also grouting operations were continuing favourably. The liners for diversion canal access tunnels were in place, part of the aggregate conveyors were installed, the main part of the concrete batch plant had been erected, with excavation down to rock in the wingwall and U-abutment areas. Traffic in the Cornwall canal had been suspended for the winter, permitting the continuous use of access bridge at Lock 19.

Rehabilitation work extended over a wide area during December. At townsite No. 1, lot staking and surveys progressed favourably. In townsite No. 2, surveying of power lines and water intake lines was carried out, as well as the transferring of Bell Telephone cable and local traffic lines.

In the meantime, some twenty homes were moved into new Iroquois during December for a total of over seventy homes relocated. Work on building basements also progressed favourably and was well ahead of the moving schedule. At the same time, the footings for the shopping centre were constructed. Work continued on grading and gravelling roads and sidewalks in new Iroquois.

Work on channel improvements had been concentrated in the Galops Island sector. It is estimated that the quantity of material removed to the end of the year from the main cut was about 1,500,000 cubic yards.

Extremely cold weather and the holiday season slowed progress of the project work somewhat during the month of December. The work force was approximately 2,550 persons.

Progress by NYSPA

Another milestone in the construction of the power project was passed with the opening of the Barnhart Island bridge to traffic on December 15, 1955. This was followed by the start of removal operations of the temporary pontoon bridge from Hawkins Point to Barnhart Island. Excavation quantities for all construction contracts exceeded nine million cubic yards.

At year end, in the powerhouse area, excavation continued, and more than 130,000 sacks of cement had been used here for consolidation and cutoff grouting. The access railroad had been completed on Barnhart Island, with the access highway opened to traffic. Driving of piling for the baffles on the river side of cofferdam C1 was completed and the cells were being filled.

At Long Sault dam, concrete placement continued until December 16, and was then closed down for the season, with 31,000 cubic yards in place. Construction plant operations continued as the third upstream gantry crane was being erected. Excavation for the south wing dike was resumed. In Cut "F" excavation continued to progress rapidly, as approximately two million cubic yards had been moved to date.

At Iroquois dam, excavation for the south abutment of the dam structure at Rockway Point continued. Driving of piling for cofferdam cells and construction of dikes were in progress. Placing of concrete in the dam continued, but at a slower rate due to cold weather. 5000 cubic yards were placed to date. At Massena intake, excavation for Stage 1 construction continued as material was hauled to controlled stockpile for the dike.

Channel improvement excavation continued, with the excavation at Red Mills nearly completed. Channel excavation by dredge at Chimney Island was discontinued for the winter on December 16, 1955.

Placing of concrete on the Barnhart bridge was nearly completed and traffic was allowed passage over the bridge as noted above. Riveting for the Grass River bridge was complete. Nearly all structures for the Long Sault canal construction power line had been completed and half the conductors had been strung.

Preparation of engineering drawings and specifications continued on schedule. Specifications were completed and issued during the month for insulated wire and cable and the fixed hoists for Massena intake. On land acquisition, right of entry had been 85 per cent obtained. Reservoir clearing had been commenced.

Extremely cold weather and the holiday season retarded work in December. The work force during the month averaged 3040 persons.

Reforestation and Parks

In an illustrated booklet published in December by the New York State Power Authority, Robert Moses, chairman, has outlined the Authority's policy on reforestation and landscaping areas adjacent to the works, in part as follows:

"In the construction of large works such as the Seaway, there is a tendency to postpone, minimize and even forget serious consideration of final improvements such as trimming, reforesting, landscaping, recreation, esthetics in the broad sense. . . . There will be no such neglect on the St. Lawrence The beauty of the river and its benefits beyond commerce, industry and utilities must be preserved and enhanced. . . .

"We shall not forget reforestation of huge dykes and spoil areas, topsoiling and landscaping of roads, water front and parks, attractions for visitors, recreation facilities for local people as well as visitors, promotion of high standards of zoning and protection against eyesores. . . . Obviously some of this cannot be done until the spoil areas, dykes, dams and powerhouse are almost completed. . . .

"The land acquisition procedures for seaway and power involve the co-operation of various State agencies. . . . Also involved are the International Joint Commission, International Joint Board of Engineers, International Joint Board of Control, Bureau of Customs, Immigration and Naturalization Service and others. . . . It is perhaps the largest co-operative venture of this kind ever attempted.

"Certain problems, some of which are annual and others of a non-recurring type, are bound to follow. There is no mystery as to our policy. We have made it quite clear that we do not propose to assume the normal operating expenses of the local communities. . .

Architect's model, showing part of the Canadian section of the St. Lawrence power house. The building will span some 3,300 feet between Barnhart Island and the Canadian mainland, and will be built by Ontario Hydro and the Power Authority of the State of New York.

As to some of the more permanent improvements requiring large capital outlays, such as the badly needed sewage disposal plant in Massena, we can be of considerable help. . . .

"The Authority reiterates that its objective is not only to generate low cost power and to help build the new seaway, but to conserve the natural beauty of this magnificent river and to promote the healthy development of the entire frontage for industry, residence and recreation.

"The spoil areas . . . subsequently will be seeded and portions reforested with native pine and spruce in carefully studied arrangements so as ultimately to produce naturalistic effects. Hardwoods, which will reseed naturally, will be allowed to develop with the evergreens so as to create a native forest cover. . . . The result will be that of a strip of natural woodland and open meadow areas along pleasantly curving dykes that form the margin of the waterfront.

"The Federal Power Commission license provides for public access to the power pool for recreation. To meet this provision, the Authority is planning to provide access to the pool, including boat launching ramps at reasonable intervals. . . . A waterfront park is being planned for the village of Waddington, that will include a playground and open areas for general park use. . . .

"The Authority will develop an area now known as Wilson Hill and situated about halfway between Massena and Waddington, where many buildings may be relocated. The Wilson Hill area will become an island when the water level of the river is raised. . . . Access will be provided by the construction of a causeway. . . .

"In the meantime a permanent beach, nearer Massena and reached via Martin Road, will be constructed and will be ready for use in 1959. . . . This beach, which lies outside of the town of Massena, will be leased to the town for a nominal sum to cover the cost of maintenance and operation. It is assumed that there will be no problem in reaching an agreement to insure satisfactory standards of operation and maintenance. . . .

"The design of the St. Lawrence State Park has been progressed with particular emphasis upon the use of the lake. . . . A permanent park headquarters, overlook shelters and concession stands, and camping and picknicking areas, including the necessary related structures, will be constructed as a part of the project. . . .

"The power house will include exhibition rooms, an auditorium, a penthouse, and a promenade overlooking the lake. Ample visual and audible aids will be employed to demonstrate the operation of the project. An attractive approach drive with automobile parking for visitors will be provided. Overlooks incorporated in the park are being situated to show off the principal features of the power project. . . .

"The main highway that leads to Canada from Route 37 to the Polly's Gut bridge will be taken over by the State after completion of construction and maintained as a state highway. . . . The Authority has authorized the acquisition of easements for 1,000 feet each side of the highway to protect against the construction of advertising signs and bill boards. . . .

"It has been apparent to the Authority and to some of the bordering municipalities that a power project of this magnitude will require the adoption of local regulatory measures to insure the orderly expansion of the communities affected. . . . The Authority does not wish to interfere in any municipality's efforts to establish regulatory measures but is prepared to lend technical and advisory assistance through its staff and consultants to any of the towns or villages in the planning and zoning of their communities.

"We have indicated three possible areas between Massena and Ogdensburg where industrial plants and other commercial developments could locate advantageously. These areas are desirable because of low cost power, convenient railroad facilities and frontage on the seaway. Substantial acreages could easily be assembled by industry interested in locating on the St. Lawrence. . . .

Progress by SLSA

A contract for construction of St. Lambert lock and approaches in the Lachine section of the seaway has been awarded to McNamara Construction Company Limited, Pigott Construction Company Limited and Peacock and McQuigge Limited, all of Toronto, in joint venture. The successful bid, lowest of five tendered, amounted to $7,399,472. The work is to be completed by August 31, 1958. This contract is the twenty-eighth to be awarded by the St. Lawrence Seaway Authority and brings the total value of these contracts to approximately $57 million.

This lock is one of two locks to be built in the Lachine section, the other being the Côte Ste. Catherine lock, on which construction began last fall. To be built at the south shore end of the Victoria bridge, the St. Lambert lock will be the most easterly lock of the seaway. SLSA is to build five locks. The other two will be built by SLSDC in the international section.

The bulk of the work on the St. Lambert lock contract extends some 5,000 feet. It consists of construction of the lock, together with the excavation of the navigation channel and construction of the concrete walls which form the entrances to the lock. The contract also includes 48-inch water supply intake pipe for the city of St. Lambert and the CNR, with connection to existing intake works. Quantities involved include excavation of some 2,400,000 cubic yards of material and some 405,000 cubic yards of concrete.

Key Construction Limited and Deschamps & Belanger Ltée., both of Montreal, in joint venture, have been awarded a contract for a building to house hydraulic models at Ville LaSalle (St. Patrick Street) near Montreal. Value of the contract is $572,492. Construction of the building must be completed by the middle of May, this year.

On December 6, 1955, it was announced that Neyrpic Canada Ltd. of Montreal had been awarded a contract for the construction and verification of hydraulic models of Montreal harbour and of the Lachine rapids and for various test programs to be conducted on these hydraulic models. The building will house the models built and operated by Neyrpic Canada Ltd. This building will be 267 feet long by 115 feet wide. Specifications for its construction include steel structure, concrete work, prestressed concrete slab and also some asphalt flooring and all electrical, heating and ventilating systems.

Officials of the St. Lawrence Seaway Authority visited the Panama Canal Zone, as guests of the secretary of the Army of the United

States and the Saint Lawrence Seaway Development Corporation. The purpose of the trip was to observe the procedures of handling cargo ships and the collection of tolls through the Panama Canal.

They met at Washington, D.C., with the United States seaway party, headed by Lewis G. Castle, SLSDC administrator, and journeyed by air together, leaving Washington, January 18 for the Panama Canal Zone and returning to Ottawa January 23.

Progress by SLSDC

Low bid on a contract for the Robinson Bay lock was submitted January 10 to the Buffalo District, US Corps of Engineers, construction agent for SLSDC, by a joint venture Morrison Knudson-Walsh-Perini group, at a price of $20,172,451, the lowest of six bids.

The lock will be located about three miles east of Massena, being the furthest upstream of two locks on the Long Sault canal, the 10 mile channel south of the Long Sault rapids, the biggest man-made ditch on the seaway.

The structure will be of the concrete gravity type 860 feet long, 80 feet wide, and will have a 49 foot lift. The walls will be from 105 to 115 feet high. Approach walls will be ¾ of a mile in length. It is the first major SLSDC construction project, most contracts already awarded having been for excavation projects. Completion is called for in May 1958.

Ogdensburg Bridge

In an exchange of correspondence late in December respecting the subject of the Ogdensburg bridge, Lewis G. Castle SLSDC administrator stated in a letter to Hon. Robert Moses, NYSPA chairman, that he felt the bridge may become an eventuality, but the timing of its construction may have to be delayed until a later date when traffic count can be more accurately determined, and thus possibly provide a larger revenue bond issue to furnish funds for a larger percentage of construction cost.

The suggestion of a highway over the Iroquois control dam, he added, did not appear a good alternative, because of the 25 mile distance to be travelled between Ogdensburg and Prescott. Moreover, it would involve building two bridges in the Iroquois lock and a similar installation at Point Rockway, should the United States at some time in the future build a parallel lock at that location. He questioned if the Canadian Seaway Authority would consent to the bridge installation.

In his reply to Mr. Castle, the Hon. Robert Moses, commenting that the two authorities were in substantial agreement regarding the Ogdensburg bridge, pointed out SLSDC and NYSPA have a limited scope of activities defined by law, license and bond indentures. They were not directed or even authorized to take on or expedite the construction of the Ogdensburg bridge.

Other Seaway News

After receiving final submission on the issue of excluding British ships from trade between Canadian ports on January 11, the Royal Commission on Coastal Shipping adjourned to write its report to the Federal Government. There was no indication of when this might be completed.

General manager W. J. Fisher of the Canadian Shipowners Association, representing operators of Canadian owned deep-sea ships, proposed a middle course between extremes of opinion ranging from free British access to coastal trade, to outright exclusion of all but Canadian-built and owned ships.

He suggested that on inland waters the all-Canadian coastal trade be limited to ships owned in Canada but registered anywhere in the Commonwealth. Exclusion of British shipping, he said, would give Canadian shipping a monopoly through which it could well price itself out of the market, and thus be self-defeating. For the assistance of shipyards he suggested federal sponsorship of a shipbuilding program for ocean going ships.

Vice-president Arthur Simard of Marine Industries called for restriction of trade to Canadian built and owned vessels as a means of helping Canada's shipping and shipyards. Elimination of the coastal privileges now given British ships would ensure survival of Canada's shipbuilding industry.

Partial Lachine Development

It is reported Hydro-Québec is studying alternatives to the original idea of a single stage development for the full 1,200,000-hp potential of Lachine power immediately below Victoria bridge, which involves difficult problems respecting transportation arteries across the river.

One possible alternative being considered is a two stage development, with the first stage a dam and power house at Heron Island in the Lachine rapids and opposite Côte St. Catherine. This first stage would develop the larger half of the available power in the Lachine section, leaving the remainder to be built at a later date below the Laprairie Basin. Construction at Heron Island might also provide a means of controlling the level of Lake St. Louis if and when necessary.

Air view of excavation on overland navigation channel near Cote St. Catherine. Heron Island at Lachine Rapids, in background, is probable location for upstream of two future power developments by Hydro-Quebec.

Newsletter for Branch Members

Recently headquarters has received a copy of a newsletter issued to their members by the executive of the Belleville Branch. It seems such an excellent idea that it is now being passed on to other branches in the hope that they too may find it of interest and value.

The letter comes on two pages and is in letter press form. However, a mimeographed letter might be equally acceptable if it should be more convenient to other branches to print it that way.

Among other things the letter tells of the proposed program for the following season and gives the names of the members of the executive committee. It then goes on to talk about prizes available to members and also devotes considerable space to talking about the professional development course. Incidentally, the Belleville Branch has made an excellent showing in these P.D. courses.

Reference is made to the Canadian Committee on Counselling in Engineering and Science and the representative of that committee in the Belleville Branch. It suggests that any persons who desire counselling in these matters should get in touch with the representative.

The letter concludes with the request that members will not hesitate to send in their comments on the letter and on the branch activities. The executive hopes that through the contacts made by the newsletter, members will be encouraged to take a closer interest in branch affairs.

The executive of the Belleville Branch is to be congratulated on this enterprising effort.

Joint Boiler Meeting, Montreal, June

Some of our readers may remember that a meeting of the ASME Boiler Code Committee was held in Toronto in the spring of 1952. This year they are coming to Canada again, but this time for an even larger and more important gathering. Once each year the National Board of Boiler and Pressure Vessel Inspectors of the United States meets jointly with the ASME Boiler Code Committee in a centre other than New York. For 1956 this meeting will be held in Montreal.

Arrangements have been made on behalf of C. O. Myers, secretary-treasurer of the National Board for the meetings to be held at the Windsor Hotel, Montreal, on June 19, 20, 21, 22 and it is hoped that as many Canadians as possible will plan to attend.

Provision is being made for an open panel discussion dealing with all sections of the Boiler Code, on Wednesday, June 20, and a similar panel discussion dealing with welding repairs on the afternoon of Thursday, June 21. On Thursday morning it is planned to hold meetings of two or three of the Boiler Code subcommittees while the National Board holds its regular meeting in camera. Finally there will be a meeting of the main committee of the ASME Boiler and Pressure Vessel Code on Friday morning and afternoon.

A. LaBissonniere

Large Machinery Trailer

This machinery trailer, made in Woodstock, Ont., and weighing 78,500 pounds, is believed to be the largest ever built in Canada. The payload capacity is 220,000 pounds. For more details please refer to the December 1955 *Engineering Journal*, Page 1745.

The program is expected to include a number of social events such as receptions, luncheons, and a dinner dance as well as special

H. G. Thompson, M.E.I.C.

attractions for the ladies who will be particularly welcome.

Special arrangements are in the hands of Alfred LaBissonniere of Montreal, chief inspector of pressure vessels for the Province of Quebec and a member of the executive of the National Board, assisted by the executive assistant secretary of the Engineering Institute of Canada, H. G. Thompson, and a strong local committee including: A. M. Bain, M.E.I.C.; J. Bajada; K. H. Barnard; E. H. Brooke, M.E.I.C.; H. E. G. Dupuy, M.E.I.C.; H. M. Esdaile, M.E.I.C.; I. P. Fitzgerald; P. W. Gooch, M.E.I.C.; H. C. Hood, M.E.I.C.; J. D. Hood; G. N. Martin, M.E.I.C.; T. L. Noel; and M. D. Phillips.

January Journals Needed

The supply of January 1956 *Journals* is low, and there are requirements that have not been filled.

It would relieve the situation if readers who do not file or bind *The Engineering Journal*, would return copies of that issue to Headquarters.

Fraser River Dredging

A new dredge will be used by the Department of Public Works in the dredging operation on the Fraser River Delta, B.C., which has been a continuous necessity for many years.

Designed and constructed by Messrs. Yarrows Limited, Victoria, B.C., this is a non-propelled, heavy duty, hydraulic pipe line dredge, of the following dimensions: length overall, 150 ft.; breadth moulded, 40 ft.; depth moulded, 10 ft. 6 in.; draft, midship section, 6 ft. It is designed for dredging to a maximum depth of 45 ft.

The rigidly constructed steel suction ladder installed in the forward end of the hull contains a 24-in.-dia. suction pipe; and mounted on it is the cutter with drive shaft and bearings, driven by a 250-hp. electric motor.

At the after end is a structure for raising and lowering the "spuds" in guides, these being of tubular welded steel construction 30-in. dia. and 69 ft. long.

A 20-in. pipe on the port side and a 20-in. pipe line on pontoons discharge the spoil beyond the banks of the river. Silt, sand, clay and gravel can be handled through the system to a terminal height of 10 ft. above water level; the capacity of the diesel driven pump is 13,500 gal. per min. of spoil at 1.2 specific gravity, velocity 14 ft. per sec.

Progress of the dredge in operation is by means of wire rope haulage on each side of the suction ladder pivotting alternatively on a stern spud. As the dredge cutter moves through the silt, a swinging action is set up and the dredge advances "walking" from side to side by alternate raising and lowering of the spuds to the river bottom.

The dredge master conducts operations from the control room by electric and pneumatic controls.

Fraser River dredge.

Elections and Transfers

At the meeting of Council held at the University Club, on Friday, January 27, 1956, a number of applications were presented for consideration and on the recommendation of the Admissions Committee the following elections and transfers were effected:

Members:

I. R. Booth, *Montreal*
F. E. Burke, *Montreal*
J. B. Clarke, *Winnipeg*
R. E. Claudi, *Montreal*
H. J. K. Darling, *Calgary*
M. K. Douglass, *Vancouver*
H. P. Horlock, *Hamilton*
A. V. Johnston, *Montreal*
R. C. Keene, *Toronto*
J. W. Martin, *Mill Haven*
J. E. Nelligan, *Montreal*
G. Parrott, *Guelph*
M. Price, *Ottawa*
J. G. A. Stevenson, *North Bay*
D. C. Turner, *Cardinal*

Juniors:

K. D. Adams, *Calgary*
P. B. Franz, *Temiskaming*
H. J. Leutheusser, *Toronto*
K. MacKay, *Ft. William*
C. A. McCurdy, *Hamilton*
I. C. Martin, *Kitchener*
E. Noussan, *Montreal*
E. G. Phillip, *Kitchener*
J. M. Sargent, *Brockville*
H. W. Watson, *Moncton*

Transferred from the class of Junior to that of Member:

A. Baracos, *Winnipeg*
H. W. Beckett, *Salmo, B.C.*
C. W. Case, *Chatham*
C. B. Cooper, *Pointe Claire*
D. Danylkiw, *Montreal*
G. J. Foley, *Winnipeg*
R. F. MacKenzie, *Toronto*
H. D. McLellan, *Kitimat, B.C.*
C. H. Miller, *Toronto*
L. E. Rodway, *Calgary*
H. I. Thomas, *Edmonton*
J. Wartena, *London*

Transferred from the class of Student to that of Junior:

S. Narvey, *Toronto*
L. C. White, *Toronto*

The following Students were admitted:

University of British Columbia

L. T. Assimes — N. Malychuk
W. G. Botel — J. S. Mawdsley
N. P. Brooks — T. R. Meadowcroft
A. D. Bradshaw — R. Metzker
J. W. Carlyle — M. M. McKenzie
R. S. Charlton — J. A. McLean
C. Clark — E. Ounpuu
D. M. Davidson — W. E. Rusk
C. A. Day — S. Saimoto
G. G. Dempster — J. G. Sanderson
D. P. Dodge — R. A. Savage
A. D. Drummond — F. G. Schrack
J. H. Duerksen — W. J. Solonecki
H. A. Featherstone — J. R. Stanhope
R. M. Giegerich — J. G. Steeves
A. S. Haldeman — G. E. Taylor
J. D. Hankinson — B. A. Tweddle
D. G. Hay — G. A. Tzvetcoff
H. M. Hayward — J. Walsh
J. Jezioranski — J. A. Watson
R. G. Keech — J. W. Wedler
A. J. Kempe — O. R. Widholm
A. Kuhn — R. K. Wiltse
H. O. Lacy — E. V. Zydyk

University of Toronto

A. C. Emmott — G. J. Oliver
T. R. Fountain — A. G. Sale
R. B. McArthur — B. C. Wray
R. R. McCuaig

Queen's University

J. A. Barber — D. E. Srigley
G. F. O'Hara — K. Van Dalen
W. T. Patterson — J. D. West

Dalhousie University

W. G. Roberts

Ecole Polytechnique

G. Belanger

Nova Scotia Technical College

A. E. Creelman — E. C. J. J. O'Brien
J. D. Hodd — C. J. Scott
J. M. Marcinov — K. E. Tingley

University of New Brunswick

J. R. Holyoke — R. E. Platts
R. E. Ketch — J. A. Swim
F. E. Kimball

Mount Allison University

R. S. Butler — D. M. Watt
G. E. Frampton

McGill University

E. A. Asistores, Jr. — D. M. Palko

University of Alberta

J. S. Bereznicki

Loyola College

A. D. Greciano

Graduates

H. B. Fleming, B.A.Sc., (Chem.), Queen's, 1955.
K. Meipoom, B.Sc. (Civil), Toronto, 1955.
J. M. Tannenbaum, B.A.Sc., (Civil), Toronto, 1955.

Applications through Associations:

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections and transfers have become effective:

ALBERTA

Members:

A. C. Dalrymple — L. R. Lauer
E. V. Hunt — R. E. Morton

Junior:

G. A. McNeill

Junior to Member:

R. N. Dalby — J. H. Keating

SASKATCHEWAN

Members:

E. Amendolagine — J. H. Heather
R. E. Anderson — G. J. McLeod
A. C. Cluff — H. van Hees
E. E. Erling — W. G. Wegenast

Students:

S. G. Bruskiewich — E. E. Lepine
L. B. Crawford — J. Martin
C. Fedosiewich — B.W. Mickleborough
G. F. Furse — J. R. Moar
R. M. Halyk — E. N. Parsons
H. M. Hill — E. C. Sherwin
D. M. J. Kent — E. A. Stumborg
M. H. Kuervers — R. B. Thompson

Junior to Member:

J. L. Campbell — R. C. Strayer
K. J. Newbert — D. C. Taylor

MANITOBA

Member:

J. Conrad

NOVA SCOTIA

Members:

J. H. Evans — H. Rounsefell
G. H. Lilly

Junior to Member:

K. R. Langille — J. E. Peters

News of Other Societies

American Society of Mechanical Engineers (29 West 39th St., New York, N.Y.). . . . The 1956 spring meeting will be held at the Multnomah Hotel in Portland, Oregon, March 18 to 21.

The full program, with 16 technical sessions of importance has been arranged. Several will be devoted to various phases of the wood industries. Also, there will be three sessions dealing with nuclear engineering, while other subjects on the program include material handling in airplane manufacture, power, fuels, gas turbines and material processing.

E.I.C. members will be welcome to attend without payment of a registration fee. Full particulars may be obtained from E.I.C. or ASME headquarters.

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Canadian Electrical Association (Tramways Bldg., Montreal 1). . . . Divisions in the Western Zone will hold meetings at the Macdonald Hotel, Edmonton, March 19-21.

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Canadian Institute of Timber Construction (150 Wellington St., Ottawa 4). . . . The 1956 annual meeting will be held on March 27-29, at the Royal York Hotel, Toronto.

The Chemical Institute of Canada (18 Rideau Street, Ottawa 2). . . . Schedule of meetings is as follows: February 23, conference of Protective Coatings Division, at the Royal York Hotel. Toronto; February 24, conference of Protective Coatings Division, Ritz-Carlton Hotel, Montreal; March 5-7, conference of Chemical Engineering Division, Guildwood Inn, Sarnia; May 28-30, annual conference and exhibition, Sheraton-Mount Royal Hotel, Montreal.

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Cleveland Engineering Society (2136 East 19th St., Cleveland 15). . . . Design for Profit is the theme of the annual machine design conference, March 5, 1956.

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Prospectors and Developers Association . . . Atomic Energy of Canada Limited will have an exhibit at the annual meeting of this association. Royal York Hotel, Toronto, March 5 and 6, 1956.

This exhibit will be open to the general public and staff members of A.E.C.L., Ontario Hydro, Canadian General Electric will explain exhibit material and discuss atomic energy developments and atomic power.

Thirty-five Years Ago

Comment on the *JOURNAL* of February 1921

Are we getting mature, is it a reflection of our changed corporate personality, have we less of which to be proud, or why is it that the official literature of the *Institute* is now a lot less colourful than it used to be? Take, for example, the reports for 1920 of Council and of its various committees as published in the *Journal* for February, 1921.

Council thought it "particularly gratifying to report the splendid professional meetings held during the past year", while the Committee on Policy lauded Council for having "established precedents which make the *Institute* one of the most progressive and practical professional engineering bodies in the English-speaking world. . . . In its support . . . of fundamentally important matters . . . the *Institute* gives place to no other comparable organization. . . . Progressive and often pioneer action . . . has been taken by the *Institute* . . ."

All of these statements may be quite true, but I doubt if any of us would express them as positively or in quite as flamboyant language today. By 1921 the *Institute* had proved to itself that it was a really important organization and it made no bones of saying so publicly. I think we are just as useful and important today as we were then—certainly we do a good deal more for our members—but we hesitate to make claims involving even a tinge of boastfulness.

A Report of Activities

Financially, the *Institute* wound up 1920 with a surplus of about $6,100, most of which was contributed by the *Journal*, whose advertising revenue had reached about $28,000. Some of this increase came through branch solicitations; the branches were being given a commission on any advertising they might sell. This was a bonanza to some of them; one collected $390 in a few months, almost enough to pay all its expenses for a year.

Our membership stood at 4,173, including 124 applications pending. It had grown by 836 during 1920, or by about 26 per cent. which must be a near record, if not a record. Almost every branch had an enthusiastic membership committee, actively engaged in rounding up all unattached engineers in its territory.

This large increase in membership brought the *Institute* face to face with problems of finance. More income had to be found if it were to continue to give its members the services they had been getting, let alone expand and improve. So a proposal to raise fees was submitted to the Toronto annual meeting, where it was soundly rejected. This action seems to have been taken only by those present at the meeting; there is no hint that absent members had any opportunity to vote by letter ballot.

There were 23 donations to the library during 1920, most of them pamphlets, including one entitled "Righteousness vs. Religion". Perhaps the author, one of our members, thought his fellows in need of redemption. I wonder if we still have the pamphlet and if it were ever circulated at all.

Six Technical Subjects Treated

The principal technical paper in this issue was "Mechanical and Electrical Equipment of the Toronto Union Station", by W. J. Armstrong, A.M.E.I.C., then associated with Ross & Macdonald, the architects of the building. Mr. Armstrong's detailed description showed that there was nothing very novel in most of the design. There was one noticeable feature, however. Steam for heating was purchased and the condensate did not have to be returned, so it was used for the domestic hot water supply, requiring only a little heating to bring it to the required temperature.

The whole east wing of the building was occupied by Postal Station A and was especially designed for that purpose. Here a complete system of conveyors for handling mail was installed, as well as galleries for the inspectors. Each inspector was to carry a portable telephone, which he could plug in at any of 40 stations to communicate with any other inspector on duty or to put through an external call. There was not much chance for a clerk to steal a letter with these bloodhounds watching him.

T. Linsey Crossley, A.M.E.I.C., had a paper on the Canadian pulp and paper industry in this *Journal*, which I found interesting. It was not very technical and would probably not appeal to a pulp and paper man, but to an outsider it gave a lot of information that he should have welcomed. Mr. Crossley was one of those rather rare engineers who can write well and with a touch of subtle humour. Did you know that our first paper was made at St. Andrews, Que., in 1803? And did you know that Mr. Crooks won a prize of £100 offered by Upper Canada for the first paper made in that province, beating John Eastwood and Colin Skinner by a few days only? With its statistics brought up to date, this paper would serve well as a general description of the Canadian pulp and paper industry today.

One can't say as much for "Present Day Illumination Standards", by G. C. Cousins. Artificial lighting in 1920 and in 1955 have little in common. We use equipment and methods undreamed of then, although our objectives are still much the same.

Mr. Cousins' paper was followed by "Municipal Engineering", by R. O. Wynne-Roberts, M.E.I.C. His contention was that the municipal engineer did not get the recognition to which he was entitled and he attempted to prove his case through historical references, backed up by a smattering of recent statistics. I must say that I was not much impressed by this paper, which I doubt if we would publish today.

In 1921 the activated sludge process of sewage treatment was new on this continent, though Houston, Tex., had a 15 million gallon plant and Milwaukee, Wis., was building a larger one. It was but natural, then, that the *Journal* should publish a paper on this topic by G. C. Nasmith. Some of Mr. Nasmith's tentative predictions have proved wide of the mark. For dewatering sludge he gave pressing little future, which turned out to be true, but he also thought centrifuging likely to become the standard method, which it has not. Apparently, vacuum filters had not then been considered: now they are the most commonly used apparatus.

In a well-written paper, Frank Barber, A.M.E.I.C., took issue with the *Institute's* standard specifications for concrete and reinforced concrete. While detailed with respect to design, he thought them much too loose in their clauses covering construction methods and materials; there was too much use of "if practicable", "approved", "as ordered by the engineer" and similar phrases. He believed it quite practicable to write much more precise clauses covering the construction side of concrete work, which would yet be fair to the contractor, and illustrated his points by copious quotations from his own specifications for bridge forms and centering.

Another paper on concrete was "On the Economics of Building Design", by J. M. Oxley, A.M.E.I.C. Though it occupied only seven pages in the *Journal*, it must have represented an immense amount of work, for it derived costs per square foot of floor for a selected type of concrete warehouse or factory of any number of stories from one to eight. Only the structural elements were considered; the costs of heating, plumbing, lighting, elevators, etc., would have to be added. Of course, the actual figures given are of little use today, but they might still be used for rough estimates if corrected by the application of the proper index numbers.

Perhaps I appreciate this paper more than most readers did, for I once had to make similar calculations for another type of structure. I ended with reams of calculations, but you could put the final results on a couple of sheets of paper.

A thumbnail biography of J. M. R. Fairbairn, M.E.I.C., the incoming president of the *Institute,* was given in this *Journal.* Jack Fairbairn was everything this note says he was and more, but I am willing to wager that the fulsome adjectives the writer dredged out of his subconscious embarrassed Jack. In fact, I think the whole note in rather poor taste.

Institute Business

Most of this *Journal's* editorial section was given over to a condensed account of the business transacted at the Toronto annual meeting in January, 1921. Nothing startling occurred, except, as I have already said, a proposal to increase membership fees was flatly rejected.

For the first time in several months a few letters from members were published. One described a simple method of binding the magazine into yearly volumes, another pleaded for a more responsible status for Juniors and the third attempted to explain the meaning of "subordinate engineer", as used in the proposed Ontario licensing act, not too successfully.

Branch news was pretty humdrum, though the Niagara Peninsula members were a little suspicious of the licensing act drawn up by the provincial section and refused to endorse it until some of their questions were answered.

Closing this *Journal,* there is only one question I want to have answered, "How did the *Institute* increase its income?" For that, I suspect I shall have to wait some months.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Allan Keay Grimmer, M.E.I.C., mayor of Temiskaming, Ont., died in Temiskaming on January 1, 1956. Mr. Grimmer had been the mayor for 32 years.

Born in St. Andrews, N.B., on June 4, 1882, Mr. Grimmer received his B.A. degree from the University of New Brunswick in 1905, and his M.Sc. degree in 1907. During the summers of his university courses he was employed as rodman and instrumentman with the C.P.R. western Ontario surveys, and as resident engineer with York and Carlton Railway. After graduation he was city engineer at Fredericton, N.B., for three years before going to the University of Manitoba as assistant professor of civil engineering for one year.

From 1910 to 1915 Mr. Grimmer was city engineer at Medicine Hat, Alta., after which he returned to Fredericton to work as a consulting engineer. He designed and built the mechanical filtration plant for Woodstock, N.B., and other engineering works in the province. In 1918 he was employed on the reconstruction of Halifax after the explosion. Later he supervised the construction of a seaplane base in Sydney, N.S.

Mr. Grimmer went to Temiskaming in 1919 as town department engineer, later becoming town department manager for the Riordan Company, and its successor, Canadian International Paper Company Ltd. He retired as town department manager in 1952, but was retained as consultant by the company. Mr. Grimmer was in charge of the complete development of Temiskaming, incorporating modern installations of water, sewers, automatic telephone system, etc. He also supervised the construction of the Townsite of Thorne, Ont. He was chairman of all Victory Loan campaigns and of the ration board during World War II, and was regional chairman of the Canadian Federation of Mayors and Municipalities.

A. K. Grimmer, M.E.I.C.

He was a member of the American Water Works Association, the International City Managers Association, the Association of Professional Engineers of Ontario, and of the Corporation of Professional Engineers of Quebec.

Mr. Grimmer joined the Engineering Institute in 1910 as Associate Member and transferred to Member in 1920. He attained life membership in 1947, and served on the Council of the Institute in 1953.

Rupert Henry Vaughan, M.E.I.C., retired Department of Public Works engineer, died on November 3, 1955, at Oliver, B.C.

Mr. Vaughan was born in Sydney, Gloucester, England, on May 5, 1883, and received his general education at Tonbridge School, Kent, England. He studied engineering privately at Stony Stratford, Glasgow, and at Paisley, and then worked as a junior draughtsman at Arrol-Johnstone Motor Works at Paisley, and at Lanchester Motor Works in Birmingham.

Mr. Vaughan came to Canada in 1908 and joined the Esquimalt and Nanaimo Railway in British Columbia, working as rodman, leveller, and transitman, until 1915, when he went overseas with the British Expeditionary Force and served as a lieutenant. At the end of the war he returned to the railroad as assistant engineer of maintenance of way. In 1922 he joined the engineering staff of the Ocean Falls Pulp and Paper Company in B.C. and remained with them until 1933. From 1933 to 1937, Mr. Vaughan was in charge of relief camps in the Fraser Valley of British Columbia, and then joined the British Columbia Department of Public Works. as resident engineer at Duncan, B.C. He remained with the Department of Public Works until his retirement in August. 1955.

He became an Associate Member of the Engineering Institute in 1921 and transferred to Member in 1940. Mr. Vaughan attained life membership in the Institute in 1952.

LeRoy Brown, M.E.I.C., president and general manager of L. R. Brown & Company Ltd. in Sault Ste. Marie, Ont., died on September 10, 1955, in Sault Ste. Marie.

Born at Delhi, Ont., on August 23, 1891, Mr. Brown received his B.A.Sc. degree from the University of Toronto in 1915. After graduation until 1921 he worked in various capacities with the Toronto Chemical Company, the Algoma Steel Corporation, Dominion Tar and Chemical Company, and with the Newfoundland Power and Paper Company at Cornerbrook, Nfld.

Mr. Brown was city engineer of Sault Ste. Marie from 1921 to 1926. From that time on he was engaged in private construction work, and since 1934, under the name of L. R. Brown and Company Ltd.

He joined the Engineering Institute as a Student in 1914, transferred to Associate Member in 1917 and to Member in 1940. Mr. Brown was an active member of the Sault Ste. Marie Branch of the Institute, having served as a councillor in 1948 and 1950.

Henri A. Gibeault, M.E.I.C., former director of Public Works for the City of Montreal, died on November 5, 1955, at his home in Montreal.

Born in Montreal on April 1, 1885, Mr. Gibeault graduated from the College de Montreal and received his civil engineering degree from the Rensselaer Polytechnic Institute in 1908. Following graduation he was named associate professor in civil engineering at Villanova College in Philadelphia. Returning to Canada in 1914, Mr. Gibeault became assistant engineer of municipal improvements for the town of St. Lambert, Que. In 1920 he was appointed to the position of chief examiner of the Montreal Municipal Service Commission.

Two years later he joined the Montreal Public Works Department as assistant to the director, becoming assistant director in 1930, and also assistant chief engineer for the city in 1937. In 1942 Mr. Gibeault became director of the Public Works Department, the position he held until his retirement last year. His services were retained, however, by the city after his retirement, as consultant in connection with the St. Lawrence Seaway.

Mr. Gibeault was a member of the Canadian Institute of Sewage and Sanitation, the American Public Works Association, and the Corporation of Professional Engineers of Quebec.

He became an Associate Member of the Engineering Institute in 1915 and transferred to Member in 1940. Mr. Gibeault had attained life membership in the Institute in 1951.

Walter A. Rush, C.B.E.I., M.E.I.C., former controller of radio for the Department of Transport, died in Ottawa on September 27, 1954.

Mr. Rush was born in London, England, on April 25, 1880. He graduated from Faraday House in London, receiving honours in technical and theoretical courses in electrical standardization testing and training. He received his early experience with British electrical firms, among them the Bristol Corporation Electric Light and Power Works.

In 1905, Mr. Rush came to Canada and joined the Marconi Wireless Telegraph Company of Canada and was engaged on the construction and operation of radio stations on the east coast. He was engineer in charge of the Cape Race station in Newfoundland in 1911. He joined the Department of Naval Services in 1912 as chief inspector of the wireless service, and when radio came under the Department of Marine and Fisheries in 1922 he was named division superintendent of radio telegraph services. In 1936 the newly-formed Department of Transport named him controller of radio for the air services branch.

Mr. Rush represented Canada at numerous international conferences on radio from the North American Radio Communications Conference in Ottawa in 1929, and the International Radio Consulting Committee at The Hague the same year, to the Commonwealth Communications Council meeting in London and the Third Inter-American Telecommunications Conference in Rio de Janeiro in 1945.

During both world wars Mr. Rush was engaged on setting up coastal radio detection stations for locating German submarines and intercepting their short wave messages. During the second world war he developed the intricate radio system needed to support the expanded R.C.A.F. and the British Commonwealth Air Training Plan and the Ferry Command.

Mr. Rush was credited with many substantial contributions to the development of radio, radio communications and its adaptation to radar in Canada. He retired nine years ago after 34 years with the federal government.

He was a Fellow of the Institute of Radio Engineers, and served as vice-president of that organization in 1942. He also received a medal in 1946 from the Professional Institute of Civil Engineers of Canada, and that same year was awarded his C.B.E.

Mr. Rush became an Associate Member of the Engineering Institute in 1921, and a Member in 1940. He attained life membership in the Institute in 1951.

Alan MacKenzie James, M.E.I.C., lands and rights engineer and rural electrification engineer with the Nova Scotia Power Commission, died on October 16, 1955, at his home in Halifax, N.S.

Mr. James was born at Halifax on November 8, 1890. He received his B.Sc. degree from Dalhousie University and then studied mining engineering at Nova Scotia Technical College. From 1915 to 1919 he was on active service with the Canadian Field Artillery in France and England.

Returning to Canada, Mr. James was employed for a time as manager of Dunbrack Lead Silver Mine at Musquodoboit, N.B., and then in 1920 he joined the Nova Scotia Power Commission as engineer on field surveys, subsequently becoming rural electrification and land and rights engineer with the commission at Halifax.

Mr. James became a Member of the Engineering Institute in 1940.

Henry Morton Lake, M.E.I.C., special engineer with Algoma Steel Corporation Ltd. in Sault Ste. Marie, Ont., died on October 26, 1955 in Sault Ste. Marie.

Mr. Lake was born in Toronto on July 18, 1890, and received his general education in Willesdon, London, England. While working as machinist and fitter with the Grand Trunk Railway at Lindsay, Ont., he followed engineering studies through International Correspondance Schools. In 1910 he was employed as a draughtsman with Algoma Steel Corporation Ltd. During the first world war Mr. Lake was in business for himself working on structural steel design and fabrication.

At the end of the war he rejoined Algoma Steel as assistant chief draughtsman, and in 1925 became chief draughtsman and assistant chief engineer for the company, a position he held until 1954. Mr. Lake was then named special engineer for the company, the position he held until his death.

Mr. Lake became a Member of the Engineering Institute in 1944.

Harry Stanley Rimmington, M.E.I.C., bridge engineer for the Canadian National Railways at Winnipeg, died on October 24, 1955 in Winnipeg, Man.

He was born in Toronto on December 7, 1890, and received his early education there at Harbord Collegiate. Entering the University of Manitoba in 1907, he graduated in the first engineering class of that university in 1911, receiving a degree of bachelor of civil engineering.

Upon graduation Mr. Rimmington began his 45 years of continuous service with the bridge department of the Canadian National Railways. He progressed through positions of assistant engineer, designing engineer, assistant bridge engineer, and in 1945, was named bridge engineer for the western region of the C.N.R.

Mr. Rimmington was a member of the American Railway Engineering Association, and of the Association of Professional Engineers of Manitoba, having been president of the latter organization in 1944.

He became a Member of the Engineering Institute in 1952.

NEWS OF THE ASSOCIATIONS & CORPORATION

Information received through co-operation with the provincial organizations

Ontario

Merritt W. Hotchkin Elected President

Nearly a half century of active participation in most of the western hemisphere's mining fields has done nothing to dull the lustre and challenge of such a vocation in the eyes of Merritt Windes Hotchkin, newly-elected president of the 14,000-member Association of Professional Engineers of Ontario.

M. W. Hotchkin

Mr. Hotchkin, a resident of Kirkland Lake, Ontario, assumed the Association's highest office in January, succeeding John R. Montague, of Toronto.

In his career as prospector, mining engineer and geologist, he has worked in many of the active mining areas of Canada and the United States.

He is currently associated with Wright-Hargreaves Mines Ltd., as engineer-in-charge of outside exploration.

Born in Chicago, the son of a medical doctor, Mr. Hotchkin plunged into the practical end of mining even before he graduated from Michigan School of Mining and Technology, class of 1908. For one and a half years prior to graduation, he worked in the mining and milling industry in western United States and Alaska.

After receiving his B.S. degree in mining, he spent the first three years prospecting the Gowganda and Porcupine areas with an associate and discovered in Porcupine what he described as "an economic deposit of gold ore", that is currently producing.

His find was sold to copper king F. Augustus Heinzie and with part of the proceeds, he bought control of a group of mining claims in the Kirkland Lake district, now known as Sylvanite Gold Mines Ltd.

Shortly afterwards, he began engineering work at the Tough Oakes Gold Mines Ltd., owned by the late Sir Harry Oakes and associates; and soon was its manager. However, production ceased shortly after the outbreak of World War I when the rich surface vein systems were cut off by extensive north and south faulting in the rock.

During the war, Mr. Hotchkin worked for the British Imperial Munitions Board under the late Sir Henry Flavelle, in Ottawa, and was in charge of molybdenite production, a metal used in the hardening of steel for airplane crank shafts and for making armor-piercing shells. In 1917 he was awarded the degree E.M. (Engineer of Mines) for accomplishment in the mining industry.

Following World War I, he returned to his mining engineering career, carrying out base metals exploration for himself throughout Canada, certain states in the United States and Mexico.

Then in 1929, when the base metal industry had reached its peak and began to decline, he joined forces with two friends in a small exploration company. Mr. Hotchkin's job was to find a gold mine for the company.

He recommended the Tough Oakes mine, despite discouraging reports from engineers and geologists. Unable to raise funds for exploration work, in Canada, he went to New York and interested the American Smelting and Refining Company in its potential. One year later, after exhaustive examination and detailed underground geological mapping, Mr. Hotchkin located the faulted portion of the high grade ore body, which turned out to be one of the richest gold veins found in Canada. Between 1932 and 1953 when it was closed down, Toburn Gold Mines Ltd., with Mr. Hotchkin as general manager, produced some $15,000,000.

In addition to being general manager of Toburn he was assigned the duties of vice-president and managing director of Asarco Exploration Company of Canada Ltd., a wholly owned subsidiary of the American Smelting and Refining Company of New York.

Following his retirement from Toburn in 1953, he returned to his "first love"—exploration work, and became associated with the Wright-Hargreaves Mines as engineer in charge of outside exploration, a position he currently occupies.

Married, with two married children, Merritt Hotchkin lives with his wife in Kirkland Lake. He is an active sportsman, with curling and golf his chief pastimes. He has been active in northern Ontario baseball and hockey association work and civic affairs and is also vice-president of the Canadian Seniors Golf Association (for golfers over 55).

He is also one of the few men to be an honorary life member of the Canadian Legion, an honour bestowed upon him in 1947 for his active interest in that organization.

In addition to his affiliation with the A.P.E.O. since 1937, he is a past president of the Ontario Mining Association, a member of the American Institute of Mining and Metallurgical Engineers and a past vice-president of the Canadian Institute of Mining and Metallurgy and also a Fellow of the Geological Association of Canada. He is also a 32nd Degree Mason, a Knight Templar and a member of Rameses Shrine.

News of Members

R. F. Legget, of Ottawa, director of the Division of Building Research of the National Research Council, attended the recent annual meeting of the Geological Society of America in New Orleans and spoke on the Division's permafrost research work taking place at Uranium City, Sask.

Department Heads Are Named

Relative to the recently established electric products department of Linde Air Products Company, a division of Union Carbide of Canada Ltd., several appointments have been announced. These include the appointment of **F. Gordon Murphy**, as general manager of the new department and of **John W. Ross**, as operations manager of the new electric products department.

Mr. Murphy, a mechanical engineering graduate of the University of Toronto, has been with Linde Air Products Company and its predecessor, Dominion

Oxygen Company, for the past ten years and for the past two years has been central district manager. Mr. Ross, also a Toronto graduate in mechanical engineering, has likewise been with the organization for ten years and for the last year has been manager of engineering services.

A. S. Robertson Retires

After 41 years of service with the Hydro-Electric Power Commission of Ontario, **A. S. Robertson,** of Niagara Falls, Ont., has retired from his position as manager of the Niagara Region.

A 1914 graduate in electrical engineering of the University of Toronto, Mr. Robertson joined Hydro the same year. For many years he has been recognized as an authority on operations, generation and plant design and has held the position of manager of the Niagara Region since 1948. One highlight of his Hydro career was his work in connection with the construction of the Queenston-Chippawa development, now known as the Sir Adam Beck Niagara Generating Station No. 1, and at one time the largest hydro-electric plant in the world.

G. Ashley Hutchinson has been appointed executive vice-president and director of Eddy Match Company Ltd. in Pembroke, Ont.

Mr. Hutchinson, a native of Ottawa, served as a navigation officer with the R.C.A.F. during World War II. He is a graduate mechanical engineer of Queen's University, Kingston, and of the management training course of the University of Western Ontario, London. He joined Eddy Match Co. Ltd., during 1955 as executive assistant to the president of that company.

M. C. Hart is now associated with Filtro Electric Limited, 5 Parnell Avenue, Toronto 13, in the capacity of plant superintendent. Prior to accepting this new position, Mr. Hart, who graduated in mechanical engineering from the University of Toronto in 1949, was plant engineer of the Scarborough plant of Link-Belt Limited.

P. Guy Money has been appointed general manager of Aceromex Atlas S.A., Ayuntamiento 158, Mexico 1, D.F. This company is the exclusive representative and distributor of Atlas Steels Ltd., of Welland, Ont.

H. L. Coons has announced that the name of the firm of engineering consultants, King Coons, Ltd., has been changed to Herbert L. Coons and Associates Limited, with offices at 194 Bloor Street West, Toronto.

Lester W. Childs is president of Cummins Diesel Michigan Inc., 3601 Gratiot Avenue, Michigan. **J. S. L. Shales** is vice-president of the company which handles the sales and service of Cummins diesel engines in the southern peninsula of Michigan and the northwest counties of Ohio.

K. C. Mohun is with Iroquois Constructors Ltd., at Cornwall, Ont., as cost engineer.

James E. Twiss has moved from Copper Cliff to Toronto where he is assistant chief electrical engineer of the R. M. Way and Company, Ltd., of 696 Yonge Street, Toronto. Mr. Twiss was formerly assistant to the electrical superintendent of The International Nickel Company Ltd., in Copper Cliff, Ont.

W. A. Jackson has resigned the position of vice-president of Gaswell Construction Ltd., Kirkland Lake, and as of the first of this year accepted the post of general superintendent of North Shore Construction Co. Ltd., in Quebec.

W. H. Martin, of Hamilton, Ont., has established a consulting service through Martin Engineering Inc., of Montreal and Toronto, and Martin Industrial Sales, Ltd., of Hamilton, in vibration analysis and source detection in balancing of rotating components on industrial machinery and equipment. He is also engaged in the training in the use of the IRD vibration analyzer, an electronic instrument designed by the International Research and Development Corporation of Columbus, Ohio, for whom Mr. Martin has been recently appointed as Canadian representative.

Allan M. Luce, of the Department of Transport, has been transferred from the Welland Canals Branch to Ottawa where he is operating engineer at the Department's Canal Services Headquarters.

Mr. Luce graduated from Queen's in 1948 and shortly after joined the Department.

Raymond J. Neals has moved to Toronto from La Tuque, Que. and is in the technical service department of Electric Reduction of Canada Ltd., 321 Davenport Road, Toronto. Mr. Neale is technical service engineer in the pulp and paper section.

Robert A. Wilbur, president of Ajax Engineers Ltd., has announced that the company's offices have been moved from Howland Avenue, Toronto, to 260 Merton Street. Mr. Wilbur is also president of Marley Canadian Ltd.

George Forrester is employed in the manufacturing engineering department of Ford Motor of Canada Ltd., at Oakville, Ont., and is now living in Port Credit. Mr. Forrester was previously in the methods engineering department of Lever Bros. Ltd., Toronto.

James W. Speight has joined the staff of P.S.C. Applied Research Ltd., of Toronto, after many years with the research division of the Hydro-Electric Power Commission of Ontario in Toronto.

G. L. Reist, of St. Catharines, Ont., has accepted the position as chief supervisor, Chatham area, of the frequency standardization division of Canadian Comstock Co. Ltd. His new headquarters will be in Chatham.

Prior to the move Mr. Reist was with Sterling Electric Co. Ltd., of St. Catharines.

Lieut. Col. G. W. Thompson has been reposted from Army Headquarters, Ottawa, where he was assistant director, in charge of plans and training, of the Directorate of Electrical and Mechanical Engineering, to Ortona Barracks, Oakville, Ont., where he is Central Command electrical and mechanical engineer.

W. David Hargraft has left the chemical division of the Shell Oil Co. of Canada Ltd., and is now engaged in industrial sales with Gypsum Lime and Alabastine Ltd., 50 Maitland Street, Toronto.

J. J. Marta, of Canadian Liquid Air Co. Ltd., has been transferred from Vancouver, B.C. to the Toronto offices of the company.

H. A. Mitchell is now located in Buffalo, N.Y. and is with the production control department of The Rudolph Wurlitzer Co., North Tonawanda, N.Y. Mr. Mitchell was earlier with Fleet Manufacturing Ltd., of Fort Erie, Ont.

Reginald S. Gray, formerly an assistant engineer in the electrical department of the Toronto Transportation Commission, has accepted the appointment of electrical engineer with H. H. Angus and Associates Ltd., consulting engineers, Toronto.

British Columbia

Engineers in the News

H. W. Poole has been appointed superintendent of the Sullivan Concentrator, Kimberley, according to an announcement by **W. G. Jewitt,** assistant general manager of mines of the Consolidated Mining and Smelting Company. In his new position, Mr. Poole will assume part of the duties previously carried out by **A. C. Robertson,** who, as Cominco's superintendent of concentration, continues to have overall responsibility for all of the company's mills and concentrators.

H. L. Fritz is manager and vice-president for the industrial electrical contracting firm, The Tide Company (B.C.) Ltd., which has established headquarters at the Annacis Island industrial development in New Westminster. Mr. Fritz, registered as an engineer both in Canada and the United States, was formerly with the parent company of the new concern, the Tide Company of Tacoma, Washington. Prior to that, he was the district engineer for the City of Tacoma.

M. D. E. Robinson has been appointed manager of engineering service in the western district of Linde Air Products Company, a division of Union Carbide Canada Ltd. Mr. Robinson will be located in Vancouver.

E. G. Taylor has been appointed an associate on the staff of R. J. Cave and Associates. Mr. Taylor, who heads the municipal and civil engineering department of the firm, was until recently with the Directorate of Works (Army), Department of National Defence, Ottawa.

H. M. Anderson formerly with the B.C. Forest Service, has accepted a position with the Interior Spruce Mills at Prince George.

A. W. Holloway, of Crown Zellerbach Canada Ltd., has been loaned to the Pulp and Paper Industrial Relations Board to make a special survey. He will leave Ocean Falls to reside temporarily in Vancouver while on the project.

P. Knight has accepted a position with Phillips, Barrat and Partners. He was previously employed by the B.C. Engineering Company.

E. L. McPherson, previously of the B.C. Electric Company, has accepted a position in the electrical engineering department of H. A. Simons Ltd.

Personals

News of the Personal Activities of Members of the Institutes

Joseph M. Breen, M.E.I.C., president and general manager of Canada Cement Company Ltd., was recently appointed a director of Du Pont of Canada Securities Ltd. and its operating company, Du Pont Company of Canada Ltd.

A native of Toronto, Mr. Breen is also a director of the Montreal Trust Company, Canadian Refractories Ltd., and the North American Life Assurance Company.

Beginning with Canada Cement in 1922 after his graduation from the University of Toronto, he served as technical engineer from 1922 to 1934 when he was appointed chief of the company's technical staff in Montreal. He became assistant general manager in 1947, executive vice-president and general manager and a director the following year, and then president and general manager in 1949.

F. Gordon Murphy, M.E.I.C., has been appointed general manager of the newly organized electric products department of Linde Air Products Company, division of Union Carbide Canada Ltd., in Toronto.

Mr. Murphy graduated from the University of Toronto in 1940 with a B.A.Sc. degree in mechanical engineering and has been on the staff of Linde Air Products and its predecessor for the past ten years. He has held a number of positions in the field in both the Ontario and Quebec areas and for the past two years has been central district manager.

F. G. Murphy, M.E.I.C.

He is a member of the American Society for Metals, the Canadian Welding Society, and the Society of Automotive Engineers.

John W. Ross, M.E.I.C., has been appointed operations manager of this newly formed electric products department of Linde Air Products Company.

He graduated from the University of Toronto in 1941 with a B.A.Sc. degree in mechanical engineering and has held various supervisory positions with Linde Air Products for the past ten years, acting in the capacity of manager of engineering service for the past year.

John W. Ross, M.E.I.C.

Mr. Ross is a member of the American Society of Metals and of the Association of Professional Engineers of Ontario.

Dean Adrien Pouliot, M.E.I.C., head of the faculty of science at Laval University, has been appointed vice-chairman of the Canadian Broadcasting Corporation board of governors. He has been a member of the board since 1939.

A well-known lecturer, Dean Pouliot holds an honorary degree of doctor of applied science from Laval University, an honorary doctorate of laws from the University of Montreal, and the Grande Medaille d'Honneur des Ingenieurs—Docteurs de France from the University of Ottawa.

J. M. Breen, M.E.I.C.

He is a member of La Societe Mathematique de France, American Mathematical Society, and the Canadian Institute of Mining and Metallurgy, among others. He served as vice-president of the Corporation of Professional Engineers of Quebec in 1950.

Dr. Thomas H. Hogg, M.E.I.C., a past-president of the Engineering Institute, has been elected a director of Philips Electrical Company Ltd. An internationally known consulting engineer, Dr. Hogg is also a director of John Inglis Company, Chartered Trust Company, Anglo Canadian Wire Rope Company, British Newfoundland Corporation, and English Electric Company, among others.

From 1913 to 1947 Dr. Hogg served with the Hydro-Electric Power Commission of Ontario, starting his career as assistant engineer and finally becoming, in 1937, chairman and chief engineer of the Commission. He retired from the Commission in 1947 and since then has been actively engaged as a consultant to the Federal Government on hydraulic matters and western water problems. He has also been on the Senate of the Uni-

• Personals

versity of Toronto for many years, having graduated from that university in 1908 with a degree of B.A.Sc. His professional degree of C.E. was won in 1912, and the degree of D.Eng. (honoris causa) in 1927.

Dr. Hogg, who joined the Engineering Institute in 1904, served as president of the Institute in 1940. He received the Sir John Kennedy Medal of the Institute in 1948, and also attained life membership in the Institute that year.

E. D. Gray-Donald, M.E.I.C., vice-president, personnel and public relations, of the Shawinigan Water and Power Company in Montreal, has been elected chairman of the Montreal Branch of the Engineering Institute. He is also vice-president and director of the Quebec Power Company in Quebec City.

Born at Amoy, China, he came to Western Canada at an early age, and was educated at Collegiate School, Victoria, B.C. In 1915 he went to Great Britain and completed his schooling at George Watson's College, Edinburgh. Subsequently he worked at Vickers Ltd., in London, and after the war spent two years in Palestine on general engineering work, returning to Canada in 1921.

He attended McGill University and graduated in 1926 with a B.Sc. degree in electrical engineering. After postgraduate work at Laval University he received the degree of M.ès. Sc. in 1934.

In June, 1926 Mr. Gray-Donald joined the Shawinigan Water and Power Company and followed its apprenticeship course, being transferred to the Quebec Power Company in 1927. He filled successively the positions of assistant superintendent and superintendent of the power division; assistant general superintendent, and from 1937 to 1942, general superintendent of the Quebec Power Company and the Quebec Railway, Light & Power Company. He was then appointed chief engineer of both companies in 1942, and then vice-president and chief engineer of the Shawinigan Water and Power Company in 1950. He was appointed to his present position in 1954.

Mr. Gray-Donald is a member of the Institution of Electrical Engineers

E. D. Gray-Donald, M.E.I.C.

J. Macé, M.E.I.C.

(Great Britain), the American Institute of Electrical Engineers, the Society of Automotive Engineers, the Canadian Electrical Association, and the Corporation of Professional Engineers of Quebec.

He is very active in the affairs of the Institute, having served on the Council in 1942, 1948 and 1953. He was chairman of the Quebec Branch of the Engineering Institute in 1944. He first joined the Institute in 1922 as a Student.

Major-General N. E. Rodger, C.B.E., C.D., M.E.I.C., has assumed the appointment of vice-chief of general staff at Army Headquarters in Ottawa. He was formerly general officer commanding Prairie Command at Winnipeg, Man.

Maj.-Gen. Rodger is a graduate of the Royal Military College and of McGill University. He was appointed to a commission to the R.C.E. in 1928 and in 1939 held the rank of major. From December 1941 until September 1942, with the rank of lieutenant-colonel, he was personal assistant to **General A. G. L. McNaughton,** M.E.I.C. Subsequently he became brigadier general staff, 2nd Canadian Corps, in which capacity he served until the end of the war. After the war he was appointed to the Canadian Army Staff at Washington, D.C. Major-General Rodger was quartermaster general of the Canadian Army for five years and then in 1951 attended a senior officers' course in England prior to his appointment at Winnipeg.

J. M. Macé, M.E.I.C., has been appointed assistant district sales manager (eastern) with Northern Electric Company Ltd. in Montreal. He was previously manager of wire and cable sales, eastern district, for the company.

Mr. Macé graduated from McGill University in 1935 with a bachelor's degree in electrical engineering. He joined Northern Electric in 1936 in the power apparatus sales department.

During the war he was named sales engineer for marine power and degaussing equipment. In 1946 he was transferred to the rural electrification department and was made manager at Quebec City the following year. He was named manager of rural electrification and power company sales for the eastern district in 1950, and then became manager of wire and cable sales the following year.

Mr. Macé is a member of the Corporation of Professional Engineers of Quebec, and of the American Institute of Electrical Engineers.

Andrew G. Watt, M.E.I.C., has been appointed vice-president and general manager of the structural steel division and of the warehouse division of Consolidated Steel Corporation Limited in Saint John, N.B. He was previously

A. G. Watt, M.E.I.C.

general manager for the Corporation.

A native of Scotland Mr. Watt came to Canada in 1927 and joined Canadian Vickers Limited in Montreal as structural draughtsman. In 1929 he went to Saint John, N.B., where he was chief draughtsman with Saint John Drydock and Shipbuilding Company Ltd. for eleven years and personnel manager for two years.

Mr. Watt joined Foundation Maritime Limited in 1942 at Pictou, N.S., as personnel manager; and he was industrial relations and personnel director of Fergusson Industries of Pictou from 1943 to 1945, when he returned to Saint John Drydock and Shipbuilding Company Ltd. as chief draughtsman of the structural steel division, becoming assistant chief engineer in 1950. He joined the Consolidated Steel Corporation in 1954.

Mr. Watt is an active member of the Saint John Branch of the Institute and was chairman of the Branch in 1953. He was elected to serve on the Council of the Institute last year.

W. H. Price, M.E.I.C., has been appointed assistant general manager of Mid-Western Industrial Gas Ltd. in Edmonton, Alta.

A 1949 graduate in chemical engineering from the University of Alberta, Mr. Price joined Mid-Western in 1952 and has progressed from the position of field engineer to chief engineer, the position he held at the time of his new appointment.

Mr. Price has previously been with The Petroleum and Natural Gas Conservation Board.

Jacques Lemieux, M.E.I.C., consulting engineer and partner in the firm Cote, Lemieux, Carignan & Bourque in Sherbrooke, Que., is the new chairman of the Eastern Townships Branch of the Engineering Institute.

Mr. Lemieux received his general education at St. Charles Seminary in Sherbrooke, Que., and then graduated from Ecole Polytechnique in 1944 with a B.A.Sc. degree in mechanical and electrical engineering.

• Personals

Upon graduation he joined the Department of Public Works working on bridge construction in Quebec province. In 1945 Mr. Lemieux became a partner in the firm of Crépeau, Coté and Lemieux in Sherbrooke, and in 1952 he became a member of the firm of Coté, Lemieux, Carignan & Bourque, professional engineers and Quebec land surveyors, also located in Sherbrooke, Que.

Mr. Lemieux joined the Engineering Institute as a Student in 1941, transferred to Junior in 1946, and to Member in 1951. In 1951 he was also one of the charter members of the Eastern Townships Branch of the Institute.

J. Lemieux, M.E.I.C.

K. E. Bentley, M.E.I.C.

Kenneth E. Bentley, M.E.I.C., a senior engineer in the engineering division of Imperial Oil Limited, manufacturing department, has been elected chairman of the Sarnia Branch of the Engineering Institute of Canada.

Born in Billtown, Nova Scotia, he attended Acadia University and later Nova Scotia Technical College where he graduated in civil engineering in 1934.

Mr. Bentley has been with Imperial Oil Limited since graduation, working in various capacities at their Halifax Refinery, until 1949 when he transferred to Sarnia. Presently, he is project coordinator in connection with the rebuilding and modernization of Halifax Refinery.

Paul M. Smith, M.E.I.C., has now joined the St. Lawrence Seaway Authority as division engineer in Beauharnois, Que. He was previously with William R. Souter & Associates, Hamilton, Ont. architects, and was employed as superintendent of the plant extension to the Chrysler Corporation of Canada in Windsor, Ont.

Mr. Smith graduated in 1942 from Ecole Polytechnique in civil engineering and has also been associated with Surveyer, Nenniger & Chenevert, consulting engineers in Montreal. He has also spent some time in India as construction engineer of the Kande Ela Reservoir Scheme at Nuwara, Eliya, and on other irrigation projects.

Fred L. Doty, M.E.I.C., branch manager of the wholesale department of Canadian General Electric Company Ltd. at Saint John, N.B., has been elected chairman of the Saint John Branch of the Engineering Institute.

Mr. Doty graduated in 1942 from the University of Toronto with a B.A.Sc. degree in electrical engineering. He

joined the General Electric test course at Peterborough, Ont., immediately following his graduation and then spent four years in the commercial department of the head office. He was transferred to Saint John as apparatus sales engineer for two years, and then to Montreal in the same capacity for three years. He returned to Saint John in 1952 as branch manager of the wholesale department.

He became a Member of the Engineering Institute in 1952.

C. V. Davies, M.E.I.C., has been appointed erection engineer for Canadian Bridge Company Ltd. at Walkerville, Ont.

Mr. Davies graduated from Queen's University in 1947 with a civil engineering degree, and then joined Canadian Bridge as a draughtsman. He was named assistant erection engineer in 1950.

He is a member of the American Welding Society, and the Association of Professional Engineers of Ontario.

Morris Katz, M.E.I.C., who is chairman of the Canadian section of the Technical Advisory Board on Air Pollution, has also accepted an appointment as consultant on atmospheric pollution for the Department of National Health & Welfare in Ottawa.

Mr. Katz is a graduate of McGill University, having received his B.Sc. degree in 1926, his M.Sc. degree in 1927 and his Ph.D. degree in 1929. He joined the National Research Council in Ottawa in 1930 as a research chemist.

J. B. Delage, M.E.I.C., has joined the Department of Public Works of Canada as senior engineer, Quebec district. He has previously been with the Department of National Defence in Quebec City, Montreal and Chilliwack, B.C.

Rowland H. Stokes-Rees, Affil.E.I.C., who is a director of the Rubenstein Brothers Company, is now also president of Hydrotechnic Limited, which is also in Montreal.

Mr. Stokes-Rees has previously been vice-president of the Kaiser engineers division of Henry J. Kaiser Company (Canada) Ltd., Montreal.

Donald G. Dunbar, M.E.I.C., is now in Vancouver, B.C. with Crippen Wright Engineering Ltd. He was formerly in New York with the electrical engineering division of the American Gas & Electric Service Corporation.

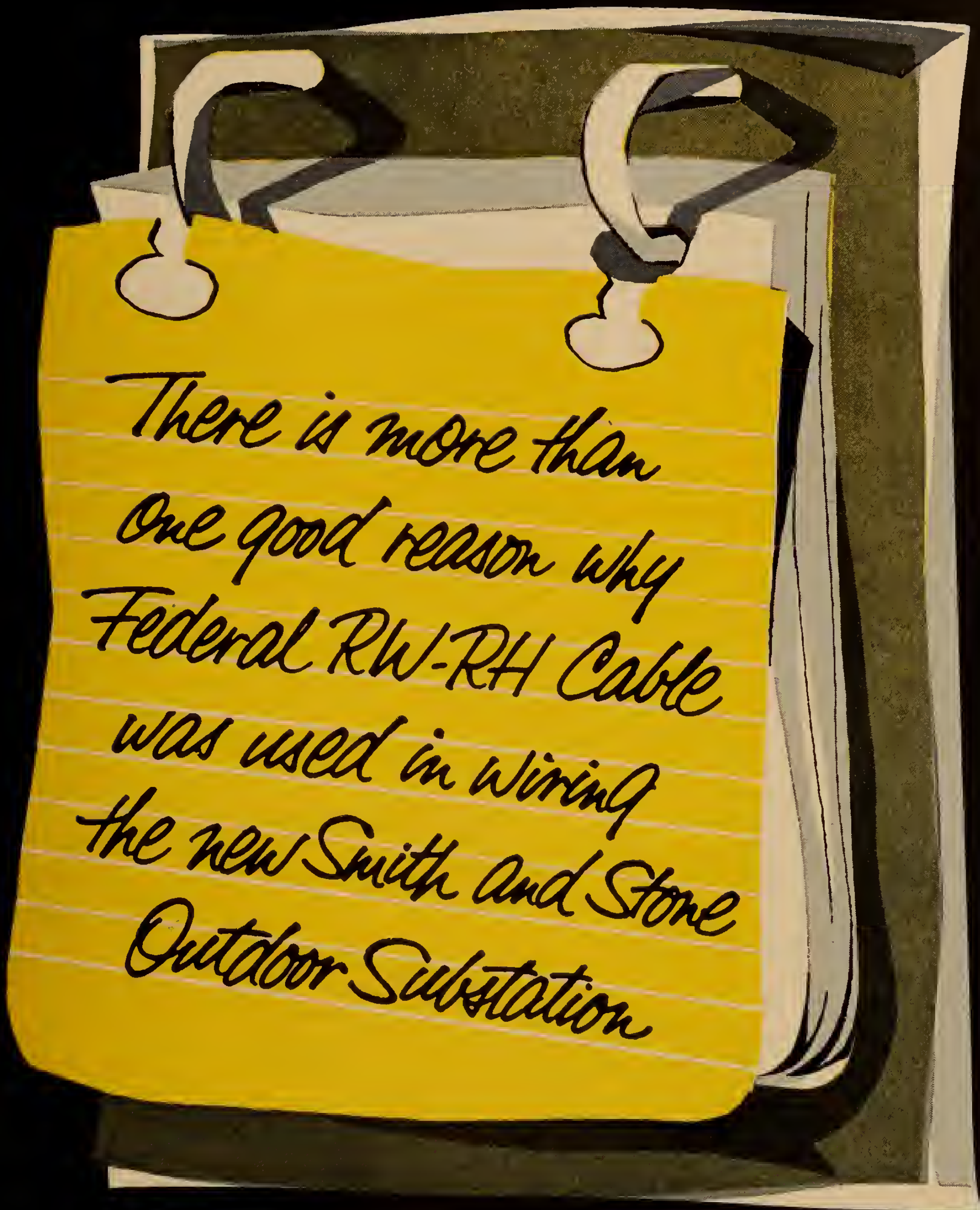
A 1949 civil engineering graduate of the University of British Columbia, Mr. Dunbar has previously been in Vancouver with International Engineering working on the design of the Kemano-Kitimat transmission lines for the Aluminum Company of Canada.

R. A. Shier, M.E.I.C., has been named assistant chief engineer with the Board of Transport Commission in Ottawa, Ont.

Mr. Shier, a civil engineering graduate of Queen's University, was formerly in Calgary, Alta. with the Board of Railway Commissioners as district engineer. He has also been division engineer with the Canadian National Railway at Belleville, Ont.

Fred Doty, M.E.I.C.

H. Matthews, M.E.I.C., has been named chief engineer of Victoria Machinery Depot Company Ltd. in Victoria, B.C. He has been chief engineer and plant manager of Vancouver Iron Works Ltd. and Vancouver Engineering Works Ltd. prior to this new appointment. He had been with these companies since 1928.



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• *Personals*

T. H. Dobbin, M.E.I.C., commissioner of works for the City of Sarnia, Ont., has been elected secretary-treasurer of the Sarnia Branch of the Engineering Institute.

A native of Rothesay, N.B., Mr. Dobbin gained early experience working in building construction and land surveying prior to the Second World War. During the war he served six years with the R.C.E. From 1945 to 1949 he was employed as assistant city engineer at Fredericton, N.B., and also in 1949 he graduated from the University of New Brunswick with a degree in civil engineering.

Then Mr. Dobbin joined H. G. Acres and Company at Niagara Falls, Ont. and at Pine Falls, Man. In 1950 he was appointed assistant director of works for the City of Saint John, N.B., and then in 1952, became commissioner of works at Sarnia.

Mr. Dobbin joined the Institute as a Student in 1947 and then transferred to Member in 1950.

E. G. DeWolf, M.E.I.C., is with the Canadian Gypsum Company at Windsor, N.S., having previously been in Sarnia, Ont. with Sifto Salt Limited as works manager.

Mr. DeWolf graduated from Nova Scotia Technical College in 1944 with a bachelor's degree in engineering. He was with Maritime Industries Limited at Amherst, N.S. as assistant plant superintendent in 1949, and then joined the Prairie Salt Company, a division of the Dominion Tar & Chemical Company at Unity, Sask., as manager. He went to Sarnia in 1954 to join the Dominion Salt Company.

R. P. Charbonnier, M.E.I.C., is now scientific officer with the Department of Mines and Technical Surveys, fuels division, at Edmonton, Alta. He was previously with the same department at Calgary, Alta., working on research in coal preparation.

D. R. Brown, M.E.I.C., has moved to the United States and is working as a design engineer with the Mobay Chemical Company in Affton, Missouri. He was previously in Maitland, Ont. with Dupont of Canada as a senior engineering assistant.

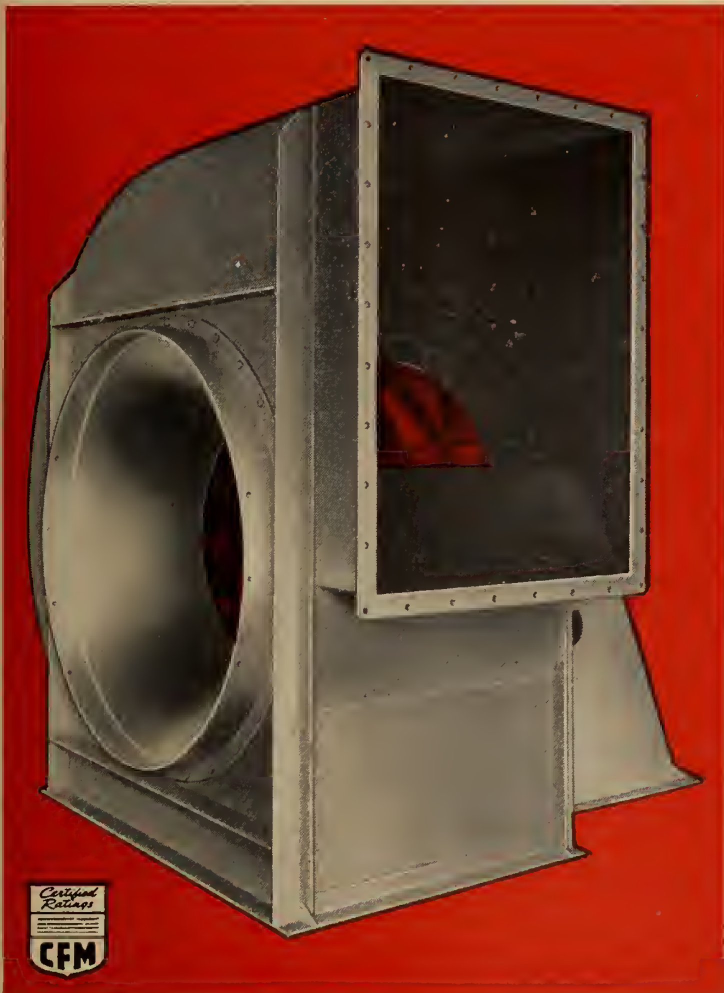
Mr. Brown graduated in 1944 from McGill University with a B.Eng. degree. After serving with the R.C.N.V.R. until 1946 he joined Canadair Limited in Montreal. He returned to McGill in 1947 as lecturer in the department of mechanical engineering and obtained his M.Eng. degree in 1951. That year he joined C.I.L. in Montreal, transferring to Maitland, Ont. in 1953.

T. H. Dobbin, M.E.I.C.

Brian J. Palmer, M.E.I.C., is now with the Dow Chemical Company at Sarnia, Ont. as project engineer.

Mr. Palmer was previously assistant chief of staff with the U.S. civil service attached to the directorate of installations at the Pepperrell Air Force Base at St. John's, Nfld.

Raymond Saarits, M.E.I.C., has joined the St. Lawrence Seaway Authority in Montreal as assistant engineer. He has been with the Dominion Department of Agriculture as design engineer with P.F.R.A. in Regina, Sask.



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• *Personals*

Robert T. Bailey, M.E.I.C., has been named assistant to the city engineer at St. Catharines, Ont. He was previously city engineer at Welland, Ont., having gone to Welland in 1951 as assistant city engineer.

Mr. Bailey graduated in 1948 from Queen's University with a B.Sc. degree in civil engineering, and has also been with Margison & Babcock in Toronto, and village engineer at Crystal Beach, Ont.

Fred K. Stone, M.E.I.C., has joined the South Saskatchewan Pipeline Company at Swift Current, Sask. He was previously in Whitehorse, Yukon Territories, with Canol Pipeline Company.

R. M. Heaton, Jr.E.I.C., has accepted a position as assistant electrical design engineer with the light and power department of the City of Regina, Sask. He was formerly with the Schlumberger Well Surveying Corporation, also in Regina.

Mr. Heaton is a graduate of the Institution of Electrical Engineers of Great Britain and has been with Canadian Westinghouse Company Ltd. and with H. G. Acres & Company in Great Falls, Manitoba.

G. M. Boissoneault, Jr.E.I.C., who is with the hydraulic resources department of the Shawinigan Water and Power Company in Montreal, is the new secretary-treasurer of the Montreal Branch of the Engineering Institute.

He is a native of Rainy River, Ont., and received his general education at Calgary, Alta. He attended the Provincial Institute of Technology and Art in Calgary and then in 1942 joined the R.C.N. After the war he entered McGill University and graduated in 1949 with a bachelor of engineering degree in electrical engineering. The following year he studied business administration at the University of Western Ontario.

Mr. Boissoneault joined Shawinigan Water and Power as a staff development trainee in 1949 and was appointed to the system operating division of the generation and transmission department in 1950. He was transferred to the hydraulic resources department last year.

He joined the Engineering Institute as a Student in 1948, and transferred to Junior in 1951.

H. T. Blake, Jr.E.I.C., has joined C. O. Monat & Company Ltd. in Montreal.

Mr. Blake graduated from McGill University in 1949 in mechanical engineering and has been with Rochester & Pittsburgh Coal Company (Canada) Ltd. in Montreal since that time.

D. L. Aker, Jr.E.I.C., has rejoined the Aluminum Company of Canada at Arvida, Que., having completed his Athlone Fellowship. He is supervisor of electrical maintenance at the Arvida plant.

Mr. Aker graduated from the University of Manitoba in electrical engineering in 1949 and then joined McKinnon Industries Limited in St. Catharines, Ont. He went to the Aluminum Company in 1952 and was in the electrical maintenance department at Kingston, Ont., prior to receiving his Fellowship in 1953.

D. G. B. Anderson, Jr.E.I.C., has joined the Long Manufacturing Company in Oakville, Ont., as works manager. He was formerly assistant manager of the service department of the Toronto Hydro-Electric System.

Mr. Anderson graduated in 1950 from the University of Toronto and has been project engineer at Valleyfield, Que., for Defence Industries Limited, and with Lever Brothers Limited in Toronto.

T. B. Lounsbury, Jr.E.I.C., has been appointed manager of meter, instrument and relay sales for the Canadian Westinghouse Company's industrial products division at Hamilton, Ont.

A 1950 honour graduate in electrical engineering from McGill University, and a graduate of the university's management and business administration course, Mr. Lounsbury joined Westinghouse in 1950 as a student engineer. Until his recent appointment he was attached to the apparatus sales department in Montreal.

J. G. G. Hamel, Jr.E.I.C., is now with the engineering department of the Wayagamack division of Consolidated Paper Corporation Ltd. at Three Rivers, Que. He was formerly with Canadian Johns-Manville at Asbestos, Que.

Mr. Hamel graduated in 1950 from McGill University in civil engineering and has previously been with the Foundation Company in Ottawa as field engineer and with Harold Doran as

G. M. Boissonneault, Jr. E.I.C.

T. B. Lounsbury, Jr. E.I.C.

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• Personals

assistant resident engineer at Lac St. Jean, Que.

Roderick R. MacKenzie, Jr.E.I.C., was recently appointed to the position of assistant engineer, maintenance of way, central region of Canadian National Railways, with headquarters in Toronto. He was previously division engineer with the C.N.R. at New Glasgow, N.S.

Mr. MacKenzie is a civil engineering graduate of the University of New Brunswick, class of 1945. He began his career with the C.N.R. with summer work in 1941 and 1942. In June 1945 he was instrumentman with the Campbellton division, subsequently becoming assistant division engineer at Campbellton in 1948. He became division engineer at New Glasgow in 1952.

J. C. Smith, Jr.E.I.C., has been transferred from the Three Rivers, Que., mill of the Canadian International Paper Company to the Dalhousie, N.B., mill of the New Brunswick International Paper Company as assistant plant manager.

Mr. Smith graduated in 1947 from Queen's University in mechanical engineering and joined N.B. International Paper at Dalhousie that same year. He went to Three Rivers in 1953 as mill engineer for Canadian International Paper.

A. M. White, Jr.E.I.C., is now with the Vancouver office of Racey, MacCallum & Associates Ltd. He was formerly maintenance superintendent of the sulphate and nitrate plants of Consolidated Mining and Smelting Company Ltd. at Trail, B.C.

Mr. White graduated from the University of British Columbia in 1948 with a B.A.Sc. degree in mechanical engineering.

C. Gordon Lindsay, Jr.E.I.C., recently joined the staff of Atlantic Bridge Company Ltd. in Halifax, N.S. He was previously attached to the U.S. Corps of Engineers at the Ernest Harmon Air Force Base in Stephenville, Nfld.

A 1948 civil engineering graduate of McGill University, Mr. Lindsay was first associated with the concrete design department of the Shawinigan Engineering Company in Montreal before going to Newfoundland in 1952.

Paul R. Brown, Jr.E.I.C., has joined the staff of Reliance Electric & Engineering (Canada) Ltd. as transformer engineer in Welland, Ont.

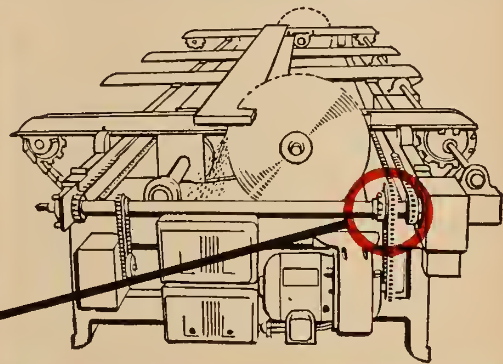
Mr. Brown is an electrical engineering graduate of Nova Scotia Technical College, 1948, and has been with the Canadian Westinghouse Company in Hamilton, Ont., as electrical engineer in the engineering department of the company. He joined Westinghouse immediately after his graduation.

Brian B. Hanson, Jr.E.I.C., is now employed as city electrician for the City of Moncton, N.B.

A 1950 electrical engineering graduate of the University of New Brunswick, Mr. Hanson has been with the Canadian National Railways in Moncton as circuit designer in the signal department.

Norman G. Brown, Jr.E.I.C., has joined the staff of Dutton-Williams Brothers Limited in South Edmonton, Alta.

MORSE TORQUE LIMITER PROTECTS MOTOR AND REDUCER FROM DEAD-STOP OF DRIVEN UNIT!



Morse Torque Limiter and sprocket act as slip clutch on Model 55 Automatic Electric Shift Trimmer made by The Wheland Company, Chattanooga. Arbors are shifted at 120 fpm, instantly stopped and locked into place. Torque Limiter on jackshaft is set so sprocket slips when motor torque (38 ft.-lbs.) is exceeded. Absorbs inertia of 1-hp, 155-rpm gearmotor; reduces shock on drive unit when driven shaft is stopped.

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In this Wheland Electric Shift Trimmer, two 200-pound saw arbors are automatically moved into position at 120 feet per minute . . . then stopped dead and locked into place.

The tremendous shock transmitted to the drive mechanism when the arbors are stopped, is safely dissipated by a Morse Torque Limiter used as a slip clutch between the driving and driven units. In addition, it prevents motor inertia from building up torque in the drive.

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• Personals

Mr. Brown graduated from the University of British Columbia in 1950 with a B.A.Sc. degree in mechanical engineering and joined John H. Ross & Company Ltd. in 1951 as sales engineer in Edmonton. In 1952 he was appointed manager of the Calgary branch of the company and then returned to Edmonton in 1953 as sales manager.

Charles Yoshida, JR.E.I.C., who received his M.A.Sc. degree in chemical engineering from the University of Toronto this fall, has joined Canadian Wallpaper Manufacturers Ltd. in Toronto.

Mr. Yoshida graduated in 1951 from McGill University with a B.Eng. degree in chemical engineering, and then joined the Wayagamack division of Consolidated Paper Corporation at Three Rivers, Que.

He is a past secretary-treasurer of the Saint Maurice Valley Branch of the Engineering Institute.

A. M. Garlicki, JR.E.I.C., has joined the engineering staff of Timberland Machines Ltd. in Woodstock, Ont., as mechanical engineer.

Mr. Garlicki is a 1951 mechanical engineering graduate of the Polish University in London, England. He has been with Babcock-Wilcox & Goldie-McCulloch Ltd. in Galt, Ont., as project engineer since 1952.

Richard C. Sircom, JR.E.I.C., is now engaged in underwater physics research work with the Naval Research Establishment in Dartmouth, N.S. He was formerly in Peterborough, Ont., with Canadian General Electric as switchgear design engineer in the apparatus department.

Mr. Sircom graduated in 1951 from Nova Scotia Technical College with a B.Sc. degree in electrical engineering and then joined the Canadian General Electric's test course.

K. A. Millions, JR.E.I.C., is now resident materials engineer with the Trans-Canada Highway division of the Department of Public Works at Banff, Alta. He was formerly resident highway engineer with the Alberta Department of Highways in Edmonton.

A 1951 civil engineering graduate of the University of Alberta, Mr. Millions was with the R.C.A.F. as flying officer in the Air Division at Headquarters in France after his graduation.

Lt. (L) G. A. Kastner, JR.E.I.C., of the Royal Canadian Navy, has been appointed electrical officer at H.M.C.S. Algonquin, an operational unit of the Royal Canadian Navy at Halifax, N.S. He was previously at Navy Headquarters in Ottawa as section head, underwater detection engineering in the electrical engineer-in-chief's division.

Lieutenant Kastner is a 1952 graduate of the University of New Brunswick in electrical engineering.

J. K. Maitland, JR.E.I.C., has joined the staff of Haddin, Davis & Brown Limited in Edmonton, Alta. He has been in Brandon, Man., on the staff at City Hall.

Mr. Maitland graduated in 1952 from the University of Manitoba in civil engineering, and has also been with Underwood, McLellan & Associates Ltd. in Saskatoon, Sask.

Marc Brunet, JR.E.I.C., has been transferred by the harbours and rivers engineering branch of the Department of Public Works from Rivière du Loup, Que., to Quebec City.

Mr. Brunet graduated in 1952 from Laval University with a B.A.Sc. degree in civil engineering and joined the Department of Public Works as a civil engineer in Quebec City after graduation.

Ronald G. Foxall, JR.E.I.C., is now employed as resident engineer at Powell River, B.C., for the Northern Construction Company.

Mr. Foxall graduated from the University of British Columbia in 1952 in civil engineering, and then joined Canadian National Railways as a trainee in Montreal with the research and development department. In 1954 he became associated with Canadian Forest Products Limited in Port Mellon, B.C., as plant engineer.

J. A. Harding, JR.E.I.C., is now with Ontario-Minnesota Pulp and Paper Company Ltd. in Kenora, Ont. He was formerly in Hamilton, Ont., with Canadian Westinghouse Company Ltd., having joined that company upon his graduation in 1953 from the University of Manitoba with a B.Sc. degree in mechanical engineering.

D. D. Young, JR.E.I.C., who recently returned from England where he spent two years on an Athlone Fellowship, has joined the mechanical development

• Personals

department of the ammunition and explosives division of C.I.L. as a project engineer in Brownsburg, Que.

Mr. Young graduated in 1953 from the University of Manitoba with a B.Sc. degree in mechanical engineering.

Edmund H. McIntyre, JR.E.I.C., has returned from England where he spent two years on an Athlone Fellowship, and is now with Canadian Refractories Limited in Montreal. While in England he was with the metallurgical staff of Steel, Peech and Tozar, a branch of the United Steel Companies.

Mr. McIntyre graduated in 1953 from McGill University with a bachelor's degree in metallurgical engineering.

W. J. Lund, JR.E.I.C., has joined Westminster Iron Works Ltd. as a mechanical engineer in New Westminster, B.C. He was previously with the Harmac Pulp division of MacMillan and Bloedel Ltd. in Nanaimo, B.C., having joined that organization in 1953.

Mr. Lund graduated from the University of British Columbia in 1953 with a B.A.Sc. degree in mechanical engineering.

R. A. J. Arsenault, JR.E.I.C., has returned to Canada following a two year period spent in England on an Athlone Fellowship, and is employed by Marine Industries Limited at Sorel, Que., as assistant superintendent of machine shop and machinery installation and repairs.

A 1953 electrical and mechanical engineering graduate of Ecole Polytechnique, Mr. Arsenault spent the first year of his fellowship studying at the Royal Technical College in Glasgow and received a postgraduate diploma in power engineering. The following year he was with Fairfield Shipbuilding and Engineering Company Ltd., also at Glasgow.

Fernand Demers, S.E.I.C., a 1955 graduate of Nova Scotia Technical College in civil engineering, has joined Perini Quebec Inc., general contractors in Montreal.

Earl Misfeldt, S.E.I.C., has joined the Department of Mineral Resources of the Province of Saskatchewan at Lloydminster.

He graduated in 1955 from the University of Saskatchewan in civil engineering.

Eric Christman, S.E.I.C., a mechanical engineering graduate of McGill University, class of 1955, is now with the control department of the Anglo Canadian Pulp and Paper Mills in Quebec City.

John J. Sled, S.E.I.C., has joined H. A. Simon Limited at Port Alberni, B.C.

He graduated last spring from the University of Saskatchewan in civil engineering and then worked with Haddin, Davis & Brown in Edmonton, Alta.

J. Gaetan Trudeau, S.E.I.C., is presently employed as field engineer with the west district, water and sewerage division of the Department of Public Works of Montreal.

Mr. Trudeau graduated in 1955 from Ecole Polytechnique with a B.A.Sc. degree in civil engineering.

Activities of the Forty-seven Branches of the Institute

and

abstracts of papers presented at their meetings

Belleville

J. A. Grant, M.E.I.C.,
Secretary-Treasurer

J. L. Colter Guest Speaker

The Belleville Branch of the Engineering Institute of Canada held its third meeting of the 1955-56 season on December 12, 1955, at the Masonic Temple. Approximately 30 members and guests attended. J. L. Colter of the Canadian National Railways spoke on the "Applications of Electronics in the Toronto Stock Exchange". He explained the processes involved in implementing and recording financial transactions in the Toronto Stock Exchange.

Mr. Colter was introduced by A. Argue and thanked by John Ross.

A supplementary film entitled "Immediate Action", supplied by the Toronto Stock Exchange, was shown.

Central British Columbia

H. D. DeBeck, Jr.E.I.C.,
Secretary-Treasurer

President Attends General Meeting

The annual general meeting of the Branch was held at the Plaza Hotel in Kamloops on November 28, 1955 with 41 present, including members, wives and guests.

Vice-Chairman A. F. Joplin was in the chair and welcomed to the meeting the president of the Institute, Dr. R. E. Heartz and Mrs. Heartz, and the general secretary, Dr. L. Austin Wright. The chairman then called on W. J. M. Owen to introduce Dr. Heartz, who addressed the meeting on the subject of the shortage of engineers and possible means of meeting the problem.

The chairman then thanked Dr. Heartz and introduced Dr. L. Austin Wright who spoke on the business of the Institute, touching briefly on the subject of confederation and the film "Leonardo da Vinci".

Dr. Wright also drew the attention of the meeting to the fact that the 1957 meeting of the Institute will be in Banff.

1956 Branch Officers

The election of branch officers for 1956 was then held with results as follows: chairman, A. F. Joplin; vice-chairman, R. G. Harris; committeemen, A. C. Dimock, E. R. Gayfer, and M. A. Thompson.

Owing to the visit of the president the presentation of annual reports and other business was deferred until the first meeting of 1956.

Executive Meeting

A meeting of the executive was held at the Plaza Hotel in Kamloops on November 28, 1955. The meeting convened at 9.20 p.m. with Mr. Joplin in the chair. Others present were Messrs. Harris, Thompson, Wade, Zirul and DeBeck.

Two applications for membership as Branch affiliates were approved, and a nomination for the presidency of the Institute was endorsed. R. L. Bigg was appointed member of the Nominating Committee. In addition to financial business, it was moved by Mr. Harris and seconded by Mr. Wade that the secretary contact Mr. Dimock in Vernon to arrange a meeting there for February 17, and that an executive meeting also be arranged for that date.

Cornwall

L. H. Snelgrove, M.E.I.C.,
Secretary-Treasurer

W. Rothwell, M.E.I.C.,
Branch News Editor

Buffet Supper and Film

The December meeting of the Cornwall Branch was held at the Cornwall Golf and Country Club on Friday, December 9, 1955. A buffet supper was served, followed by the showing of the film on the life and work of Leonardo da Vinci.

Invitations were extended to members and their wives of the local branches of the Association of Professional Engineers, the Chemical Institute of Canada, the Architects and the Medical Association. Approximately one hundred members and guests attended one of the most successful meetings of the year.

Fredericton

O. I. Logue, M.E.I.C.,
Secretary-Treasurer

N. E. Donahoe, Jr.E.I.C.,
Branch News Editor

Supper Meeting

On December 15, 1955, the Fredericton Branch held a supper meeting at the cafeteria of the Memorial Students Centre of the University of New Brunswick. Special guests for the evening were the wives of the members.

"Leonardo da Vinci"

After the supper, a preview showing of "Leonardo da Vinci", a documentary film exclusively owned in Canada by

Members of the executive of the Halifax Branch. Left to right, seated, J. J. Kinley, R. D. T. Wickwire, vice-chairman, G. A. Cunningham, chairman, W. D. Pippy, secretary-treasurer, W. A. Devereaux, past-chairman; standing, Professor B. N. Cain, Professor B. F. Vail, J. D. Kline, P. M. Lane, E. C. Parsons and O. K. Smith. Others elected to the executive are R. F. McAlpine, G. H. Dunphy and John Powers.

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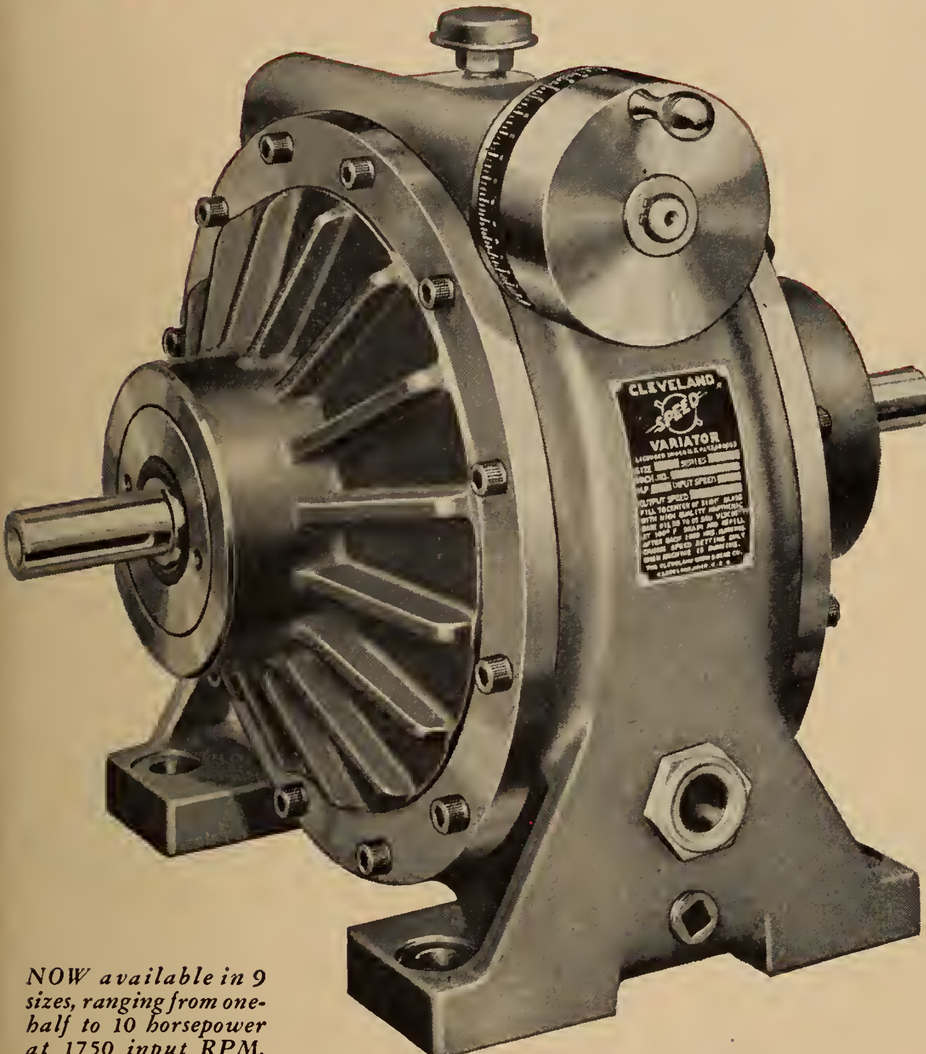

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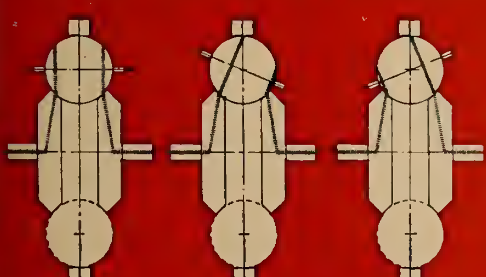

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• Branch News

the Institute was shown. Those present were favourably impressed with the film as well as with its hero.

After the film a discussion period followed on the various aspects of da Vinci's character, his inventions and accomplishments.

Halifax

W. D. Pippy, M.E.I.C.,
Secretary-Treasurer

F. H. Tremain, M.E.I.C.,
Branch News Editor

Officers for 1956

The Halifax Branch of Engineering Institute of Canada reports a year of exceptional activity. Election results were announced at the annual meeting and officers named for the Branch. Those chosen were: G. A. Cunningham, chairman; R. D. T. Wickwire, vice-chairman; and W. D. Pippy, secretary-treasurer. Other members of the executive include O. K. Smith, R. F. McAlpine, G. H. Dunphy, J. D. Kline, P. M. Lane and Prof. B. F. Vail, Halifax; E. C. Parsons, Windsor; Prof. B. N. Cain, Wolfeville; J. J. Kinley and J. W. Powers, Lunenburg.

The retiring chairman, W. A. Devereaux, reported on a highly successful year in which membership of the Branch rose above the five hundred mark. Meetings held during the year were highly diversified to meet the needs of the many technical divisions represented by the engineering profession in the Halifax area. In addition to subjects of general engineering interest, topics have been chosen which are related to marine, naval and military problems.

The newly-elected chairman, G. A. Cunningham, assured the members that meetings of general interest as well as topics of a specialized engineering nature would form a part of the 1956 program. New developments in the fields of electronics and nuclear energy will be included in the program. When he asked members to put forward their ideas regarding future meetings, a spirited discussion brought forth a wide variety of suggestions and a wealth of constructive comments for the guidance of the new executive.

The Committee chairmen appointed were: F. H. Tremain, publicity and news editor; G. H. Dunphy, Public Relations; M. L. Baker, Student Guidance; W. J. Philips, Professional Development; G. F. Vail, Student Activities; and J. D. Kline, By-laws.

Hamilton

A. F. Barnard, Jr.E.I.C.,
Secretary-Treasurer

R. R. Packer, Jr.E.I.C.,
Branch News Editor

"Trans-Canada Micro-wave Radio Relay Systems" was the subject of J. B Leworthy's talk at the December meeting of the Hamilton Branch. A 1937 electrical engineering graduate of the University of Toronto, Mr. Leworthy now heads the division of the Bell Telephone Company of Canada concerned with micro-wave radio relay systems, mobile two-way communication and television facilities.

Micro-wave Radio Relay System

Mr. Leworthy was introduced to the Branch members by H. Seeley. In discussing the new system now under construction from Sydney to Vancouver, Mr. Leworthy said that the project is one of the significant achievements to be undertaken by Canadian engineers since the war. The Trans-Canada telephone system provides circuits from coast to coast by means of seven different companies. Since 1945 circuit mileage has been increased five times. With the need for long distance dialling and for television service, these companies are now in the process of providing a micro-wave radio relay system which is due for completion in 1956.

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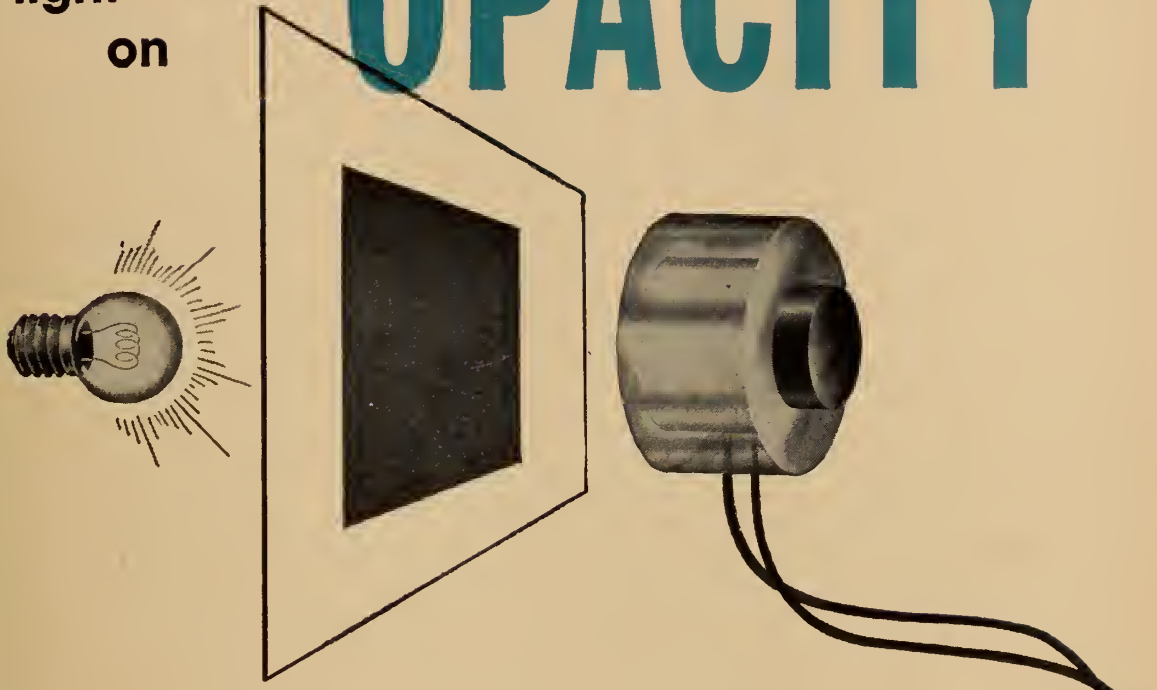

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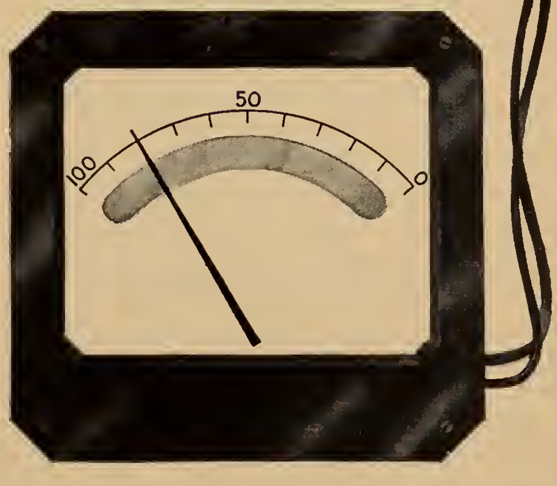

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• Branch News

system, Mr. Leworthy described some of the engineering aspects of the project which requires the services of practically every branch of the profession.

The TD2 system which works on a 3700 to 4200 kc./s. frequency with a 3 in. wave-length requires that 135 repeater stations be constructed every 30 miles to offset the curvature of the earth. Sixty-five of these stations, over a distance of 1,800 miles, are being built by the Bell Telephone Company. There are, in addition, 25 towers for spur lines.

In the selection of a route, determining factors are the availability of power, the existence of land and telephone lines, as well as transportation and communication services. Topographical maps have been made of certain areas; others have been revised to show unmapped obstructions, as in the case of British Columbia. Even in the prairie region 100-foot hills are not uncommon.

Each site is tested by means of a 200-foot portable tower and mobile radio equipment. The construction of the permanent towers, averaging 225 ft. and weighing approximately 40 tons, to provide a negligible twist under high winds, is usually done by contractors, as well as work on roads and clearing of the property.

The stations are pre-fabricated buildings approximately 36 by 21 ft. Each station is equipped with auxiliary power to ensure dependability. In addition, there is a wave guide system from antenna to radio building, in readiness for the complex switching equipment required in long distance customer dialing.

Automatic "Watch Dog"

Each tower is equipped with an automatic "watch dog", by means of which men on duty are constantly supplied with information on the fuel level, temperature, radio equipment performance, and auxiliary power supply. The "watchdog" can answer 40 questions required by maintenance men; it can also perform certain functions, such as the switching-on of auxiliary power. At each relay station repeated checks are made to make sure that signals are clear.

The path of a typical television broadcast is as follows: The broadcast studio camera converts the view into electrical impulses which are sent by telephone to the main telephone building of a major city where a frequency modulation system changes the frequency and amplitude. The signals are then transmitted through the relay stations to another major city where they are again modulated for receiver use.

At the conclusion of his talk Mr. Leworthy displayed some new inventions of the Bell Telephone Company among which were a pocket transmitter, and samples of cable and tubes used in trans-Atlantic telephone calls.

A question period followed the address. F. E. Milne, Branch chairman, thanked Mr. Leworthy on behalf of the members.

Montreal

G. M. Boissonneault, M.E.I.C.,
Secretary-Treasurer

Marc Benoit, M.E.I.C.,
Publicity Chairman

Automatic Computers

Tuesday, November 29, 1955, at the Mansfield St. headquarters of the Engineering Institute, Montreal Branch members were given the opportunity to enlarge their views on a modern tool for management represented by the family of "Automatic Computers".

The speaker, Walter Smuck, applied science representative for International Business Machines (I.B.M.), did a good job of conveying the basic principles of operation and application of these complex machines which now render possible the almost impossible of yesterday.

After a brief historical approach to the problem, Mr. Smuck described the different types of available machines plus the auxiliary equipment required. In few words, one starts with the basic punch card where the information is permanently recorded (or a magnetic tape recorder having a considerable larger capacity), and in a matter of seconds or a split second in some cases, these machines start producing results pertinent to material inventory, material routing to strategic warehouses, payroll, bookkeeping, and solutions of complex technical problems, etc. Every

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one present must have felt some sort of relief when Mr. Smuck, who said that a single one of these machines could replace thousands of office workers, also added that the machine still required at least one man to do the initial and final thinking.

Prior to the question period, a coloured film was shown depicting different types of automatic computers, classifiers, automatic punch card machines, etc.

Machines are Self-checking

One interesting point to remember, is the fact that information can be sent directly to the machines from various long distance sources; also, all the machines are self-checking and any error will stop and hold everything.

One last point of general interest is that machines can be built to suit special specific requests or problems. In all events, the manufacturer remains the sole owner of the machines. These machines are then rented on a monthly basis and the necessary skilled personnel is supplied by the manufacturer.

G. H. Hoganson, of Canadian National Railways and chairman of the Management Section of the Program Committee, expressed a vote of thanks to Mr. Smuck and the meeting chairman, Leo. Roy of the Quebec Hydro-Electric Company, declared the meeting over.

The meeting was arranged by D. Danylkiw of the Bell Telephone Company.

Montreal Electrical Section

M. J. Oldershaw, M.E.I.C.,
Chairman

Marconi Company Is Host

On Monday evening, November 14, 1955, the Canadian Marconi Company received 123 guests consisting of members of the Engineering Institute of Canada, American Institute of Electrical Engineers, and the Institute of Radio Engineers Montreal branches. The visitors were greeted by the president, S. M. Finlayson, and were then conducted on a 3½-hour tour of Marconi.

In the Marconi building they were shown such items in production as marine radar, 20 kw. communication transmitters, mobile FM communication sets, marine radiotelephone, quartz crystals, photocells, radios, television receivers, and radio relay equipment.

The guests were then taken to the McEachran Avenue premises by bus to see through the aviation, radio relay and research departments where new equipment and components are under development.

The tour ended with light refreshments in the company cafeteria.

Winnipeg Electrical Section

G. L. MacDonald, M.E.I.C.,
News Editor

D. H. McKeough is Speaker

On November 3, 1955, the Electrical Section of the Winnipeg Branch was addressed by D. H. McKeough, Switchgear Engineering Division, Canadian Westinghouse Company. The subject of his address was, "The Jetaire Air Blast Circuit Breaker".

Mr. McKeough traced the development of high voltage circuit breakers from the earliest attempt at a high power breaker built for the new Niagara Falls power development about 1895. This was a plain air break breaker powered by an air operated mechanism. The early oil circuit breakers also used a simple break under oil and development was hampered by the lack of testing laboratories, and because the nature of arc interruption under oil was not understood. It was supposed that insulating oil made an effective arc quenching agent because of its high dielectric strength, that is, the oil supply flowed between the contacts and stopped the arc from flowing. About 1929, design engineers began to realize that the arc was always encased in a bubble of gas, and that the flow of gas formed from the thermal breakdown of oil was the effective agent. The interrupting ratings of oil breakers rapidly increased

and arcing times diminished. At the same time, the new large testing stations were able to demonstrate the operation of these breakers.

Development of high voltage breakers on the North American continent, up to the present, has been largely concentrated on the development of high voltage dead-tank oil breakers which are being used up to the highest voltages and interrupting capacities. A different trend developed on the European continent where part of the effort was directed to the development of oil poor breakers and air blast breakers.

First Air Blast Breakers

The first commercial air blast breaker was built by a German firm in 1929, and by the end of the war, most British and continental manufacturers were building high voltage air blast breakers. This European trend appears to be due in part to the relatively high material costs and low labour costs prevailing in that area. The porcelain clad air blast breaker with its minimum content of steel and copper has had an advantage, whereas on this continent, the relatively high wage rates and low material costs have favoured the design of the bulk oil circuit breaker.

The modern high voltage breakers fall into three broad classes: (a) dead-tank bulk oil breakers, (b) porcelain clad oil poor breakers, (c) porcelain clad air blast breakers. The first two use insulating oil as an interrupting fluid while the third uses compressed gas. One fundamental difference between these two methods is that the oil interrupter is a 'suicide type' interrupter in that the arc generates the gas pressure for its own extinction so that the interrupting effect is a function of the current flowing. In the air blast breaker, the gas is stored at some arbitrary pressure and the interrupting effect is independent of the size of the arc. Consequently, the oil breakers tend to show some tendency towards long arcing times at low currents, particularly with low power factor switching unless the oil flow is aided by mechanical pumps or some such device. They also tend to have trouble with capacitive currents where successive restrikes can build up dangerous overvoltages in the system and discharges within the breaker can damage interrupters from the mechanical forces involved unless provided with special switching resistors for this service. Air blast breakers tend to have an excessive interrupting effort for very low currents, in the order of 50 amps or less, and may force the natural current zero. Under certain circumstances, the current chopping also may lead to switching surges which may be a hazard unless proper provisions are made in the form of surge diverters.

Porcelain Clad Air Blast Breakers

In the porcelain clad air blast breaker field, a great diversity of ideas is evidenced by the different designs available. One thing in common to all is that all use axial blast interrupters as opposed to the cross blast principle. The nominal service voltage impressed across each interrupter varies from 30 kv. to 110 kv. Some breakers have their interrupters stacked vertically, one above the other; others mount them on a slant at the top of wyes; while still others mount them horizontally at the top of tees. Most manufacturers build the disconnect switch into the breaker structure to isolate one side of the breaker when it opens because the interrupting gaps remain open only while the blast valves are held open and the disconnect must open during this time. These disconnects, or sequential isolators as they are sometimes called, are usually exposed to the weather and use different devices such as pneumatic hammers or the exhaust blast to lessen the hazard of their becoming locked shut due to icing.

Jetaire Circuit Breaker

A fourth distinctive type of high voltage breaker, which may be called a dead-tank air blast breaker, has been developed by the Canadian Westinghouse Company and has been christened the 'Jetaire' circuit breaker. Mr. McKeough showed a slide of a 115 kv. or 138 kv. design 'Jetaire' circuit breaker being assembled in the shop. The same design principles apply to 69 kv. and up, as the same interrupters, blast valves, control valves and so on are used at all voltages so that all parts will be interchangeable. At the voltage mentioned, the breaker is a three tank breaker and structurally is very similar to a bulk oil breaker. The interrupters are mounted inside the tanks, two per pole. They are arranged in series electrically and in parallel pneumatically so that the arc energy from one cannot affect the air flow from the other. The top section of the tanks are registered pressure vessels and hold air at 250 p.s.i. The blast valves extend through the bottom of the vessel into the skirt which is made weather tight by gasketed louvres and a blast valve is mounted at the lower end of each blast tube. The current is brought in and out of the tanks through conventional terminal bushings. Ring-type current transformers are mounted on the top of the breaker. The high pressure air in the tanks is used to (a) provide the interrupting medium, (b) store energy for operating the breaker, (c) increase the voltage level between live parts and ground.

Sparkover and Creepage Strength

At the start of this development, it was found that little was published regarding the sparkover and creepage strength in high pressure air in the ranges of voltage and distances in question. A test tank was built to take a 138 kv. bushing and pressures up to 300 p.s.i. and tested for breakdown voltages of different shapes of electrodes at different gaps of up to 8 in., both for 60 cycle and impulse. Several hundred of these tests were carried out under a variety of conditions and led to the following conclusions; (a) for any given arrangement the results were very consistent and therefore reliable; (b) high pressure air was at least as good an insulating medium as insulating oil.

A single pole prototype breaker was then built for a 138 kv., 5,000 mva.

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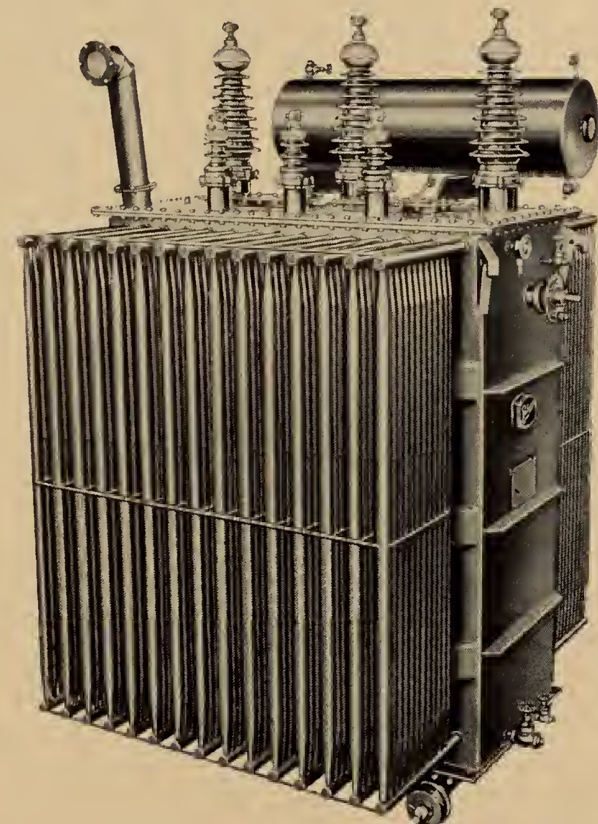

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• Branch News

rating and tested both for mechanical operating and interrupting.

Jetaire Features

The following features distinguish the 'Jetaire' breaker from previous breaker designs: Structurally the breaker is much more rugged and compact than porcelain clad air blast breakers.

The interrupter is placed directly in the high pressure air so that full tank pressure is available at the contacts even before they separate. This makes for a very efficient interrupter with short arcing times.

The only moving parts are the interrupter contacts, blast valve stem, control valve stem and auxiliary switch operator.

All moving parts are enclosed in dust-proof compartments.

Since the blast valves are mounted at the exhaust of the breaker, no atmospheric moisture can condense on the insides of the blast tubes.

Up to twelve ring type current transformers may be used, two per bushing. Potential devices also may be added simply.

The relatively large tanks serve as additional air storage for the user without adding separate tanks. This means that at least four separate close-open operations are available above lock-out air pressure without any assistance from the air supply system.

The 'Jetaire' breaker uses much less ground area than any porcelain clad air blast breaker and considerably less than bulk oil breakers of the same rating.

The ground shock is negligible during interruptions. This permits a considerable saving in foundation design.

The load current is carried on separate surfaces from the arcing surfaces. This combined with the short arcing times of ½ to ¾ cycles assures long contact life.

Contacts may be removed and inspected on any pole in less than 20 minutes.

The elimination of the sequential isolator simplifies the breaker both structurally and from an operating standpoint.

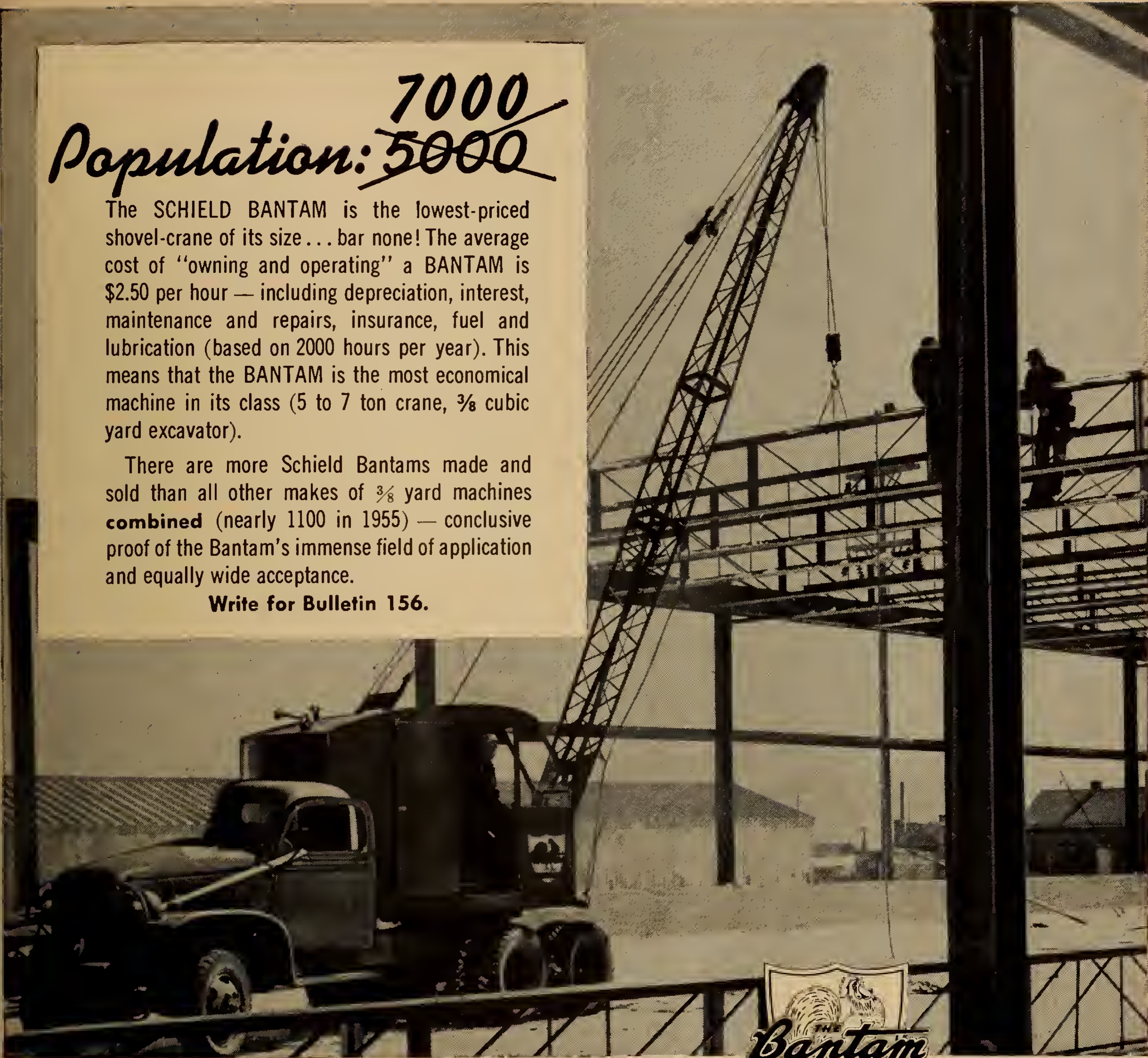
The breaker may be shipped on rails as a completely assembled unit.

Annual Dinner and Dance

On November 18, over two hundred engineers and their ladies gathered at the Marlborough Hotel for the annual dinner and dance of the Winnipeg Electrical Section. This dinner and dance is now a well known and popular social event in Winnipeg engineering circles, and it was further enlivened this year by a visit from the president, Dr. R. E. Heartz and Mrs. Heartz, accompanied by Dr. L. Austin Wright.

Life Membership Presented

An event of special interest was the presentation of a Life Membership in the Engineering Institute to Dr. E. P. Fetherstonhaugh by the president, Dr. Heartz. Dr. Wright gave the address of presentation and paid tribute to Dr. Fetherstonhaugh as an engineer, an educator and as a citizen.



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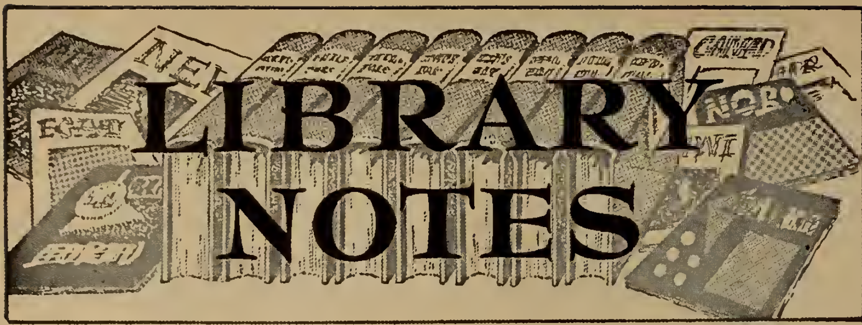

Additions to the Institute Library

Reviews — Book Notes — Abstracts

BOOK REVIEW

My mother the judge. Elsie Gregory MacGill. Toronto, Ryerson, 1955. 248 pp., $4.50.

Elsie MacGill's lively and loving biography of her remarkable mother is at once a work of a considerable historical interest, dealing, as it does, with early Upper Canadian days and graphically depicting the fight for and growth of social legislation on the West Coast.

Born to an old family of considerable influence and standing in Hamilton. Judge MacGill had an established and conventional background which was surely an unusual starting point for such an extraordinary and variegated career. It is not surprising that the daughter of such a mother should herself be Canada's outstanding woman aeronautical engineer.

One of the first women graduates of Toronto's Trinity College, Judge MacGill received her degree in 1890. She began her career as a "budding journalist" turning out, as her daughter relates, "political, social and historical pieces" for American and Canadian publications notably the American magazine "Cosmopolitan".

John Brisbane Walker, editor of that publication, hit upon, at that time, the most unusual idea of sending Judge MacGill to Japan to report on the new constitutional government then arising out of the upheaval of 1868.

Before sailing on this mission, Judge MacGill made an extended tour of the western settlements then in the throes of boom and expansion. Here she met and married her first husband, Dr. Flesher.

After her return from her successful trip to Japan, she went with him first to California and later to Minnesota.

Following his untimely death in 1901, she returned to Canada, eventually marrying an old Toronto acquaintance, lawyer James MacGill. Together they settled in Vancouver, where two daughters were born.

Mrs. MacGill soon turned her enormous energies into work for improvement and reform in that growing community. Women's suffrage, penal conditions, juvenile delinquency and the care of needy women and children all had her ardent attention.

Her objectives in the improvement of social conditions were met with bitter opposition which she cheerfully and courageously weathered with growing support for her programs.

Her efforts on behalf of juveniles culminated in her nomination as judge of the Juvenile Court in Vancouver in 1917. In this "first" in the Province of British Columbia and possibly in Canada, she again made history.

Numerous social reforms and legislation stemming therefrom all bear the imprint of this remarkable woman.

Her daughter's charming and intimate biography makes of her life story a great human and interesting documentary.

Constance G. Short, LL.B.

BOOK NOTES*

Prepared by the Library
The Engineering Institute of Canada

*Review provided through the courtesy of the Engineering Societies Library in New York.

Analyse quantitative minérale, 3e éd. Gaston Charlot et Denise Bézier. Paris, Masson, 1955. 823 pp., 7000 fr.

While this edition has been completely revised it still remains a practical guide for the analytical chemist and metallurgist, rather than a theoretical text.

The book is again divided into two sections. The first deals with the various methods used in analytical chemistry to study the phenomena of solutions, precipitations, etc. The different types of reactions which can be produced are also studied.

The larger half of the book covers the properties of the elements, arranged in alphabetical order.

This edition contains new information on spectrophotometry and electrochemical methods of analysis.

Architectural engineering. Editors of Architectural Record. New York, Dodge, 1955. 494 pp., illus., $11.50 (U.S.).

The editors of the well-known "Architectural Record" have gathered together articles by specialists on the newest developments in the field of architectural engineering. Each section is supplemented by plans, diagrams and photographs.

The reader will find cost-cutting methods, new uses for old and new materials, new structural systems and new mechanical and electrical equipment. The book is divided into six large sections covering all details of building design and construction. The first section on the building shell includes studies of roofs, floors and prefabrication; the next chapter deals with environmental control including interesting data on panel heating, thermal insulation, acoustics, etc. The next two sections discuss such utilities as vertical transportation and materials handling equipment, and site planning. The information on many new materials in the next section will be very useful, while the last chapter goes into special problems connected with structural safety, fire and explosion protection, and planning for atomic energy.

In addition to such specific information the book attempts to establish common ground between the architect and engineer by outlining basic principles, and demonstrating their applications.

Basic electrotechnics, 2nd ed. B. L. Goodlet. Toronto, Macmillan, 1955. 277 pp., diagrs., $4.10.

The present edition has not been changed to a great extent but does contain a new chapter on transient phenomena and additional material on the three-phase system. It is intended, as was the first edition, to be a textbook for students in electrical engineering, and covers basic electromagnetic theory.

There is a condensed account of steady and alternating current theory, electrostatic fields, condensers and dielectrics, and electrodynamics. There are also chapters on the calculation of magnetic fields, Maxwell's equations and electromagnetic waves, and generators, motors, transformers, and some other apparatus are briefly described. Rationalized m.k.s. units are used throughout the book.

The Beama catalogue, 3rd ed., 1955-56. London, Iliffe, 1955. 1034 pp., illus.

In this third edition of the well-known buyers' guide to the products and services of the electrical industry in Great Britain, the information has been brought completely up to date. There are again a large number of valuable illustrations and, for the reader's convenience, each section is printed in a distinctive second colour.

The products of member firms are displayed in three sections: electrical power plant; electrical equipment in industry, transport and communications; domestic and commercial electrical appliances, lighting, accessories and installation material.

In addition there is a five language glossary of technical terms, a classified buyers' guide using more than 1,200 headings, and a trade directory giving addresses of domestic and overseas branches and agents.

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Boundary layer theory. Hermann Schlichting. Toronto, McGraw-Hill, 1955. 535 pp., diagrs., $18.00.

Although the boundary layer theory is an important part of modern fluid dynamics, this is the first book to treat the subject exclusively. It first appeared in the German language in 1951 and included material which had been classified as secret during the war.

The book is written especially for engineers and for students of mechanical engineering and machine design and the emphasis is on basic physical ideas rather than on mathematical details.

The main purpose of the text is to present the mathematical and physical background of the problems involved in the motion of viscous fluids. The first section discusses the basic equations of the boundary layer theory as they are derived from the Navier-Stokes equations of motion. The second part contains the theory of laminar boundary layers, and includes the theory of thermal boundary layers. The third section covers the phenomenon of transition from laminar to turbulent flow, while the last section is devoted to turbulent flows.

Some examples and results of experiments are given to provide a clear insight into the phenomena and because they constitute the foundation of the semi-empirical theory.

The common sense of the exact sciences. W. K. Clifford. New York, Dover, c. 1946. 249 pp., pa. $1.60 (U.S.).

Another in the series of cheap editions of classical scientific works published by Dover, this has been a general reader's guide to modern scientific and mathematical thought for seventy years, covering such topics as number, space, quantity, position and motion.

*__La construction des tunnels, galeries et souterrains.__ Georges Bardout and Pierre Berny. Paris, Eyrolles, 1954. 287 pp., illus., 3400 fr.

A comprehensive treatment of tunnel construction covering planning, excavation methods, timbering, blasting, shield and compressed air operations, sintering of caissons, etc. Separate chapters are devoted to the description of equipment, to the necessary calculations, and to the evaluation of costs. Some notable tunnels are briefly described and a group of detailed diagrams of typical projects is appended.

*__Constructional steelwork.__ Oscar Faber. Toronto, British Book Service, 1955. 368 pp., illus., $8.50.

Based on British Standard 449/1948, this book discusses the design of beams, girders, columns, fasteners, and connections for steel frame buildings of the normal office or apartment type. The design of small and large roof trusses and of workshops with traveling cranes is also treated, and chapters are included on elementary design principles, materials and properties, specifications, and working stresses. Fully worked out examples are included.

Cours d'électrotechnique: 1. partie—Théories générales, 3e éd. Edgar Gillon. Montreal, Fomac, 1955. 288 pp., diagrs., $10.20.

This is a general introduction to electrical engineering theory and differs from previous editions by the inclusion of Giorgi units.

The six chapters of the book discuss electrostatics, electrical circuits, dielectrics, magnetic circuits, the theory of alternating currents and methods of measuring electrical units.

Engineering students would find this a useful background text in the field of electricity.

Les dislocations et la croissance des cristaux. Willy Dekeyser et Severin Amelinckx. Paris, Masson, 1955. 184 pp., diagrs., 2000 fr.

This book discusses the theory, advanced by Frank in 1949, of the helical growth of crystals at the supersaturation point. The authors also describe methods of observing this phenomena and cover the subject of dislocations of crystals. Because these latter are closely connected to the properties of solids, this work will not only interest crystallographers and mineralogists but also metallurgists and physicists.

Electrical year book, 1956. Manchester, Emmott, 1955. 360 pp., illus., tables, 3/6.

The 1956 Electrical year book has a new section giving a concise account of electronic fundamentals and methods, illustrating these by reference to the more appropriate of the new applications. In the section on electric lighting new material has been included on the quick-start fluorescent lamp.

Eléments de mécanique quantique. Ph. Pluvinage. Paris, Masson, 1955. 547 pp., 4600 fr.

Some of the most recent theories and discoveries connected with quantum mechanics have been covered in this new book. It presents not only the theory of the subject but also the practical applications resulting from this theory. The author's purpose in writing his book was to assist students and practising scientists and engineers to become familiar with this branch of physics.

There are three large divisions in the book, following the basic concepts of atomic physics. The first of these discusses the particle in movement on an axis, and includes Schrodinger's equation and Heisenberg's theory. The next section on the particle in space includes detailed treatment of such phenomena as spin and the Zeeman effect. In the last part of the book the general principles of the systems of particles are outlined.

First congress of the Fédération Internationale de la Précontrainte, London, 1953. London, Cement and concrete association, 1955. 255 pp., 50/-.

The present volume contains the general reports in English, French and German on the three main topics discussed at the technical session of the Congress, and the discussion on these topics in English.

The topics considered are: The influence of abnormal temperatures on prestressed concrete construction; The design of statically determinate beams and slabs in prestressed concrete, based on ultimate load; Statically indeterminate structures in the elastic and plastic states. The general reporters and members of the discussion groups include such famous names in the field of prestressed concrete as Magnel, Guyon, Hill, Dardanelli, Lazard and many others.

Frontier to space. Eric Burgess. Toronto, British Book Service, 1955. 174 pp., illus., $3.60.

The author of this interesting book has attempted to gather together in-

• Library Notes

formation and data on the long-range rocket which had previously appeared only in technical papers and reports. As in his other book, **Rocket Propulsion.** Mr. Burgess forecasts space travel and the fascinating discoveries which the advance of rocket propulsion are making possible. Most of his book could be read by persons with little scientific training but the references will make it valuable to the serious student.

The first part of the book describes the short history of long range rockets and the experiments which are being constantly carried out and which will eventually lead to the artificial satellite and the probe missile. Other chapters discuss the ionosphere, solar radiation, cosmic rays and the debris of space, and the region beyond the exosphere.

Frontiers of astronomy. Fred Hoyle. Toronto, British Book Service, 1955. 360 pp., illus., $5.00.

Mr. Hoyle is well known for two other books written in the same popular style as the present work: **The nature of the universe** and **A decade of decision.** In **Frontiers of astronomy** he reveals himself both as an authority in this particular branch of science and as an experienced writer. The book is based on studies he made at Mount Palomar Observatory in California and much of the material has not previously been presented in popular form.

Atomic and nuclear physics are discussed in two of the early chapters as well as the applications of physics to astronomy. These are followed by chapters on the earth, moon, sun, planets and various types of stars. The author then proceeds to a broader description of star systems like the Milky Way and includes the origin of galaxies and the birth of stars. The interesting new subject of radio astronomy is also considered.

The last three chapters are devoted to modern theories of the Universe and to future unsolved problems in astronomy.

Fuel: solid, liquid and gaseous, 5th ed. J. S. S. Brame and J. G. King. Toronto, Macmillan, 1955. 551 pp., illus., $8.50.

The first edition of Fuel appeared in 1914 and, as there had been no revision since 1935, this edition has been almost completely rewritten. The book is intended to be a broad introduction to fuel technology but is limited to the properties of fuels and their methods of application. The details of processes of production or utilization of fuels are not included.

The different types of fuel discussed are wood and peat, coal and coke, oil fuels, gaseous fuels and water gas. Many advances in fuel technology are described including the widespread use of pulverized coal, the conversion of coal to oil by hydrogenation or synthesis, and new methods of petroleum refining such as catalyst-cracking.

The last three chapters deal with fuel analysis, determination of calorific value and economy in fuel usage.

*__Gas turbines and jet propulsion,__ 6th ed. G. G. Smith. London, Iliffe, Toronto, British Book Service, 1955. 412 pp., illus., $6.00.

Concerned mainly with airplane engines, this book covers basic principles, thrust and performance, the relative efficiency of jets and airscrews, components, combustion, metallurgical problems, testing, and maintenance. It also contains descriptions of current American, British, Canadian and European gas turbines, a chapter on ramjets, pulsejets, and rockets, and brief discussions of gas turbines for automobiles, locomotives, ships, and for various industrial applications.

*__Instruments for measurement and control.__ W. G. Holzbock. New York, Reinhold, 1955. 371 pp., illus., $10.00 (U.S.).

Nine chapters of this book are devoted to descriptions of the operational characteristics and, in many cases, the structural details, of instruments commonly used in industrial plants for measuring temperature, humidity, pressure, flow, and other process variables. Five chapters deal with various control devices—electric, pneumatic, hydraulic, etc. — and the last chapter briefly summarizes recent trends in the use of centralized control systems.

Machine translation of languages. W. N. Locke and A. D. Booth, eds. New York, Wiley, 1955. 243 pp., $6.00.

One of the greatest problems in the world today is the language barrier which prevents understanding and tolerance among nations. In recent years there has been an effort to enlist the aid of machines in overcoming this barrier. This collection of fourteen essays surveys the progress that has been made since 1949 when Warren Weaver, with his **Translation,** started linguists and engineers thinking on this subject.

After an historical introduction the book covers such topics as the design of an automatic Russian-English technical dictionary, a preliminary study of Russian, some problems of the "Word," speech input, storage devices, the Georgetown University-I.B.M. experiment in mechanical translation, the mechanical determination of meaning, model English, syntax and recent experiments.

Most of the authors are specialists in the field of languages and mathematics and their essays will provoke much thought among engineers and other readers.

Matter and light: the new physics. L. De Broglie. New York, Dover, c. 1939. 300 pp., pa. $1.60 (U.S.).

The author, recipient of the 1927 Nobel Prize for Physics, here presents several of his studies of contemporary physics, written so that those with no mathematical training can understand the greater part of the work. Topics covered include matter and electricity, light and radiation, wave mechanics and quantum physics.

Mécanique, 5e éd. G. Bruhat, A. Foch, rev. Paris, Masson, 1955. 724 pp., 3000 fr. (Cours de physique générale).

This general textbook on mechanics gives full coverage to the various topics usually associated with the subject. It is presented in seven general sections which are subdivided into detailed chapters.

The first section deals with statics, including a basic discussion of vectorial calculus, kinematics and the theory of work. In the second section the subject of dynamics is covered in its different aspects. The third part is shorter but is devoted to a subject not always included in this type of book: metrology. The measurement of time and the theory of vibrations are explained next, followed by a section on fluid mechanics. The last two sections contain a great deal of new material on the discussions of vibrations in fluids and solids.

The book contains many equations and, as well as being a text for uni-

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versity students, it would serve as a "refresher" course for graduate physicists and engineers.

Mechanical world year book, 1956. Manchester, Emmott, 1955. 360 pp., illus., tables, 4/6.

A feature of this edition is a new section on gas turbines. Now that experience in gas turbine design has been accumulated and become more widespread, a more advanced account of current practice is required, therefore, a concise section on design procedure has been included. This presents data and detailed methods for use in dealing with the principal components.

Additional or revised material appears in the sections or tables on materials, power plants, limits and fits, keys, cutting speeds and feeds.

National directory of the Canadian pulp and paper industries, 1955. Gardenvale, National business publications, 1955. 501 pp., $4.50.

This publication is similar to previous editions, and includes the latest available statistics of the industry. At the beginning there is a general description of the pulp and paper industry, the paper box and bag industry, the roofing paper industry, the forest resources of Canada, etc. The directory then lists pulp and paper mills by provinces and towns, followed by tables showing the number of mills by type, the number of grinders, machines and digesters by kinds, location, and capacity. Other sections cover converters of paper, distributors, and merchants and trade commissioners connected with the pulp and paper industry.

Nuclear physics. Irving Kaplan. Cambridge, Addison-Wesley, 1955. 609 pp., diagrs., $8.50 (U.S.).

With nuclear physics entering the field of industrial engineering there is a great need for engineers and scientists with a working knowledge of the subject. This book attempts to provide an understanding of the atomic and nuclear bases necessary for the solution of problems involving reactors, etc. The reader needs no previous training in atomic or nuclear physics although a general background in physics and calculus is assumed.

The first seven chapters deal with the foundations of nuclear physics and cover such subjects as radioactivity, X-rays, atomic structure, atomic spectra, and relativity. The next section discusses the physics of the nucleus, while the last five chapters are devoted to special applications and subjects, including neutron physics and nuclear fission.

The petroleum refinery engineer's handbook, 2nd ed. J. F. Strachan. Toronto, British Book Service, 1955. 168 pp., diagrs., $8.50.

The main purpose of this book is to correlate inspection procedures, methods, recording and equipment used in oil refining plants. Since the first edition appeared in 1947, under the title **Practical inspection of oil refinery equipment,** new inspection methods, using electrical and electronic methods, have been introduced and are discussed in this edition.

The book is divided into five chapters. The first deals with the organization and personnel of the plant inspection department; the second with inspection procedure, and the third with corrosion and protection of oil equipment. The last two sections discuss calculations and formulae used by the inspector, and the principles of general safety in a refinery.

Physique atomique. Marcel Rouault. Paris, Colin, 1955. 220 pp., diagrs.

The many branches of atomic physics are discussed in this little textbook. Beginning with a chapter on the granular structure of matter and the constituents of the atom, it goes on to describe the theories of quanta and photons, Bohr's theory and wave mechanics. There is a chapter covering the electronic structure of atoms and the emission of spectral rays. The last chapter deals with the complex atoms and touches on such subjects as spin, X-rays and the theory of absorption.

***Research reactors.** United States atomic energy commission. Toronto, McGraw-Hill, 1955. 442 pp., illus., $7.80.

This book gives descriptions of three types of light-water-moderated reactors (pool, solution, and materials-testing), and of three other types: hydro-carbon-moderated; heavy-water-moderated, and

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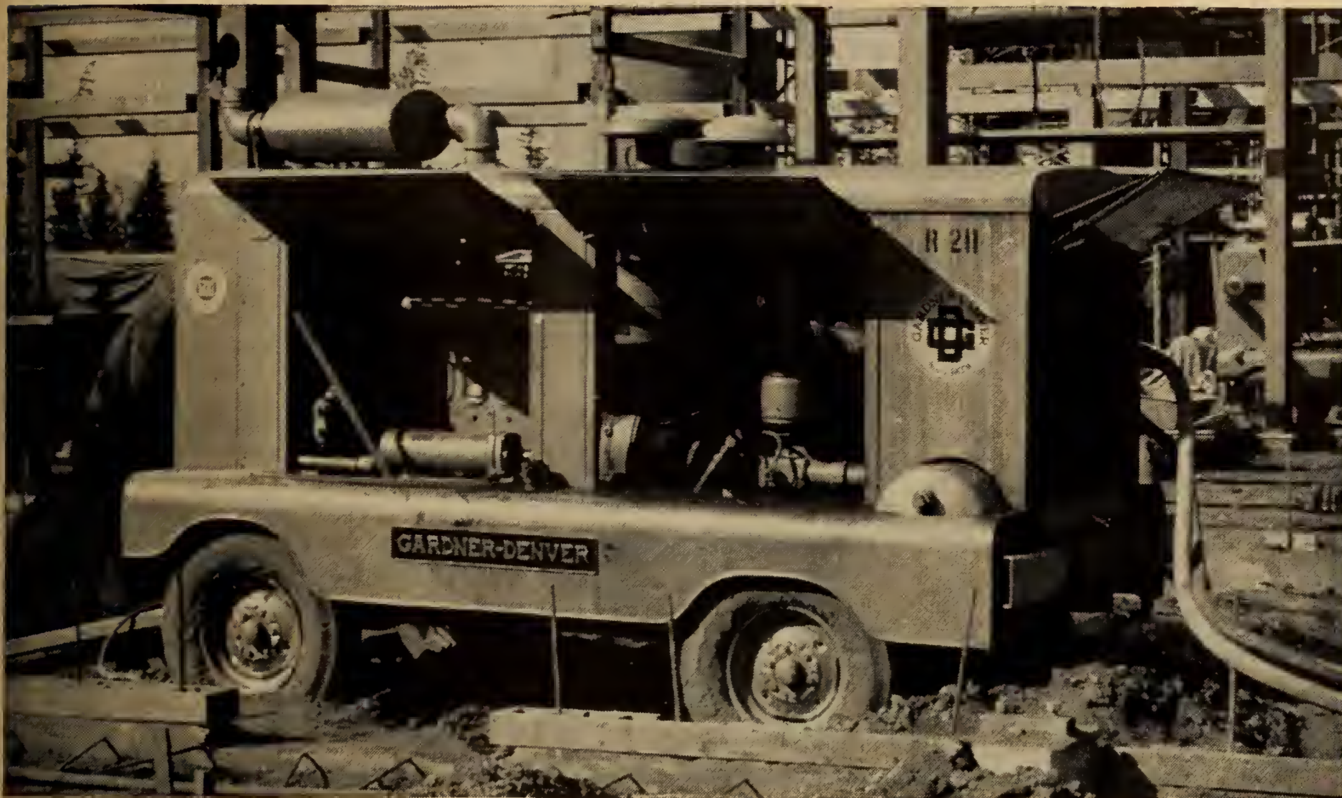

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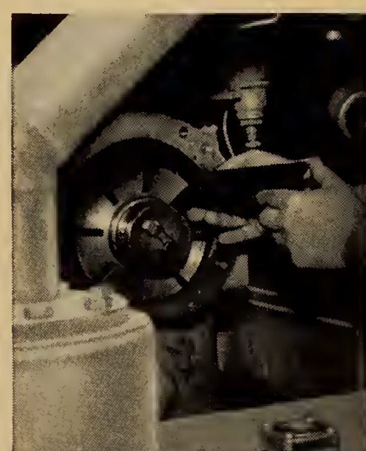

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graphite-moderated. Information given for each type includes general design features, core design and fuel handling, cooling system (where applicable), control and instrumentation, shielding, experimental facilities, and operating characteristics. The book was prepared originally for the International Conference on the Peaceful Uses of Atomic Energy.

Spectrochemical abstracts, v. 4, 1946-1951. E. H. S. van Someren and F. Lachman. London, Hilger and Watts, 1955. 179 pp., 30/-.

The eight hundred abstracts presented in this volume cover the years 1946-1951. The main arrangement is by subject, and there are complete author and subject indices. Some of the topics under which the material is grouped in-
been made to select for inclusion papers
clude the various substances analyzed—biological materials, gases, minerals, etc.—apparatus, methods and source theory.

Many of the abstracts are taken from other compilations, and an attempt has
which not only give the results of spectrochemical analysis, but also contribute to the development of the subject.

Ultrasonic engineering. A. E. Crawford. Toronto, Butterworth, 1955. 344 pp., illus., $8.00.

Although the study of ultrasonics has been generally left to the physicist, recent discoveries on the applications and effects of ultrasonic waves have led to a much greater interest in the subject among industrial engineers. While this book has devoted some space to the basic theory and generation of ultrasonic waves, the larger part deals with their use in such processes as metal coating and cleaning.

The first two theoretical chapters discuss the characteristics and measurement of ultrasonic waves, and the nature of cavitation. The section on generation is divided into four chapters, covering piezoelectric and magnetostriction transducers, jet generators and electromagnetic transducers. Besides the practical applications mentioned above the author describes the use of ultrasonics in such processes as precipitation and agglomeration, emulsification and dispersion, as well as their applications in the fields of chemistry, metallurgy, biology and medicine. The last chapter discusses ultrasonic instruments and control gear.

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

Air pollution

The effects, measurement and control of the atmospheric pollution due to combustion—a review and a bibliography. P. C. G. Isaac. (Durham. University. Dept. of civil eng. Bull. No. 3.)

Automobiles

Facts and figures of the automobile industry, 1955. Motor vehicle license fees, 1955 (Canadian automobile chamber of commerce).

Education

List of students registered in the graduate schools of Canadian universities in science, engineering and medical sciences, 1955-1956. (Canada. NRC Div. of admin. Personnel br.)

Labour supply

Adjustments to labor shortages. R. A. Lester. (Princeton Univ. Industrial relations section.)

Metals refining

Refining antimony by electrodeposition and by distillation. R .R. Rogers and R. A. Campbell. (Canada. Dept. of mines and technical surveys. Mines branch. Tech. pa. No. 11.)

Miscellaneous

A decade of progress: The Quebec hydro-electric commission, 1944-1955.

The first tool engineer. R. B. Douglas. American society of tool engineers.

For Greece a tear: The story of the Greek War Relief Fund of Canada. Florence Macdonald. (Fredericton, Brunswick press.)

Radio and television engineering

Color television receiver practices. Hazeltine corp. laboratories staff. (Rider pub. No. 162) $4.50 (U.S.) pa.; $6.00 (U.S.) cloth.

Crystal oscillators. Alexander Schure, ed. (Rider cat. No. 166-4) $1.25 (U.S.).

Frequency modulation. Alexander Schure, ed. (Rider cat. No. 166-3) 90c (U.S.).

Rider's specialized HI-FI AM-FM tuner manual (Rider pub. No. 7001, v. 1) $3.50 (U.S.).

ENGINEERING CAREERS

The Royal Canadian Army

With the constant threat of military aggression facing the western nations, Canadians have thought it wise to join with other free countries in a compact for mutual protection from foreign domination.

To protect our home soil from possible invasion and to fulfil our other obligations to the United Nations and NATO, the armed services of Canada have been increased from their token strengths of the 1930's and now are strong fighting forces equipped with the best of modern arms. Today there are close to 50,000 men in Canada's Regular Army. Canadian troops are serving in Europe, and the army has provided troops in such places as Korea and Indo-China. There are military missions in the Middle East, India and Pakistan, and military staffs at embassies in various capitals.

The peacetime task of the Regular Army is mainly one of preparedness. The army must keep itself fit so that it can fight effectively in times of war. Study, training, planning and research are its principal occupations. The advent of nuclear weapons has worked great changes in the nature of war, but it has not made armies obsolete. Victory in a new war would go, not to the side that relied on the new weapons alone, but to the side that integrated them most effectively with conventional arms and used *every* weapon most efficiently. It is still true in any war that only the soldier can seize ground and hold it. Moreover, Korea showed that only the soldier can fight small wars fought with conventional weapons.

Increased application of scientific and technical discoveries to the arts of war has altered most of the concepts of military strategy. To develop, test, service and repair the many new weapons and machines needed for defence, the army operates design establishments, proving grounds, training schools, repair depots and maintenance units. All of these give the engineer opportunities not easily matched by civilian industry. While an engineer in civilian life may be compelled to limit his talents to a narrow field of endeavour, there is wide scope for the engineer in the army.

Thus there are fine opportunities for young university men with brains, initiative and a sense of purpose. There are openings for every special talent that the engineering profession develops. The army uses every engineering skill and technique.

The life of the engineer in the army is one of study, teaching and of leadership in the service of Canada. It is a life which provides variety in employment, experience and travel. Advancement is based on ability. Clever engineers can go to the very top. In the army you will find no end of challenge for your ability. The following are some of the fields in which military engineers are indispensable: architectural design, radiation control, radar, design and development of vehicles, weapons, electrical and telecommunication equipment, development of guided missiles, map making, photogrammetry, Shoran plotting, and many others.

THE ENGINEERING CORPS

In the Regular Army there are three corps which employ professional engineers. These are: The Corps of Royal Canadian Engineers, The Royal Canadian Corps of Signals, and the Corps of Royal Canadian Electrical and Mechanical Engineers. Here is a brief outline of their vital work:

The Corps of Royal Canadian Engineers

The RCE is one of the largest and most varied technical arms of the army's combat forces. It provides vital engineer work that permits the troops to live, move and fight. Airfields must be levelled, harbour facilities built, railways and roads constructed, water and sewage systems installed, light and power provided, rivers bridged, obstacles demolished—this list scratches the surface.

In peacetime the RCE plans construction, repairs army properties, supervises building projects, maintains the Northwest Highway System and develops architectural design. To win battles, commanders must have the best of maps. It is the responsibility of the RCE to supply them. The Army Survey Establishment is the second largest topographical agency in Canada. It uses electronic instruments, helicopters and a wealth of the latest scientific equipment — a really up-to-date organization.

Everyone knows the splendid work done by the RCE during floods, fires and hurricanes. Providing aid to the stricken populace in times of disaster is another task of soldiers who wear the iron ring.

The Royal Canadian Corps of Signals

Without efficient up-to-date communications a modern army would be in a state of chaos. Radio, telephone, land line and cable systems are all essential to speed information to and from commanders both in the field and in permanent locations. The Royal Canadian Corps of Signals provides this communication network.

The Signal Officer plans and supervises the setting up and operation of mobile radio stations, the design and installation of line communication systems using equipment which must be portable yet thoroughly reliable. The army's permanent communication system in Canada uses modern radio teletype, tape relay and local telephone services. Much study is also being done in the fields of microwave radio relay, antennae systems, and in suppression of radio interference.

An important pioneer communication network installed and operated by this corps is the Northwest Territories and Yukon radio system. This system carries on a fine public service, providing many of the isolated communities with their only outside contact.

The Corps of Royal Canadian Electrical and Mechanical Engineers

The modern army is highly mechanized and uses a great variety of electrical, electronic and mechanical tools and weapons. The secret of its successful operation lies, of course, in the skill and speed with which the Electrical and Mechanical Engineers keep all the machines working. There is nothing so useless as a gun that will not fire accurately or a tank that breaks down at a crucial moment of combat. To keep all equipment in first class working condition, the Army has men who are thoroughly trained in electrical, optical and mechanical precision work.

The Royal Canadian Electrical and Mechanical Engineers are the repairmen of the army. In both their own shops and with units of other corps, their motor, tank and gun mechanics, electronic and instrument repairmen, machinists, welders, electricians, and other tradesmen, do every kind of repair on all types of army equipment—from tanks to watches and from field cookers to radar sets. Directing these skilled workers requires top engineering know-how.

DESIGN AND DEVELOPMENT ESTABLISHMENTS

Discoveries made during recent years in such fields as nuclear physics, electronics and new substances compel the Canadian Army to exercise and encourage the highest initiative in the design and development of new equipment. To do this the Regular Army operates five Design and Development Directorates which are responsible for progress in the fields of armament, vehicles, signal stores, engineer equipment, and general stores and clothing.

Some of the best scientific talent in universities and industry is working with the armed forces in matters of defence. But the importance of all new technical discoveries from a military point of view can only be fully assessed by engineers who are trained directly in military operations. The army engineer working in the design and development fields plays a valuable role in collaboration with civilian scientists and technicians engaged in defence projects.

Army development project engineers keep in close contact with advances in technology by liaison with such organizations and firms as: Canadian Arsenals, Limited; The National Research Council; Atomic Energy of Canada, Limited; Canadian Industries, Limited; The Aluminum Company of Canada; The Steel Company of Canada; Massey-Harris-Ferguson; Sorel Industries, Limited; General Electric; Northern Electric; and Westinghouse.

There is a great deal of analytical thinking to be done, and the professional engineer in the army has ample opportunity to exercise his imagination.

TRAINING

Engineering graduates with COTC training are appointed to the Regular Army in the rank of Lieutenant. Those without COTC training are enrolled as Second Lieutenants and take a short course which is the equivalent of COTC training. On the successful completion of this course they are promoted to Lieutenant.

A tri-service training scheme which will appeal to engineering undergraduates is the Regular Officer Training Plan (ROTP). The ROTP makes it possible for university students to complete their studies at government expense. The financial benefits to undergraduates who join the army under ROTP amount to approximately $1,700 a year in pay, subsistence, tuition, books and other academic fees. Most Canadian universities provide courses which are acceptable for subsidization under ROTP.

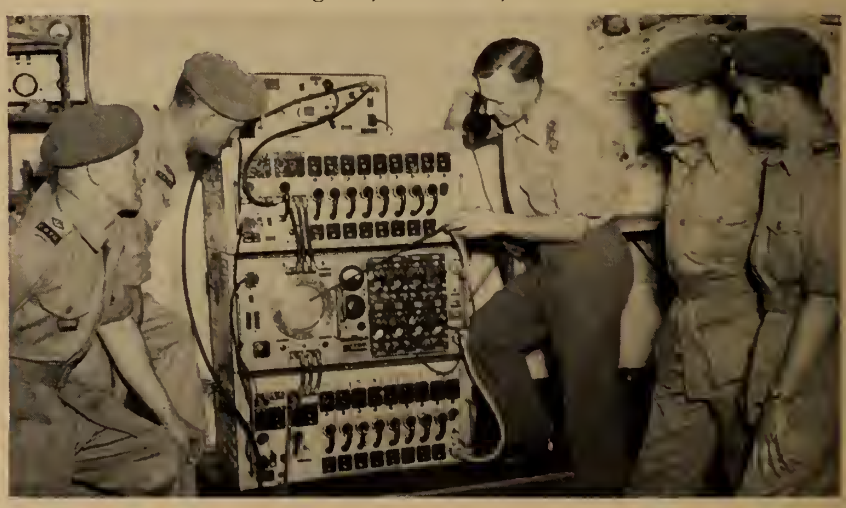
On completion of his initial training, the new Lieutenant is posted to a unit of his corps where he takes a technical course designed to gear his university education to service engineering problems. His next posting is to a unit where he undertakes regimental duty. This is a most important phase of his practical training. It is during this period that he develops qualities of leadership and man-management by training and administering troops. It is his job to mould his NCOs and men into an efficient, well disciplined and enthusiastic team.

During this phase he also carries on his studies, is taught and coached by his superior officers to prepare for promotion and greater responsibility. He is given a variety of duties over a comparatively short period of time.

As their careers develop, selected officers are often sent for advanced training in other countries, particularly to the U.S.A. and U.K. For officers desiring to raise their educational standards, the army sponsors a number of post-graduate courses at universities in Canada, the U.S.A. and U.K. These courses lead to Masters degrees in such fields as automotive engineering, chemistry, biochemistry, communications engineering, soils, sanitary and structural engineering.

When the professional engineer eventually leaves the army, the

Lecture on radiocommunications being given at the Royal Canadian School of Signals, Barriefield, Ont.



knowledge and experience gained in the service will greatly improve his opportunities in business.

PAY AND PROMOTION

A comparison between army and industrial salaries shows that 55 per cent of professional engineers do not reach the amount of pay and allowances which engineers in the army receive. Moreover, the average salary of engineers employed in industry does not surpass that of their Army counterparts except in the middle thirteen years of their employment.

Promotion is based on individual merit, qualifying time in rank, and seniority. A survey taken since the end of the second world war shows that on the average the new officer may look forward to four years as a Lieutenant, five years as a Captain, and seven years as a Major. At that rank both the army and civilian engineering fields show the same pattern for future promotion; as in all worthwhile careers, the highest positions and salaries go to the men who show executive ability in addition to their technical skill. It might be of interest to know that a number of graduate engineers have attained the rank of Major-General in the Army, including S. F. Clark, H. F. H. Hertzberg, H. Kennedy, W. H. S. Macklin, W. J. Megill, N. E. Rodger, C. Vokes, G. Walsh, H. A. Young; M. A. Pope became a Lieutenant-General.

Candidates who are enrolled as Second Lieutenants receive pay and allowance of $250 a month. On successful completion of their short course they are promoted to Lieutenant with pay and allowance of $319 for unmarried officers, or $380 for those who are married.

Army Officers also receive special allowances under various circumstances. These include risk allowance, foreign service allowance, and northern allowance. All army personnel receive complete medical and dental care free of charge. The new officer is given $375 as an incoming clothing allowance to buy military uniforms.

The duty of an army officer in wartime is a strenuous occupation. It is a task for young men, and as a part of keeping itself in fighting trim the army must be able to retire officers when they are too old for effective military service. One result of this is that most officers retiring are still young enough to continue their careers as engineers in industry.

Donjek bridging project on the Northwest Highway System.

The Defence Services Pension Act provides for the payment of a pension to army officers on completion of a full term Army career. In addition, there is an act that ensures a pension to the officer or his dependents in case of injury or death which arises out of or is directly concerned with military service.

MARRIAGE ALLOWANCES POSTINGS AND LEAVE

There is plenty of room for an enjoyable family life for the army man. When an officer is transferred, his family and belongings are nearly always moved with him at public expense. The married officer who has completed his introductory training and is at least 23 years of age will receive a marriage allowance of $40 a month.

Of course the army cannot supply all military personnel with married quarters. But it is a fact that military authorities are doing their best to accommodate as many people as possible with the facilities available at the moment and that they try to speed up their programme for more such buildings. In the case of the Second Canadian Infantry Brigade, the Government sends English and French teachers from Canada to make sure that the children of our soldiers in Germany receive the same education as those in Canada. In short we may say that in peacetime the Army is doing extremely well in this regard and that few civilian enterprises can boast of similar achievements.

Postings are usually for three years' duration. Wherever he goes the officer lives in a social environment that is friendly and rewarding. Sometimes new postings look uninviting, but often turn out to be surprisingly pleasant. Postings to out-of-the-way stations are frequently filled by volunteers, but the army considers such postings as part of the normal duty of every Army man.

The army officer must frequently work on week ends or in the evenings, because his work is involved with matters that cannot be put aside and with the lives and welfare of other men entrusted to his care by the Queen's Commission. But the army recognizes that holidays are important for morale. All army personnel normally get 30 days annual holiday, and in some cases travelling time up to 8 days may be allowed. Leave is also granted under special circumstances, such as for convalescence, after a foreign posting, or for compassionate reasons.

SELECTION

Selection of army officer candidates is rigorous and any new officer can be proud of his acceptance. Candidates undergo a thorough examination for suitability, and successful applications are forwarded to the officer selection committee at Army Headquarters for further screening. The physical requirements are high, and a complete medical inspection must be passed. But the energetic young engineering students or graduates who have a liking for the challenge and responsibility of service life usually possess the qualities from which fine officers are made. In brief, the army offers them an excellent opportunity for good comradeship, excellent training and a chance to do their part in the defence of Canada. √

Employment Service

THIS SERVICE is operated for the benefit of members of The Engineering Institute of Canada and for industrial and other organizations employing technically trained men—without charge to either party. It would be appreciated if employers would make the fullest use of these facilities to list their requirements—existing or estimated.

NOTICES appearing in the SITUATIONS WANTED column will be discontinued after three insertions. They will be reinstated, on request, after a lapse of one month.

REPLIES to advertisements should be addressed to File No. 000, Employment Service, The Engineering Institute of Canada, 2050 Mansfield Street.

INTERVIEWS with the Institute Employment Service, 2050 Mansfield Street, Montreal—Telephone PLateau 5078—may be arranged by appointment.

SITUATIONS WANTED

EXECUTIVE ENGINEER, M.E.I.C., P. Eng. (Quebec) B.Sc. Queens with electrical and mechanical background and strong management and administrative experience desires change and seeks a senior and challenging appointment where his abilities can be fully used. Married with three children and speaks and writes French. Full details of past experience and positions will be furnished to serious inquirers upon request. File No. 937-W.

GRADUATE ENGINEER, M.E.I.C., P. Eng. (Que.) McGill, substantial background manufacturing operations, plant organization and administration. Plant and project engineering. Layout, methods studies, standard costs, production control, material handling. Some sales. Age: mid-forties. Available reasonable notice. Seeks opening as production executive or assistant. Plant engineer or sales. Resume on request. File No. 1186-W.

CHEMICAL ENGINEER, B.Sc., (Ch.E.) M.E.I.C., M.A.I.Ch.E., 43, married, Canadian and U.S. resident; equal knowledge of English and German, Experience: 9 years research and development in fuel technology, 5 years process and project engineer in petroleum refinery engineering. Desires assignment in Germany, Austria or Holland as process, project, or sales engineer in the field of petroleum refinery engineering. Presently employed. Available on one month notice minimum. File No. 1314-W.

MECHANICAL ENGINEER — sound technical and executive background gained through 18 years of practical engineering experience. B.Sc. and M.E., M.E.I.C., A.S.M.E., P.Eng. Ontario, Canadian. Age 40, married. If a future with scope for advancement exists in your organization for an engineer with this background, please contact File No. 2745-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng. (Ont.), N.S.T.C. graduate 1950, 27 years old, single. Two years pulp and paper mill design and layout, one year diesel locomotive maintenance, 18 months railway car building and heavy repair. Desires responsible position where qualifications and experience can be utilized. Available on reasonable notice to present employer. File No. 3271-W.

ADMINISTRATIVE ENGINEER AND PHYSICIST available on part time short term, or retainer basis. Already has a satisfied clientele and now wishes to expand operations. Total of 26 years experience in small and large firm management, testing, instructing, reporting, co-ordinating and service selling. At present, specializes in working for companies requiring extra assistance for short periods at reasonable rates. Where necessary, the following qualifications and affiliations can be cited: B.Eng., M.Sc., M.E.I.C., Soc. Sigma XI, C.A.P., P.E.Q. Security risks previously approved. File No. 3322-W.

ENGINEER, PRESENTLY EMPLOYED, is looking for an interesting and challenging supervisory position in construction or an allied industry. Experience in practically all phases of light and heavy construction with owner and contractor. Experience includes supervision in field and office, evening courses on industrial management as well as field and design work on civil and mechanical engineering projects. Married, age 35, B.Sc. in civil engineering at U.N.B. 1949, P.Eng., M.E.I.C. Will supply summary of experience on request. File No. 3386-W.

ELECTRICAL ENGINEER, B.Eng., McGill 1950, P.Eng., Jr.E.I.C., C.G.E. Test Course, desires responsible position with development or managerial prospects. Experience includes design and construction of industrial power and lighting systems, power factor correction, frequency conversion, system control, air conditioning, resistance welding, material movement and various fabrication processes and plant engineering work (4 years). Polyphase induction motor (½ to 600HP) design, application and test experience (2 years). Overseas World War II five years. Married with three children. Now in Hamilton area but will consider any location. Available on reasonable notice. File No. 3859-W.

MUNICIPAL ENGINEER, JrE.I.C., P.Eng. (Ont.), Queen's (civil) 1949, age 33, single, with 6½ years municipal experience including 2½ years as Town Engineer in Ontario town of 8000 population, seeks an opening in municipal or allied field with future and responsibility. Available in 1956 on one month's notice to present employer. Anywhere in Canada. File No. 4012-W.

CIVIL ENGINEER, M.E.I.C., P.Eng. (N.S.) A.M.I.C.E., (Britain), age 34, married with family. Seeks responsible appointment with consultant, municipal authority, or well established contractor, preferably in Nova Scotia or New Brunswick. Experience in Britain included 8 years with municipal authorities, mainly designing and supervising highways, sewers and buildings. 2½ years with consulting civil engineer in Canada, designing large sewerage and water distribution schemes. Used to writing specifications, taking-off quantities, and preparing reports and estimates. Good administrative experience. Available on one month's notice to present employer. File No. 4157-W.

ELECTRICAL ENGINEER, Jr.E.I.C., McGill 1951, P.Eng., experienced in industrial maintenance, consulting engineering and construction. Desires responsible position in one of these fields where qualifications and experience may be fully utilized. Location not important. Available on one month's notice. File No. 4202-W.

ELECTRICAL ENGINEER, B.Eng. (Hons.), M.A.Sc., M.E.I.C., P.Eng., age 37, married and presently completing tenth year as a professor of electrical engineering. Most of teaching has been on advanced level with emphasis on power. Broad general experience in construction, public utility engineering and as a naval officer. Has done considerable consulting work of a general nature. Seeks appointment conducive to personal and professional growth. File No. 4402-W.

TO CONSTRUCTION FIRMS AND CONSULTANTS located in Montreal area: Civil engineer, Jr.E.I.C., seeks a partial position to work during evenings and Saturdays in concrete design, reinforcing details, supervision of contract and in estimating costs. Additional information obtained by phone or sent on request. File No. 4477-W.

MECHANICAL ENGINEER, M.E.I.C., P.Eng. (Ont.), single, aged 29. 5 years apprenticeship, 8 years combined machine design, project engineering, estimating, tendering and sales in medium/heavy engineering. Presently employed but desires a more responsible position principally interested in administrative design and project engineering. References available. Location preference, Toronto or surrounding cities. File No. 4796-W.

MECHANICAL ENGINEER, Jr.E.L.C., 1952 B.Eng., married, age 34. Completed training course with large manufacturer of electrical equipment. Presently employed; experience includes cost reduction and product improvement work as manufacturing engineer on switchgear equipment, induction and synchronous motors. Varied experience in sales and field engineering. Capable public speaker. Desires sales or product engineers' position demanding initiative and with opportunity for advancement. Preferred location in Ontario or Maritime Provinces. File No. 4820-W.

PROFESSIONAL ENGINEER, B.A.Sc. Electrical 1953, S.E.I.C., 27 years old, married, two children. Fluently bilingual, 2½ years extensive design and supervision work with consulting engineering firm. Other diversified experience as resident engineer on construction project. Capable of dealing with people at any levels. Would consider position where initiative, ability and productivity is needed and which offers challenge and advancement. Location preferred: Eastern Ontario or Quebec. File No. 4830-W.

CHEMICAL ENGINEER, Jr.E.I.C., B.Eng., McGill, 1952, A.I.Ch.E., Jr.E.I.C., C.I.C., P.Eng., age 28, married, desires a more responsible position. Experience in development work in chemical plant and paper mill. Also administrative experience as production supervisor in a chemical plant. Presently employed in Quebec, however would consider employment anywhere in production supervision or development. File No. 4832-W.

CREATIVE ENGINEER, supervisory and management background in chemical and process metallurgy fields, and with sound engineering understanding. B.A.Sc. (Toronto), M.Sc. (Queen's), and A.H.I. business course. M.E.I.C., age 34. Can contribute in plant management, operational analysis or technical administration. File No. 4833-W.

HYDRAULIC ENGINEER, M.E.I.C., Junior member A.S.C.E., graduate B.Sc. (C.E.) Man. 1948, M.Sc. Utah State 1955. Married, 31, two children, returning to Canada desires employment in hydraulic design or related fields. 6½ years experience in drainage, irrigation and highways. File No. 4834-W.

GRADUATE ENGINEER, economist, accountant, 33, experience in construction, cost and production control, management, Government, and commerce in the Far East, requires senior executive or advisory appointment in Ontario, Quebec or foreign. File No. 4835-W.

THE ENGINEERING JOURNAL

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YOU CAN BE SURE.. IF IT'S Westinghouse
SIR ADAM BECK No. 2 GENERATING STATION
In this new Niagara River plant of Ontario Hydro, as in most important generating stations across Canada, you find the name "Westinghouse" on machines producing electricity.
CANADIAN WESTINGHOUSE COMPANY LIMITED, HAMILTON

Applications of High Alumina Cement

P. H. Harris,
Director,
Lafarge Aluminous Cement Company Ltd.,
London, England.

This paper indicates the main characteristics and uses of high alumina cement and outlines its origin and qualities.

During the last few years, there has been an increasing use of high alumina cement in Canada. This material is also known as aluminous or calcium aluminate cement.

It is not a special type of Portland cement, but is of the hydraulic type, and the concreting techniques employed are in general very similar to those employed with Portland cement. It must not be forgotten, however, that high alumina cement is a completely different chemical substance; briefly, the principal cementing constituent of high alumina cement is mono-calcium aluminate, whereas in Portland cement, it is di- or tri-calcium silicate. This fact has an important bearing on the physical properties of the two cements. Typical analyses given in Table I show the essentially different chemical make-up of the two types of cements.

The raw materials and manufacturing methods employed make high alumina cement considerably more expensive than Portland cement, and therefore its use is normally only justified in situations where one or other of its four main characteristics are necessary or desirable. In brief, these four main characteristics are:

(1) Great rapidity of hardening following a normal setting time.

(2) Resistance to many chemical agents that attack ordinary cements.

(3) Ability to provide a "refractory concrete" which will withstand white heat.

(4) In low atmospheric temperatures, the concrete will harden normally without the application of external heat.

High alumina cement was evolved at the beginning of this century. Although the first traceable patent was taken out in 1888[1], this, like other early patents[2], only covered the calcium aluminates as additives to a variety of materials including Portland cement, plaster, etc.; apparently, these early patentors did not realize the significance of calcium aluminate as a cement on its own. The first workers to realize this significance were the Société J. & A. Pavin de Lafarge, who patented a manufacturing process for high alumina cement in France (1908)[3] and England (1909)[4]. This process essentially consisted of melting bauxite and lime in a water-jacketed blast furnace, the resultant clinker being ground to cement fineness. The cement was known as Ciment Fondu[5] which means literally "melted cement".

The experimental work that led to this material's production was carried out in order to produce a cement that would be completely immune from sulphates whether found in the ground or in sea water. Extensive full scale trials during world war I showed that it was, in fact, immune from these conditions, and Ciment Fondu was first marketed in France in 1918.

During the 1920's the commercial sale of high alumina cements commenced in England (Ciment Fondu, 1923) and the United States (Lumnite, 1924). Although high alumina cement was first marketed for its sulphate resisting properties, it was soon discovered that it had rather remarkable rapid-hardening characteristics. These rapid hardening qualities were soon utilized in industry and they are worth mentioning.

The only existing standard specification for high alumina cement, British Standard Specification 915-1947, calls for the following physical properties:

Compression — on 1:3 vibrated mortar cubes:

24 hours: over 6000 p.s.i.
72 " " 7000 p.s.i.

Setting time (Vicat):

Initial: From 2 to 6 hours.
Final: Less than 2 hours after initial.

Soundness (Le Chatelier): Expansion not greater than 1 mm.

Some recent test results[6] obtained from 12 in. standard compression cylinders give an idea of the strength curves to be expected from various mixes. Forty-eight cylinders were tested, all of which were cured in a fog room at 65°F. from the time of casting to that

Table I. Analyses of Cements

	High Alumina		Portland	
	A	B	A	B
Insoluble	0.11	0.52		
SiO_2	3.6	9.5	23.84	21.2
FeO	6.4	4.6		
Fe_2O_3	10.4	4.4	2.12	7.11
Al_2O_3 and TiO_2	41.4	41.2	3.96	2.64
CaO	36.9	38.5	64.96	63.04
MgO	1.0	0.89	1.2	1.05
SO_3	0.03	0.21	1.31	1.6
Other impurities to 100%	—	—		

of testing. Tables II and III give the results of these tests.

The compressive strength figures largely speak for themselves, but it is also interesting to note that samples were taken for six and twelve hour strengths. A typical 1:2:4 concrete (mix 3, Table II) gave the following results:

6 hours: 1440 and 1350 p.s.i.

12 hours: 5120 and 5110 p.s.i.

These figures show the remarkably high strengths of high alumina cement concretes at very early ages and, furthermore, that even weak mixes have strengths of structural grade. It should be noted, however, that these weak mixes will be porous and therefore not suitable for every application.

It will be seen from Table III that the hardening of high alumina cement is virtually complete 24 hours after casting, and the heat release during this period, due to the intensity of the chemical reaction, is enough to protect the concrete against damage in temperatures many degrees below freezing point. As the chemical action reaches its height 10-14 hours after casting, the period of time over which frost penetration can occur is comparatively short.

(2) In warm weather, when aggregates are exposed to direct sunlight, it is also a good idea to wet down aggregate piles in order to keep the placing temperature of the concrete within reasonable limits.

Following these two simple rules should ensure good grade concrete in the field, but, should the reader be in any doubt, the manufacturers should be consulted.

If the ultimate strengths inherent in this type of concrete are required, it is not normally recommended that structural high alumina concrete is poured when atmospheric temperatures above 85°F. are expected during the pouring and hardening period; this is due to the difficulty of effectively cooling any mass of concrete, but the season when such sustained temperatures are experienced is comparatively short, and this should not represent any real inconvenience to the user.

Chemical Resistance

High alumina cement concrete has an extensive use when resistance to a wide variety of aggressive chemicals is required. The resistance of this type of concrete to the influences that can affect Portland cement is probably due not only to the absence of highly reactive free lime, but also to the gelatinous aluminous hydrate formed during the hydration of the calcium aluminate. In practice, this means that high alumina cement can be used in contact with pure water, very dilute acids, sulphates and certain organic compounds. Whereas high alumina cement cannot be regarded as an acid proof cement, concrete made with it is resistant, and in many cases immune, to attack from the various acidic industrial wastes which readily attack Portland cement.

One of the chief applications of high alumina cement is for floors which are subject to spillage of aggressive liquids. In situations where attack is likely to be at the limit of the concrete, high alumina cement can be used for mortar joints to impervious tiles, but under the majority of circumstances an ordinary stone and sand concrete is sufficient, providing, of course, that the aggregate is equally immune from attack.

A full survey of the chemical resistance of the high alumina cements has already been published[7] and any reader requiring information about a specific problem is advised to consult it. It is unfortunately, not within the scope of this article to deal with all cases as these are numerous, but the list below will give some idea of the types of plant in which high alumina concrete has been used successfully:

Fertilizer Plants: Resistance to dilute sulphuric acids and sulphates.

Gas Producing: Resistance to gas scrubbing liquors.

Tanneries: Resistance to tan liquors (but not chrome tan).

Food Products: Resistance to fats, sugars, etc.

Breweries and Distilleries: Resistance to dilute organic acids.

Meat Packing: Resistance to oils, fats, and organic acids.

Sugar Refineries: Resistance to sugar, molasses, etc.

Candy and Chocolate: Resistance to cocoa butter, fats and sugar.

Dairies and Milk Products: Resistance to lactic acid and cream fats.

Ice Cream Plants: Resistance to lactic acid and cream fats.

Plastics Industry: Resistance to phenol and formaldehyde.

When considering the use of high alumina cement for any of these purposes, it should be borne in mind that it is attacked by caustic alkali solutions.

Refractory Use

In recent years, the refractory use of high alumina cement has gained predominance in Canada and the United States and the terms "refractory concrete" and "insulating concrete" are now in common usage, as meaning a mixture of high alumina cement and crushed refractory or refractory insulating aggregates. The wide acceptance of these materials has been largely due to their cheapness of installation and mainten-

Table II. Test Results

Mix	Nom. proportions	Water/ cement	Slump in.	Comp. factor	Workability
1	1:2:4	0.35	0	0.73	very low
2	"	0.45	0	0.81	very low
3	"	0.55	1	0.87	low
4	"	0.65	8	1.00	high
5	"	0.75	—	1.00	high
6	1:3:6	0.82	4	0.98	high
7	1:4:8	0.90	1¾	0.90	medium

This rapidity of hardening and the heat evolution associated with it has a close effect on the ultimate strength of the concrete. It can readily be seen that the higher the atmospheric temperature at the time of placing, the higher the starting temperature of the concrete constituents, and therefore, the higher the ultimate internal temperature of the concrete during the hardening period.

(1) For this reason high alumina cement manufacturers recommend that all high alumina cement concrete should be cured with cold water during the period from final set to, say, 24-hours after placing. This curing helps to keep the internal temperature down and thus ensures good grade concrete.

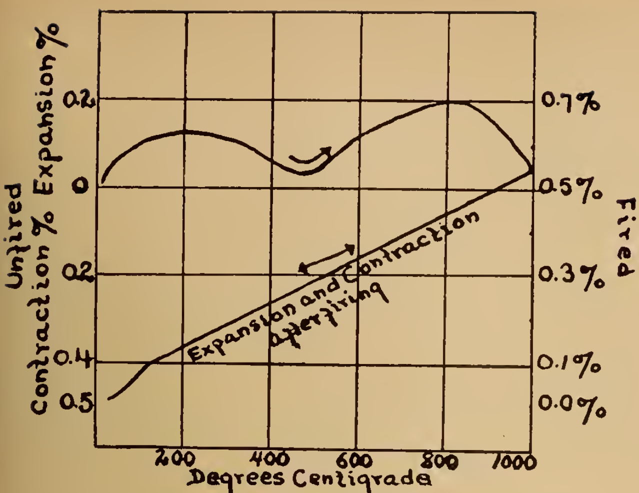


Fig. 1. Expansion and contraction characteristics of refractory fire-brick concrete.

ance, and their effectiveness as low and medium temperature refractories.

In order to satisfy the demand for these concretes, a large industry has grown up which specializes in manufacturing "ready to use" dry refractory and insulating concrete mixes. These mixes only need the addition of water, and are normally designed for specific purposes; they provide the user with a practically foolproof method of making these concretes. These dry mixes are known generally as castable refractories.

The placing techniques used with refractory concrete are generally the same as those used with structural concrete; many methods are open to the user, including concrete cast in place, Guniting, pre-cast concrete sections and units. There are, however, three general points which must be remembered.

(1) Reinforcing steel should not be used in positions where it is likely to reach a temperature of over, say, 600°F; or, if this is impracticable, then arrangements should be made to use high-temperature steel and artificially to break the bond between the steel and concrete, either by applying a thick coating of pitch to the steel or by wrapping it in several thicknesses of building paper.

(2) Manufacturers of dry mix castable refractories, usually specify the amount of water to be used in their mixes, but should the user contemplate mixing and placing his own home-made refractory concrete, it must be remembered that the majority of the aggregates employed are porous and should be pre-soaked in order to cut down any suction of water needed to hydrate the cement.

(3) The expansion characteristics of refractory concrete are different from other refractories, and can be best illustrated by a simple graph as shown in Fig. 1.

As a general rule, it can be said that a given volume of refractory concrete will be the same size at 1800°F., as when first cast.

Although the manufacturers of high alumina cements recommend that the same curing procedure is carried out with refractory concrete as formerly outlined, the concrete can still be put into service 24 hours after casting, although care has to be taken during the first heating owing to the excess water being driven off the concrete.

When the user contemplates placing large masses of refractory concrete, such as furnace foundations and large underground flues, he will find it cheaper and more practicable to crush and grade his own scrap material and make his own refractory concrete on site. Any type of alumino-silicate fire-brick is suitable for this purpose, but silica brick should not be employed owing to its expansion characteristics at comparatively low temperatures. Special bricks, such as sillimanite, chrome, magnesite, silicon carbide, etc., can be used, and they will largely reflect their own particular characteristics in the concrete. A simple table is given below which shows the various aggregates which can be used in each temperature range:

Temperature service up to 1800°F.

Suitable aggregates:

2nd quality crushed fire clay brick.

Crushed insulating fire clay brick.

Expanded shale materials.

Calcined diatomaceous earth.

Olivine, trap rock, emery (2000°F.).

Perlite, vermiculite, pumice.

Temperature service 1800° to 2400°F.

Suitable aggregates:

Crushed fire clay brick—first quality or high heat duty brick.

Crushed pottery saggers.

Calcined clays.

Selected crushed insulating fire clay brick.

Temperatures over 2400°F.

Chromite

Fused alumina

Sillimanite

Dead burned magnesite

The advantages of carrying concrete construction techniques into the refractories industry are obvious and therefore, require no comment here except to say that the simplification and adaptation of design is almost limitless. Refractory concrete does, however, have other properties which will be of particular interest to the refractories user.

(a) It appears that some non-ferrous metals (e.g. aluminum) do not wet refractory concrete and, therefore, it is easy to clear melting furnaces between charges; furthermore, in the case of pure metals, pick-up from refractories is drastically reduced.

(b) The cellular structure of refractory concrete gives it a truly remarkable resistance to the spalling action of wide and rapid fluctuations of temperature. As an example of this, a cube of concrete

Table III. Test Results

Mix	Cement lb./cu. yd.	Water gal./cwt. cement	Av. Wet Density lb./cu. ft.	One-day strength lb./sq. in.	14-day strength lb./sq. in.
1	561	3.9	155.5	7889	9290
2	558	5.1	153.5	6890	7910
3	540	6.2	152.5	5720	7450
				5610	7420
4	523	7.3	150.0	4800	6280
5	507	8.4	150.0	3460	3600
6	373¾	9.2	150.0	2790	2770
7	294	10.1	152.5	2510	2600
				1980	2050

Table IV. Comparison of Insulating and Refractory Concretes

Insulating Concrete	Refractory Concrete
Made with High Alumina cement and crushed refractory insulating brick or lightweight aggregate.	Made with High Alumina cement and crushed refractory firebrick.
Only suitable in general for hot face temperatures up to 2000°F. (with certain special lightweight aggregates it can be used up to 2400°F.)	Suitable for hot face temperatures up to 2400°F. (with certain special refractory grogs it can be used up to 2800°F.
Lightweight (30-80 lb. per cu. ft.). Comparable to insulating brick construction.	Heavier than insulating concrete (110-120 lb. per cu. ft.) although somewhat lighter than firebrick construction.
Low thermal conductivity (somewhat higher than that of insulating brick used.)	Higher thermal conductivity than insulating concrete (although considerably lower than that of firebrick.)
Lower strength than refractory concrete (but higher than insulating brick used.)	Comparatively high strength.

at white heat can be immersed in cold water without any spalling or distortion taking place.

(c) Refractory and insulating concrete can be cast integrally without fear of subsequent separation in service. This property would be of some value to the user requiring thermal efficiency, but having hot face temperatures beyond the range normally covered by the insulating aggregates.

The strength of refractory concrete in service depends on the ceramic bond formed between the cement and the fine aggregate particles, and since a higher proportion of cement gives a ceramic bond at lower temperatures, it is generally advantageous to use fairly rich mixes when operating temperatures are not likely to exceed 1800-2000°F. Conversely, if operating temperatures of over 2400°F. are expected, then weaker mixes should be used. Variations within this range are almost limitless and, therefore, a general rule can be stated that the lower the cement, the lower the ultimate strength, but the higher the refractoriness, and vice versa.

In order to give practical expression to this rule, the following mixes will cover the majority of cases met with. Aggregates should be reasonably well graded from maximum size to dust, the maximum size being determined by the maximum thickness of section envisaged.

Mix "A"

For use in sections of, say, six inches or over. If very thick sections are anticipated, the maximum aggregate can be raised to 1½ in., and in such cases four to six volumes of aggregate (1½ in. down to dust) to one volume of cement should be used.

Coarse firebrick ¾ in.-⅛ in.—3 vol.

Fine firebrick ⅛ in. to dust—2 vol.

H. A. cement—1 vol.

Mix "B"

For use in sections from 2 in.-6 in. in thickness.

Medium firebrick ⅜ in.-⅛ in.—2 vol.

Fine firebrick ⅛ in. to dust—2 vol.

H. A. cement—1 vol.

Mix "C"

For use in thicknesses thinner than 2 in., or for patching.

Fine firebrick ⅛ in. to dust—2½ vol.

H. A. cement—1 vol.

The above mixes are for use in the temperature range between 1800°F. and 2400°F., but if temperatures at the upper end of this range are expected the cement content of the mixes can be reduced with advantage, as this type of concrete is approaching its service limit.

If service in temperatures above 2400°F. is required, then there are several courses open to the prospective user.

(1) The use of a weak mix (6-8 vol. of aggregate to one of cement) using as aggregate an alumino-silicate brick of over 40 per cent alumina content.

(2) The use of a mix incorporating a highly refractory aggregate such as sillimanite, fused alumina, silicon carbide, etc.

(3) The use of a proprietary high-temperature castable refractory.

Insulating Concretes

When greater heat insulation is required from the concrete, a refractory insulating aggregate should be employed, and in order to prevent any confusion between refractory and insulating concrete the main general differences are shown in Table IV.

Although all these differences do not necessarily apply when special insulating aggregates are used, the table does illustrate the essential differences between the concretes.

Insulating concrete will usually give a lower compressive strength than refractory concrete, both before and after the concrete is heated, and its strength is more or less proportional to the unit weight of the concrete. Aggregates of the Haydite type are an exception to this rule, and will give strengths comparable to refractory concrete, i.e., about 3000 p.s.i. cold strength.

The thermal conductivity factor (K factor) of the various concretes made with insulating aggregates vary within fairly wide limits and, therefore, the pertinent details of each group is given in Table V.

Combinations of the above aggregates can be used in order to produce concrete of relatively high insulation with greater strength. √

Table V. Thermal Conductivity of Concretes

Aggregate	Conductivity (K) Btu/hr./sq. ft./°F./in. (at 1500°F.)	Concrete wt. per cu. ft. lb.	Service limit °F.
Firebrick	7.5	120	2500
Ins. firebrick	2.5 - 3.5	60/70	2400
Haydite	3.0 - 3.5	90	2000
Diatomaceous earth	2.7	60	1800
Vermiculite	1.5 - 2.0	30/40	2000

References

[1] Snelus, Gibb, Swan, Smith and Whammond. B.P. 10,312.

[2] Among others: Spackman Eng. Co. U.S.P. 903,019; B.P. 10,110; B.P. 18,345.

[3] Lafarge. French Pat. 390,290 and 391,454.

[4] Lafarge. B.P. 8,193.

[5] Reg. Trade Mark of the Lafarge Aluminous Cement Co. Limited, London, England.

[6] Concrete Laboratory, Canterbury University College, New Zealand, in accordance with N.Z.S.S. 192:1952.

[7] Hussey and Robson. High alumina cement as a constructional material in the chemical industry. Symposium on materials of construction in the chemical industry — Birmingham University, April 1950. (Soc. Chem. Ind.).

Strain Gauge Analysis

Applied to the Design of Construction Equipment

H. A. Spencer, M.E.I.C.
Mechanical Engineer,
Research Council of Alberta,
Edmonton, Alta.

and

E. H. Brennan, M.E.I.C.
Chief Engineer,
Barber Machinery Limited,
Calgary, Alta.

Electrical strain gauges are being used to analyse difficult designs when solutions cannot readily be found by conventional methods. Strain gauge analysis offers a new and valuable approach for the designer, particularly in the manufacture of construction equipment—a field in which arbitrary methods have often been used in the past.

For fairly simple structures, when loading conditions are known or can be estimated, the pattern of stress may be calculated. Where shock loads are indeterminate, it is customary to use a "load factor". However, for some complex applications, a designer may be at a loss to estimate an appropriate load factor, since each component of a structure may be subjected to different kinds of shock. In such cases, tedious and difficult calculations may be required.

Frequently it is difficult to trace the distribution and magnitude of the stresses through an intricately braced structure. For example, an overhead loader has a wide range of attitudes in which the components may be stressed, and it may be impossible to calculate the position of maximum stress for each component.

Confronted with such difficult problems, a designer resorts to his mechanical judgment to proportion his design. Invariably, the tendency to "play it safe" results in "overdesign" of the structure. Even so, when the first test models are built, failures may occur. These are remedied, generally, by reinforcement of the member at the point of failure instead of through a redesign to improve the distribution of the stresses. Such design methods do produce a saleable machine since it is not likely to fail in service. Overdesign, however, imposes two disadvantages on the manufacturer of construction equipment:

(1) Material is wasted, thereby increasing the cost of the product.

(2) The "payload" is decreased, as each additional pound incorporated in the equipment represents a decrease of one pound in payload capacity.

Since the construction contractor is interested primarily in the payload per dollar of investment, any increase in the payload capacity will increase equipment sales.

Conservative designs may never fail in service, but may not be economically competitive. Less conservative designs cost less to produce, but they may be dangerous to operate and breakdowns may occur frequently. Hence, a correct design is most important, and involves knowing the magnitude of stresses which actually occur so that an appropriate design load factor may be selected to anticipate sudden shocks.

Overhead Loader-Dozer

The "Malo" overhead loader and bulldozer[1] was built first in 1947 to fit a "crawler" tractor. From the illustrations of an early model (Fig. 1) and a current model (Fig. 2), one may see the structural changes which have been developed.

The primary design was engineered as thoroughly as possible, using the meagre information which was available to the designers, who corrected for the few failures that occurred by the simple expedient of stiffening and enlarging those components which required greater strength.

Eight years of experience with this overhead loader had proved that the machine performed its function well and did not fail under operating conditions. However, the management thought that the machine's efficiency could be improved and manufacturing costs reduced by redesign of some of the components to accommodate the actual stresses applied. To accomplish this purpose it was decided to conduct a strain gauge analysis of the unit under loaded conditions to determine:

(1) The actual stress distribution through those parts which seemed stronger than necessary.

(2) An accurate load factor as an aid to future design work.

(3) A stress pattern from which actual loads on components (such as bearings, bolts, pins and welds) could be calculated.

(4) The upper stress range in known critical sections.

Test Equipment and Procedure

Two amplifiers ("Brush" model BL-310), attached to one dual-pen magnetic oscillograph (Brush model BL-222), were set up to record strains. Baldwin SR-4 strain gauges, with a gauge factor of approximately 2.0, were used; these were of the usual felt and paper type to be applied with nitrocellulose cement. The overhead loader-dozer was mounted on an International TD-9 crawler tractor.

Fig. 1. First model of the overhead loader-dozer, built in 1947.

Fig. 2. Current model of the overhead loader-dozer.

of rail embedded in the concrete floor in front of the testing area and the tractor, with load in place, was driven forward at normal speed to apply a push to the barrier.

Each day, before testing, the Brush strain analyzer was warmed up for 30 minutes and left on for the duration of the tests. Gauges, which had been cemented into place, were soldered to lead wires before each test. The leads were attached firmly to each machine component so that, as it moved, there would be no pull on the connections. Before each test the gauges were calibrated in position at "no load". Since only a two-pen instrument was available, testing was limited to two gauge points at a time. Dummy gauges were set as near to the tractor as

Test Preparation

The following strain gauge positions were selected:

(1) The highest stress points as determined by mathematical analysis.

(2) The high and low stress points which, in the designers' judgment, required analysis.

(3) Positions known to have failed occasionally during heavy service.

In addition to these positions on the loader, several gauge points were selected on the tractor itself, to determine the effect of severe overhead loader action.

The selected points were buffed clean and the strain gauges applied with their axes parallel to the highest expected stresses in each component (see Fig. 3).

The rated capacity of this overhead loader-dozer for the TD-9 tractor is about 1½ cubic yards. Since this yardage of wet gravel weighs approximately 4,200 pounds, a number of pieces of solid steel shafting totalling this amount were fastened securely to the inside of the bucket. The load was placed so that its centre of gravity coincided, as nearly as possible, with the centre of gravity of a normal gravel load in order to simulate actual working conditions.

Since a fixed load would provide stresses greater than normal, it served as a fair test for the loader. However, the loaded bucket was not moved to the "unload" position for two reasons: (i) unrealistic impact loads would have resulted since, normally, in the unload position, the load is loose; (ii) a fixed load of 4,200 pounds in the unload position might create a hazardous condition of unbalance.

Simple methods were used to approximate the loader's working conditions. To simulate the effects of loading, unloading, and travelling over rough ground, a chock was placed under one track. This provided sufficient height to raise that track completely off the concrete floor, at an angle such as to support most of the weight on the front idler. By abrupt clutch and hydraulic applications the tractor and loader were made to rock and pitch violently, thus providing the stresses which occur when travelling over rough or uneven surfaces. To simulate pushing into a gravel pile or the normal impact of bulldozing through trees and rocks, a steel barrier was welded to a piece possible to equalize temperatures, and all testing was done indoors in the large heated shop.

Notes were written directly on the graph paper as it moved past the recording needles in order to correlate strain with the position and action of the loader. When check runs seemed advisable they were performed immediately.

As most stresses were very low, a maximum sensitivity of 10 micro-inches per inch per graduation was used for most of the tests. When stresses were of greater magnitude, the sensitivity was reduced to 20, 50, or 100 micro-inches per inch. For rapid stress fluctuations, repeat runs were made at higher tape speed so as to record the stresses more accurately. Maximum stresses within the range of 18,000-22,000 p.s.i. were assumed to be satisfactory.

Stress was calculated during the test by the formula:

$$S = Ee$$

where S = stress, p.s.i.
E = Young's modulus, 30×10^6 p.s.i.
e = unit elongation, inches/inch

Test Procedure Outline

Each test of two gauge points was run through in the following sequence:

(A) Bucket movement with tractor on level floor:

(1) Digging.

(2) Steady lifting to overhead position.

(3) Steady lowering to floor.

(4) Jerky lifting to overhead position.

(5) Jerky lowering to floor.

(6) Dropping bucket freely from 5°, catching it just before it struck the floor.

(B) Bucket movement with one track on the chock: repeating the operations shown in (A).

(C) A "loaded push" against a solid barrier.

Test Procedure Details

To simulate rough "digging", the bucket was pushed down until the front of the tractor was raised off the floor; then, while in this position, hydraulic pressure was rapidly applied and released.

The steady "lifting" and "lowering" tests were performed to obtain design data for the "steady state" stress condition through the complete range of load travel.

The jerky "lifting" and "lowering" tests were performed to establish a normal "load factor" for rough operation and to determine the highest stresses which could be expected under these conditions.

The "dropping and catching" operation was achieved by allowing the load to drop freely from 5°, and then catching it just before the bucket struck the floor. This involved a free drop of approximately three feet and represented an extreme action which should never occur in practice. It imposed the severest stresses on most components, and should represent the maximum stresses which would occur under operating conditions.

The "loaded push" test was carried out only when determining stresses on the yoke and mounting bar, since it soon became apparent that all the forces were carried directly through the yoke to the track frame of the tractor. This test, which involved a full throttle run at the barrier, produced impact forces severe enough to break the barrier and its braces.

Fig. 3. Typical attachments of strain gauges to components.

Results and Application

From the graphs (Fig. 4) maximum stresses were calculated. Analysis of these figures gave the following interesting results.

(A) *Component Parts*

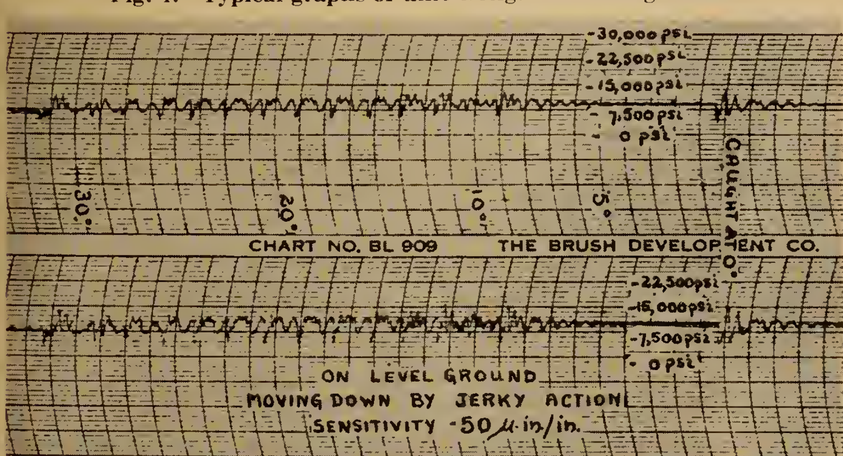
(1) The back section of the pickup arm, which had been enlarged to accommodate eccentric loads, was found to be much too strong as the maximum tensile stress was 8,400 p.s.i. This component currently is being redesigned.

(2) The cylinder saddle casting, which carries the hydraulic cylinder trunnion and the pickup arm fulcrum bearing, also had been made strong to accommodate eccentric loads. Since the maximum stress was 11,000 p.s.i. on this component, it also is being redesigned.

(3) The yoke section was found to be of good design and no suggestions for improvement were necessary. The maximum stress at the outside front corner was 22,500 p.s.i., which occurred during a loaded push at the barrier. This was in agreement with previous engineering calculations.

(4) The outside support plate, which fastens the hydraulic cylinder saddle to the tractor frame, was found to be slightly overweight since its maximum stress was 10,500 p.s.i. The inside support plate was considered to be well designed since its maximum stress was 19,500 p.s.i. In addition to redesigning these plates for more equal distribution of the load, consideration will be given to replacing them by flat bars so that more open space will be available for cleaning the track rollers.

Fig. 4. Typical graphs of unit elongation during a test.



(*Continued on page 230*)

The Friction of Ice
and Its Economic Significance

C. D. Niven,

National Research Council,
Division of Physics,
Ottawa, Ont.

The low friction of ice is such commonplace knowledge that until recently scientists have paid little attention to the explanation of this strange phenomenon. Ice however is unique among common substances in so far as several of its physical properties are concerned—to cite one other of these, it expands on freezing. Reynolds, the great pioneer of hydrodynamic lubrication, saw that there might be some connection between these two properties: if freezing causes expansion then pressure must tend to cause melting and this suggested to Reynolds that the pressure of a skate or sleigh runner on ice would tend to form a film of water and therefore ice might supply its own lubricant. It was quite difficult to prove or disprove that theory and so unfortunately it came to be accepted by knowledgeable people; thereby the stimulus for the investigation of the real problem was removed. If the phenomenon was commonplace, the explanation was reckoned to be self-evident to anyone who knew why an iceberg floated.

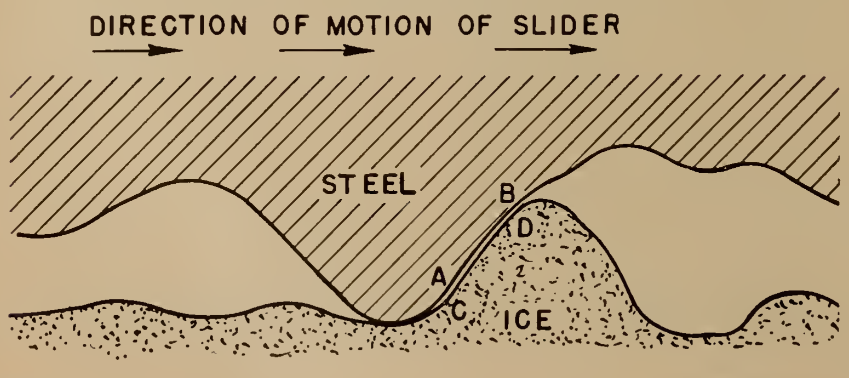
As the ideas of Hardy on adhesion of molecules became woven into the theory of friction, Bowden saw that all was not well with the accepted explanation because the pressure which would be required looked too high, and he favoured the idea that if water were present to supply the lubricant then it was generated by heat, not by pressure. Around this time the problem took on a new significance, because the aeroplane had become a regular means of transportation and skis were required for landing on snowcovered lakes. Among the first in this field of investigation was Klein[3] who supported the heating rather than the pressure-melting theory, be cause of course loadings per unit-area are comparatively small on skis. More recently, however, McConica[4] of the American Ski Company while definitely opposing the pressure-melting theory has cast doubts even on the correctness of the heating theory and has been led to conclude that "lubrication was effected . . . by a fluid film of adsorbed vapour". Clearly the explanation is not as simple as Reynolds' suggestion had implied: a real understanding of the problem can in fact only be reached by considering molecular or at any rate microscopic phenomena.

Before discussing the friction of an exceptional material like ice, it is perhaps not out of place to mention some of the modern ideas on the friction of normal substances. Thanks to the work of Bowden[1] and others, information on the friction between unlubricated surfaces is fairly extensive at the present day. If solid surfaces be closely examined it will be found that they are not nearly as smooth as one imagines. As one writer has expressed it, the surface appears like a mountain range in miniature. Thus when one surface rests on another, one miniature mountain range turned upside down is resting on another miniature mountain range. Only the highest of the peaks therefore make contact. Although some scientists have endeavoured to explain friction by the interlocking of these peaks, the majority of authorities on the subject believe friction is caused by the adhesion of these peaks or "asperities". Bowden and his collaborators have contributed some very convincing evidence to show that the adhesion theory is correct.

Bowden and Ridler[2] have shown that high instantaneous temperatures can be generated when one substance slides over another. Thus constantan sliding on steel can generate instantaneous temperatures up to 1000°C. If a metal with a much lower melting point be substituted for constantan then the maximum temperature that can be observed is the melting point of that metal. Since there is high temperature and high pressure at the tips of the asperities in contact with the other surface it is reasonable to expect that welding will take place. That such a supposition is correct has been amply proved. Bowden has published photographs which show that one metal can actually pull microscopic chunks out of the other metal. It has also been shown that just as oxide or other contamination tends to prevent a sound weld, so they reduce friction as a general rule between metals.

Returning now to the problem of ice friction, one can assume in the first place that heat is generated at the asperities on the surfaces of the slider and of the ice. There can be no doubt about this because it requires work to move a slider over ice which is perfectly

Fig. 1. Diagrammatic representation of two asperities coming in contact with one another.



level: this is more obvious at colder temperatures. From the observation described above referring to temperatures developed by the friction of a low melting point metal, it is safe to assume that in the case of ice the maximum asperity temperature which can be reached on slider or ice surface is 32° F. Therefore the heat developed is either absorbed as latent heat used in melting some of the asperity on the ice surface or else it is carried away by conduction to the main body of either surface and eventually lost to the atmosphere.

Much interest has centred for long around the debatable point as to whether water was present or not under a slider on ice. Actually such a discussion is quite irrelevant unless one wants to bolster up the old hydrodynamic lubrication theory. Experimental evidence indicates that there is no continuous layer of water under the slider except at temperatures over 32° F. McConica goes as far as to point out that if water be present as a fluid, increase of speed would cause increase of friction, while observation shows that friction decreases on dry ice with increase of speed. This subtle argument gives a definite reason for supposing that water is not present below 32° F. as a fluid layer. On the other hand it is to be expected that there be a softening of the asperities on the ice with actual melting in some cases. One may also expect that in those cases in which melting occurs, some asperities will melt considerably more than others. This can be surmised from the record which Bowden has published, demonstrating that 1000° C. and other high temperatures are reached only occasionally when constantan slides on steel.

If attention be now concentrated upon those asperities which do melt, it is easily seen that the possibility of making a weld between ice and slider depends to a considerable extent on whether water wets the slider or not. The importance of one substance "wetting" the other substance if a satisfactory weld is to be obtained is illustrated in the every-day technique of tinning before soldering. It is to be expected then that those substances which are not easily wet by water will show a lower friction than those which are. At low temperatures this is amply demonstrated by the much lower friction of materials like Bakelite and Teflon which do not wet easily as compared to clean steel which does wet easily. Lightly loaded steel has in fact very bad sliding qualities on ice at low temperature. Such facts as these indicate that much the same processes are at work when a slider slides on ice as when metal slides on metal—asperities are heated; asperities then start to weld together or "adhere"—a force which is called the frictional force is required to break these welds by shearing.

There is, however, one thing which has not been taken into consideration. When two asperities meet there is a sudden increase in pressure along the surfaces (AB and CD in Fig. 1). Heat is developed as AB attempts to slide up CD and CD down AB because the molecules in the asperity are compressed as the asperity is forced to shear. In normal substances increase of pressure tends to facilitate solidification but in the case of ice it tends to retard solidification. So it is to be expected that the increase in pressure along the AB-CD interface operates against the increase in temperature in the case of a normal substance, but that in the case of ice both increases cooperate in tending to melt the asperity, so that if a weld is to be formed conduction must carry away the heat sufficiently quickly to cause freezing.

The low friction of ice is well known, but the reasons for this phenomenon are not so well established. The author discusses current theories and the possibility of economical transportation in northern areas.

Such reasoning would lead one to expect, firstly, a reduction of ice friction with high loading or high speed because the pressure along the AB-CD interface is increased; and secondly, an increase of ice friction when the ambient temperature is low because then the conduction of heat away from the asperities is high.

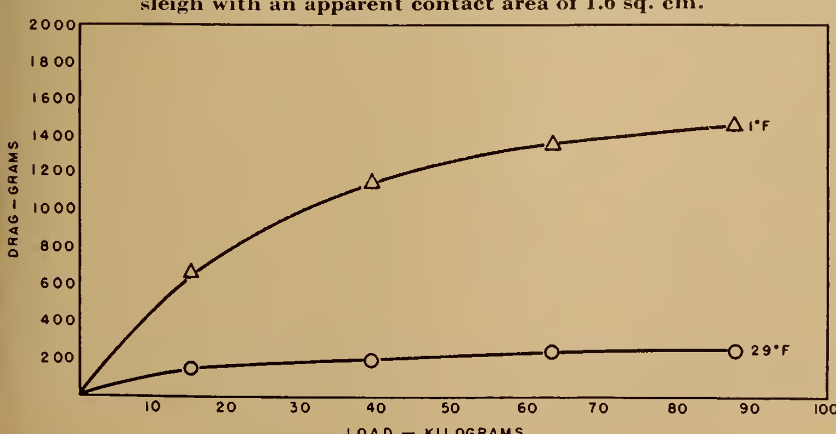
The Economic Significance

Reduction of friction with increase of load implies a definite violation of Amontons' Law (frictional force proportional to load). The writer had the privilege of discussing the problem with Mr. W. E. Wakefield of the Forest Products Laboratories, Ottawa, who had observed this reduction in friction at high loading during some tests carried out with actual sleighs: Mr. Wakefield at that time made the rather remarkable statement that after a certain load was put on a sleigh the drag increased but little by additional loading. The statement sounded so much like getting something for nothing that the writer thought it warranted verification under controlled laboratory conditions. If the statement were really true it added an exceedingly important item to the data that had to be explained apart from its economic implication.

Figure 2 shows some data obtained on a turntable and indicates that the statement is correct. Drag appears to be practically constant when the load per unit area of apparent contact is high enough. Presumably, after enough pressure is available along AB-CD (Fig. 1) completely to liquidate the asperity, the load over and above what was needed to supply

(*Continued on page 230*)

Fig. 2. Drag *v.* load curves at 29° F. and 1° F. for a miniature stainless steel sleigh with an apparent contact area of 1.6 sq. cm.



A PILE LOAD TEST

D. F. Coates, M.E.I.C.,
Assistant Professor, Department of Civil Engineering, McGill University, Montreal, Que.

A brief account is given of a pile load test which brought up many of the theoretical and practical questions that often arise in piling work. In addition, some interesting light was thrown on the behaviour of the soils encountered.

A pile load test was performed which brought up many of the theoretical and practical questions that often arise on any piling job. In addition, some interesting light was thrown on the behaviour of the soils encountered. As most piling problems must still be solved empirically, a brief account of this test is presented.

The test pile was a steel-encased concrete cast-in-place pile. The base diameter was 11 in., the diameter increasing in 1-in. steps every 8 ft. The pile was 45 ft. long, thus the diameter at the top was 16 in.; 3000 lb. of concrete was used inside the No. 12 gauge shell. The test pile was the first pile driven of a group of four.

All piles on this job were driven by a single-acting steam hammer weighing 6200 lb. with a drop of 3 ft. Eighty per cent efficiency was assumed for the hammer, thus giving a blow of 15,000 ft.-lb. of energy. The hammer blows were transferred through a driving head, containing a hardwood cushion, to a 48 ft. mandrel, weighing 10,000 lb., inserted in each shell. All piles were driven to a resistance of 6 blows/inch for a penetration of 1 foot. No driving resistance record was retained of the test pile (it being selected after the driving), but the records of two adjacent piles, *A* and *B* (see Fig. 2 and 3) are shown.

During the driving of the other three piles in the group, the base of the test pile heaved up 2 in. The upheaval of the shells generally occurred during the driving of the last 3 ft. to 6 ft. of the adjacent piles. The test pile was not retapped as the results of the load test were to be used in determining the retapping policy. The spacing of the four piles was 3 ft. centre to centre in one direction and 4 ft. 6 in. in the other direction.

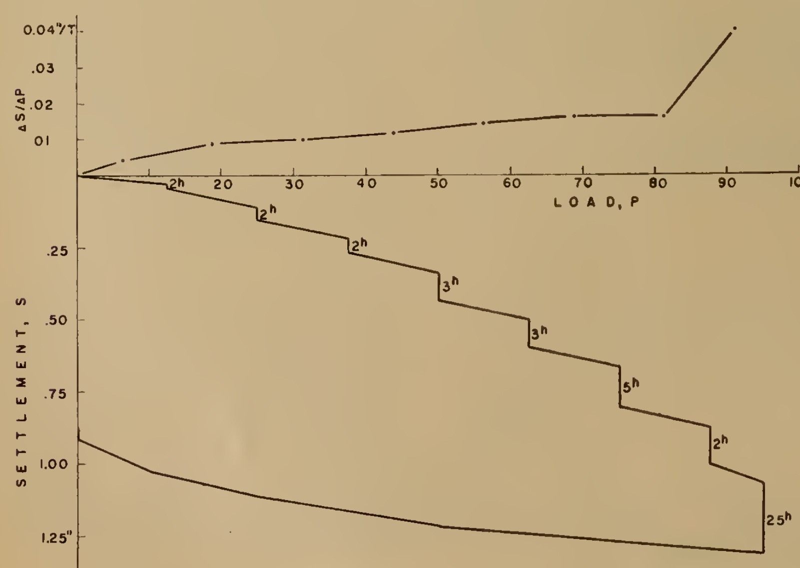
Soil Profile

The building site was in the St. Lawrence lowland region. The principal soils in this area are glacial till, post-glacial marine and lacustrine clays (Leda clays), and alluvium.

Three borings were made on the building site some distance from the test pile (see Fig. 4). These showed that for 25 ft. below the datum (the level of the fill at the time of the borings) there were strata of organic and non-organic, soft to firm clay (Fig. 4). The average unconfined compression strength of five tests on samples between 6 ft. and 20 ft. depths was 0.5 tsf. From 25 ft. down to bedrock there was glacial till of varying amounts of silt, sand and gravel, and of varying relative densities from loose to very dense. The bedrock varied from 57 ft. to 64 ft. below the datum. The average D_{10} of the till was of the order of 0.006 mm. (with practically no particles smaller than 0.003 mm.), and the uniformity coefficient varied between 20 and 50. Some of the maximum particle sizes taken in the standard spoon sampler (2 in. *OD*, 1.5 in. *ID*) were ⅜ in. in *TB*-1 at 45 ft, 1½ in. in *TB*-1 at 50 ft., 1 in. in *TB*-2 at 40 ft., and ⅛ in. in *TB*-3 at 50 ft. (Fig. 4). These indicate that the high penetration resistances found at these points were probably due in only one case to the interference of stones. (The resistance is to a standard 2 in. *OD* sampler driver by a 140 lb. hammer dropping 30 in.).

The ground water level at this time was 3 ft. below the datum.

Fig. 1. Load test settlement curves (time, in hours, of load duration also shown).



Load Test

The load test was run 10 days after the pile had been driven. The pile was loaded in increments of 12½ tons up to 87½ tons (Fig. 1) by jacking against the pile driver. The maximum test load was 95 tons. Each load increment was maintained until the rate of settlement was less than 0.01 in. per hour. The maximum load of 95 tons was applied for 25 hours.

By plotting the increase in settlement per unit increase in load against the total load (Fig. 1) a curve was produced that indicated that failure took place between 87½ and 95 tons (failure being accepted as the point at which the settlement becomes disproportionate with increase in load). This type of curve makes the point of failure more distinct than a normal load-settlement curve.

The permanent or net settlement of the pile after the load had been removed was 0.87 in. The maximum settlement of the pile head under 95 tons was 1.32 in. The elastic deformation of the pile assuming only point resistance would have been about 0.26 in. (the confining effect of the steel casing is insignificant with regard to this deformation). Thus the elastic deformation of the soil would have been 0.19 in. In view of the previous upheaval of the shell of 2 in. it is possible that the ultimate capacity of the pile was actually greater than 95 tons.

Retapping

Owing to the upheaval of a large number of the pile shells, the retapping of most of these piles was carried out after the shells had been filled with concrete. The *predominant* pattern of this retapping showed penetration resistances from five to nine blows per inch for depths twice the distance of upheaval — with no sharp decreases or increases. As the retapping was done with the top 12 ft. of the mandrel sitting on the concrete pile, this indicated a similar, if somewhat lower, penetration resistance to that obtained in the original driving. From this, two conclusions could be drawn: the surface friction had not increased or "set" appreciably between driving and retapping (two weeks to a month), and the 1 in. to 2 in. of upheaval did not produce a void under the pile, i.e. it had not been produced by water pressure alone unless the surface friction had increased and supplied the resistance to driving until the bottom of the void had been reached under the pile (the exact compensating effects of these two mechanisms required to produce the retapping record seems improbable). Thus upheaval would seem to have occurred as a result of the compression and shear strain in the soil produced by the adjacent piles.

Besides the above behaviour on retapping a few piles showed very little resistance and were driven down several feet. Presumably the original driving resistance of six blows/inch here had been supplied largely by the water not being able to flow away from the pile during driving. Eventually the excess hydrostatic pressure would have been dissipated and the piles driven farther through soft till.

This explanation brings up an interesting paradox concerning till. Recent experience (both personal and of others) has indicated that till can sometimes be both medium soft and dense (dry density of the order of 125 pcf). One of the properties that may be used for identification is that this till seldom contains many particles greater than ¼ in. Resistance to the standard penetration test may not provide the necessary clue due to the effect of pore water below the water table. A few of the soil samples from this job indicated that some of the till fitted this description. Unfortunately, it is not known if this soil occurred where the piles disappeared on retapping, although it seems a likely explanation.

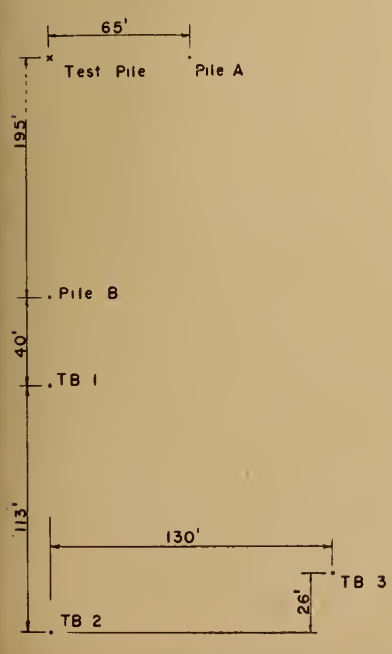


Fig. 2. Location of test pile in relation to piles A and B, and test borings 1, 2 and 3.

Pile Capacity

The pile capacity can be calculated for the driving resistance from the Hiley formula. The energy of the hammer blow was considered to be 15,000 ft.-lb. If the coefficient of restitution of the hammer on the driving head is assumed to be 0.25 and the temporary compression of the ground, pile, etc. is assumed to be 0.3 in. (from ref. [1]), the ultimate capacity of the pile is calculated as 115 tons. This is about 27 per cent higher than that indicated by the load test. Moreover, the same figure would be obtained by this calculation for the piles that were retapped several feet.

According to Meyerhof[2] the ultimate bearing capacity of piles in sands and gravels can be calculated from

$$Q_f = \gamma\ ADN/2$$

where γ is the effective soil density,
A the area of the toe,

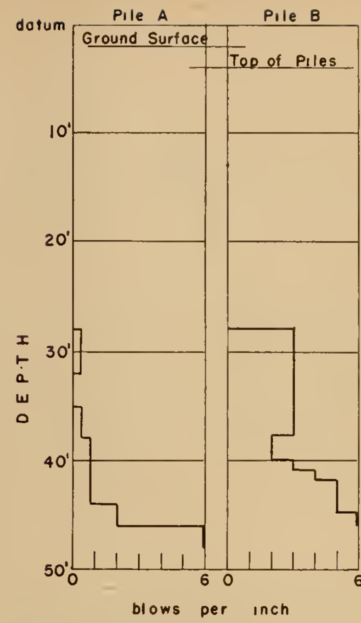


Fig. 3. Driving resistance record of piles A and B.

D the depth of toe below the sand surface, and
N the bearing capacity factor.

For a compact well-graded sand N is 960; for a loose well-graded sand N is 240. Thus for this dense silt, sand, and gravel till the ultimate pile capacity using N of 960 is calculated as 330 tons. Using an N of 240 the ultimate pile capacity is calculated to be 83 tons.

Alternatively, Meyerhof's expression for clays might be used.

$$Q_f = 9\ cA + c_a F$$

where c is the cohesion of the soil at the toe,
c_a is the average adhesion along the pile shaft, and
F is the embedded surface area of the shaft.

Thus if the average adhesion is assumed to be made up of 40 per cent of the cohesion of the clay (the possible thixotropic regain of the Leda clay in 10 days) and 1000 psf. (ref. [3]) for the till, c_a is 590 psf. If the cohesion of the till is also assumed to be 1000 psf. then the pile capacity is calculated as 50 tons. If the cohesion of the till were 2000 psf. (which has been obtained in some quick tests in similar tills) the pile capacity would be calculated as 53 tons. However, this calculation does not seem applicable as it does not take into account the frictional properties of the till (the drained ϕ usually being above 30°, although the undrained ϕ varying between 0 and 40°).

Using Terzaghi's bearing capacity formula[3], and assuming the angle of internal friction of the till to be 35°, the cohesion of the till to be 600 psf., the adhesion-friction of the till

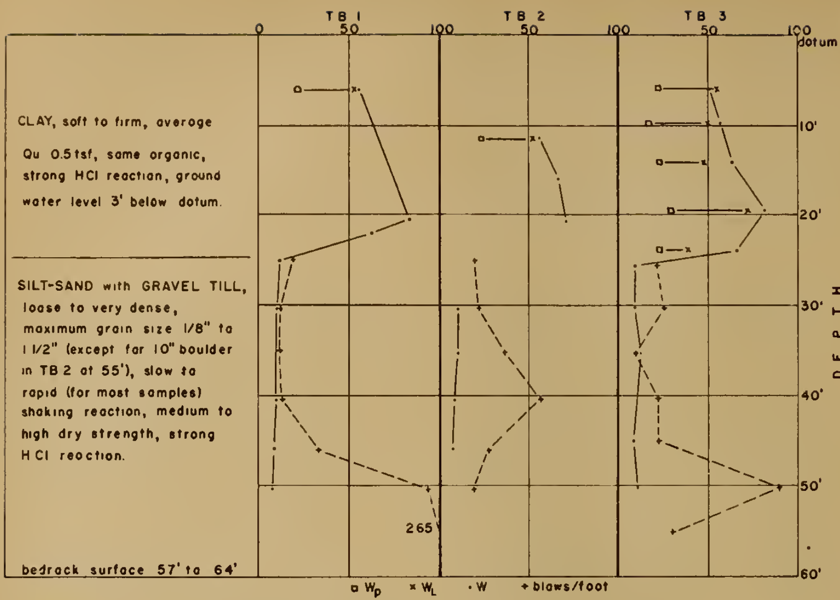


Fig. 4. Soil data from three test borings.

to be 800 psf., and the adhesion of the clay to be 200 psf., then the ultimate load is calculated as 97 tons. The close agreement of this calculated ultimate capacity with the load test value, in view of the many assumptions, is to a large extent coincidental; however, the assumed strength values are those that are considered to be most probable for the dense till.

It can be seen from this record that although soil theories might help, the practical problem of determining pile capacities for a large number of piles on one job has not yet been solved. Furthermore, the variation of the engineering properties of glacial tills needs to be better understood.

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THE FRICTION OF ICE

C. D. Niven

(*continued from page 227*)

that pressure gets over "free": the obstacle in the path simply no longer exists. The liquidated asperity has nonetheless still to freeze again. Figure 2 shows that the drag in "zero" temperatures is about five times what it is just below "freezing".

The fact that ice in moderate Canadian winter temperatures provides a means of getting something for nothing by way of trans portation seems to offer great commercial possibilities and scope for engineering ingenuity in that immense tract of very sparsely populated country in Northern Canada lying between James Bay and the Yukon.

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STRAIN GAUGE ANALYSIS

H. A. Spencer, M.E.I.C. and E. H. Brennan, M.E.I.C.

(*continued from page 225*)

(B) *Load Factor*

Through comparison of the "steady load" and "suddenly applied load" conditions for all the components, a maximum "load factor" of 1.9 was obtained. This factor should prove useful in all future design work for tractor-mounted equipment.

(C) *Stress Pattern*

A comparison of the stresses imposed on the components while the tractor was on the level floor with those while one track was on the chock indicated few differences. In no instance was the stress greater when one track was on the chock. This indicated conclusively that the method used in mounting the overhead loader, which retains the full track oscillation of a standard tractor, is superior to other mounting methods which, under oscillation, may apply twisting stresses to both loader and tractor.

Strain gauges, attached to the tractor at critical points, showed that the greatest stresses on the tractor occurred during the "digging" operation, and corresponded in severity and location to that occurring during normal bulldozing. Thus, the manufacturer was supported in his contention that the loader applies no greater stresses on the tractor than those produced by a bulldozer. Actually, the maximum stresses found were quite normal for this tractor.

(D) *Critical Section Examination*

Two points on the loader had given occasional trouble under very severe conditions. Stresses found at these points were 28,500 p.s.i. and 26,300 p.s.i. At one of the points a reinforcing band was welded over the section and, on further tests, the corresponding stress was found to be 18,000 p.s.i. This band was incorporated into the design. The other point also was redesigned to provide a similar normal stress figure under load.

Strain gauge analysis is useful when applied to the design of construction equipment since it provides a continuous record during a practical test. Designers at Barber Machinery Limited, in co-operation with the Research Council of Alberta, applied the method and obtained information readily and at reasonable cost. The construction industry should find this testing technique of considerable aid in solving design problems.

The authors wish to express their appreciation to Dr. George Ford, of the Civil Engineering Department, University of Alberta, for his assistance with the project.

Reference

[1] Barber Machinery Limited, Calgary, Alta.

AUTOMATION TO DATE

R. W. Bolz,
Editor, Automation Magazine,
Cleveland, Ohio.

As part of the Centennial of Michigan State University, the School of Engineering organized a symposium on automation, of which this was the introductory paper. Automation, with its influence in such fields as economics, quality, and labour, is of interest to the engineer, who plays a major part in its development. This paper is presented as an appropriate contribution to the subject.

Today automation brings both a challenge and an opportunity for engineering. Few developments have ever evolved that offered so great a potential for elevating the status of the engineer and improving his position in all industries. Success in the field of automation will rest to a large extent on the ability of engineers to utilize the principles of automation wisely: by seeking to reduce costs of operations, improve product quality, and effect better distribution of products to help attain a gradually increasing standard of living.

And this can be attained. We see automation evolving as a natural and highly satisfactory answer to many of the problems which have arisen in the past decade. Under a rising living standard, with a continuously increasing educational level, the stage arrives at which choice and desire become effective. Brute labour jobs cannot be filled, and machines must be created to do these jobs.

Developing simultaneously are other factors of importance, among which is our rising population with its changing ratio of age groups and a fast rising market demand. To fill this demand for good products, automation has been gradually evolving as a logical solution. No amount of labour, were it plentiful, would suffice in many present-day instances. The modern light bulb is an excellent example: whereas one plant with 230 employees produces 1,200,000,000 bulbs per year on continuous automatic equipment, 1927 methods and machinery would require 75,000 men to produce this quantity. The economics are self-evident.

What is Automation?

Many have talked of automation and have given their individual interpretation of its character. To the layman the result has resembled to a striking degree the age-old fable of the eight blind men and the elephant. Each blind man gives an accurate picture of what he feels it to be and is positive he is right. The fable ends, "and they fell to quarrelling among themselves," (Engineers, of course, are not subject to such error!)

Stepping back for an objective view of the whole, we can more readily perceive the basic character of automation as it is today.

Although new in name, automation basically involves the application of principles which have evolved steadily over a long period of years. It is not confined to transfer machines or materials handling; it is not merely the application of electronic control, instruments, computers and feedback. Accomplishment of really economic automation requires a combination of equipment, machines and controls. Defined in broad terms it is—manufacturing, processing or performing of services as automatically as economics permit or demand.

In the achievement of automation, groups or sequences of operations, along with mechanisms, machines and control devices, are brought into a single system to produce continuous or cyclic operation. Wherever two or more automatic operations are tied together with overriding automatic controls to create a self-feeding, a self-initiating, and self-checking process; an automated system is created. Material, data or pieces can be introduced into the system manually and automatically and the processing steps carried out without manual intervention to completion. Generally, almost any process can be automated. It is possible to automate a single operation, a sequence of operations, a whole department or a plant.

Automation can be segregated into several types. It is possible to create an automatic batch or a continuous system. One process, for instance, may be more economically carried out in batches while another is most economical when operated continuously. Process characteristics, as well as economics, dictate the best method. Likewise, metal-working in job-shop operations may require batch-type arrangement, owing to continuous change, while mass-production operations are more economically carried out on a continuous basis.

Secondly, automation systems

may be set up with end-control or in-process control. With the end-control, processing is completed before testing, checking, or gauging is done. This is suitable with many processes and feasible with others. However, where precision output is necessary, in-process control is desirable for economic reasons. Material being processed is under continuous control: metal parts, for instance, are gauged in the machine and correction or size control is accomplished during the operation. Chemical and similar processing operations are held under continuous sensing and measuring instrument control, and necessary corrections are fed back to the equipment continuously.

Automation of plant operations may range from lines of automatic equipment, such as presses which are automatically fed and cycled continuously, to complete manufacturing facilities where components are fed, sorted, oriented, assembled, and tested automatically. Where job-lot operations are involved, flexible automatic control of standard machines is sought in order to achieve the economic results desired.

Process Industries

In such areas as chemical and petroleum processing, flow of component materials is continuous from step to step under instrument control to final desired end products and byproducts. Automatic instruments maintain preset temperatures, pressures, or flow, and record and control specific portions of the processing cycle. Materials may be weighed, fed, conveyed, and dispensed by automatic devices. Completed products may be fed directly to automatic bagging, packaging, canning, bottling, or other equipment and then to storage.

In the food procesing field, automatic machines again are linked together to produce an automated line. Food processing, like many modern chemical and metallurgical processes, defies manual control owing to speeds, pressures, loads, and accuracy of measurement because of sanitary and critical processing conditions. Automatic control devices monitor the conditions, flow or movement of the product continuously as preset. Processing may be continuous and untouched by hand throughout to the final packaging and cartoning stages. Here, owing to necessity, economic processing has been achieved. Today, necessity is leading to similar achievements in other areas.

Distribution

An area in which automation today is rising to meet a critical need is in merchandising and distribution. Here the delays and problems of distributing products are being overcome through the use of automatic machines designed to handle, store, unload, and load for shipment. Laborious handling of goods, both in-plant and in warehousing, is carried out automatically with systems of machines and handling devices. Conveyors of belt, chain, plate, roller, screw, and overhead-rail types automatically deposit, retrieve and carry products under control of limit switches, photoelectric cells and numerous other devices to dispatch them as needed. Central push-button control panels permit selection, coordination and dispatching as desired. Stores are resorting to use of automatic devices to stimulate sales, speed handling of goods, increase customer service, and keep close control over inventories.

Metalworking

In metalworking today, automation ranges from simple units all the way to complete plants. Through automation the big problem of handling between operations is eliminated almost entirely with accompanying cost savings. In this regard there are two approaches: (1) handling can be mechanized; (2) handling can be eliminated. Machining, stamping, heat treating, washing, degreasing, plating and finishing operations, as well as assembly of complete units, is being done.

With the achievement of practical tape devices, numerous machines can be controlled. Not only can a coded tape be used to reproduce information in complete form, but such a tape can also be used to control other kinds of equipment. Today many machines can be so controlled. Machine tools are in use which follow instructions punched into a tape or recorded by similar coding marks on a photographic film or magnetic tape.

Milling machines automatically carry out a series of machining operations by this means. Complex machines grouped into a single unit read a tape to drill specific sequences and sizes of holes, select a suitable rivet from automatic feeders, place the rivet, buck it properly, and drive the rivet under precisely controlled conditions. As requirements change or design is modified, a new tape and fixtures adapt the equipment as necessary. Used in aircraft manufacture where design changes are frequent, such automation offers improved quality as well as flexibility and speed of production.

Automation and Mass Production

You may well ask: What is the difference between automation and ordinary mass production as we know it? First, automation should not be confused with ordinary mass-production techniques. Mass production, as developed from the original ideas of Eli Whitney, comprises the basic approach and science of manufacturing, without individual fitting, large quantities of products from groups of components produced in mass. The primary feature of mass production revolves about the dimensional standardization of components to permit interchangeability in assembly. Note however, manufacture may be entirely by hand methods from start to finish. Mass production techniques, though, constituted a major step in creating the possibility of providing large quantities of complex products with superior quality and uniformity at lower cost in time and money. But, today, hand methods often fail to fulfil the requirements because of economics, market demand, speed, labour and other factors. The solution is the succeeding step in the manufacturing picture—automation.

In this picture the design of products has a strong influence. Real economy in mass manufacture of products has been closely associated with good design for production, but failure to ensure the best design features has seldom denied satisfactory results. Actually, it has even been possible to defy good design criteria and depend on the skill of the men along the lines to supply the necessary correction factors. Not so in automation. Mere mass production techniques must be superseded by modern production design for automatic manufacture. Although there are instances where production of components and assemblies has been automated without design change, in most cases significant savings await ingenious design modification.

This is also true of automatic assembly. To attempt to assemble automatically without consideration of design modification for suitability would parallel the attempt to mass produce without regard to the technique of interchangeability. Today, with automation, simplicity in product design is the byword. With some designs, even arduous labor and large expenditures may not provide the desired economic result. The much publicized "Project Tinkertoy" bears this out. After thorough economic studies were completed it was found out that semi-automatic methods offered the most effective result, not complete automation.

In this analysis of the project it was found that the electronic amplifier of simplified modular design reduced manufacturing cost 38.5 per cent over conventional piecemeal design. This method consists in hand-assembling the simplified machine-produced components. Fully mechanized production of the same modular design reduced cost 44 per cent with roughly the same output per hour. However, seven of the process steps proved to be lower in cost with the hand method. When substituted in the otherwise mechanized procedure, the combination offered the lowest total cost per unit.

Significant factors in the project were that $665,000 was required to create the all-automatic facility and $82,000 the semi-manual. Little savings would accrue from increase in size of either facility. Limitations on the output, and hence economics, of the mechanized production installation were found to centre around equipment cyclic rates, machine delay time, reject percentage, equipment costs, numbers and skills of operators and equipment maintenance. This example merely indicates that automation is not a panacea. As always, a neat overall compromise in both design and production provides the best final result.

Overriding considerations in basic design detail which must be brought into play for automation can also, and often do, contribute direct additional benefits. Typical cases on record show that the constant drive toward suitability for automation procedures and for simplicity result in much superior products from standpoints of performance, uniformity, stability, service life and maintenance. The overall economic results not often recognized constitute an advance worthy of note in any management planning.

Another field that assumes key importance in automation is statistical quality control. Although desirable in ordinary mass production, it is not always used nor is it an absolute necessity. Common methods of gauging, after manufacture without machine control, are still commonplace and still largely suitable. To permit economic automatic assembly or automatic production of separate pieces, in-process continuous gauging to eliminate scrap and off-size is desirable and often necessary. Though not commonly recognized, feeding, chuting, orienting, and assembling operations in automation fail most often because of nonconformity of parts.

"When automation develops in industry, what happens to labour? Is it displaced? . . . The answer, of course, is No."

Through automatic size and uniformity control of parts being produced, production of bad pieces is eliminated. Of little economic importance in production for hand assembly where scrap can be detected by the assembler, in-process gauging before continuous production assembly operations is important. Extremely small irregularities can easily jam intricate devices. Hence, some crude operations may often be impractical to automate.

Here, again, design for economical automatic production assumes critical importance. Individual pieces can be designed for maximum facility in the reproduction process; in the gauging procedures; in the handling, chuting, orienting, and feeding steps; and in the actual assembly arrangement.

Where granular and fluid materials are processed, the same holds true: the quality of the product produced is dependent on the control of the ingredients. Manual control usually results in high rate of loss and wide variations. Quality can be improved and maintained by automatic control of ingredients. Cost is largely reduced by eliminating scrap and re-run and attaining faster output. In many cases, scrap reduction and quality control alone account for significant savings. In one instance, by replacing hand inspection test with an accurate automatic test, not subject to operator variations, apparent scrap was reduced almost 50 per cent. In another instance, automatic metering and weigh feeding of ingredients eliminated millions of pounds of re-run. Cost savings are worthy of real concern, but in many of these cases actual losses fail to appear as such or are accepted as a necessary evil associated with the particular product.

This then is the area of feedback. Regardless of the level of automation, information can be fed back through the control system more or less to "ride herd" on the accuracy of the job being done. Gauges and measuring devices can monitor processing operations to hold pre-set values or vary values as desired; mechanical controls can maintain pre-set or sequences of steps as needed. They can also shut down the process in event of trouble. In other cases the actual procedure itself forms the feedback loop (if it cannot be completed the operation stops) or even an operator at the final controls can form the feedback loop.

The main purpose is quality or accuracy.

Information and Data Handling

An important segment today in automation is the problem of information and data handling. This has grown to enormous proportions in all areas of commercial and industrial enterprise. Automation in this field is being actively developed as a solution. Profitable operations may hinge closely about immediate and accurate information concerning markets, production, and sales. And with increasing markets there is need to tie such information directly to plant operations. Processing and storing of data for operations is already being done with automatic machines. Original information recorded on an automatic typewriter which creates a continuous coded punched tape forms the basis from which subsequent operations can be automatically carried out. Address stencils, order sheets, work sheets, cost sheets, accounting data, shop orders, bill of materials, and numerous other data can readily be produced from an original punched tape. Punched cards likewise can form the basic means for subsequent operations. Speed, accuracy, and space savings are important advantages gained. Data available on punched tape or cards can be transmitted by teletype to outlying plants where a similar tape produced serves as the master data source.

Automation and Labour

When automation develops in an industry, what happens to labour? Is it displaced? Is the ultimate the workerless plant as so often predicted?

The answer of course, is no. Labour-saving devices actually create new jobs. A study of the employment of production workers since the turn of the century reveals an unchanging trend in employment — upward — directly tied in with an upward rate of mechanization.

Most automatic plants today help employ more people than before automation. Whereas automation can often reduce direct plant labour, this is not effective net reduction. High-grade maintenance labour must be added to care for the complicated equipment. The old-fashioned factory electrician is no longer adequate. Needless to say, automatic machines are not foolproof. They require many more skilled technicians for control and maintenance; much more advance planning and research is needed preceding their operations; and many more sales and service industry personnel must be added in the distribution end of the vastly increased end-product market.

Engineers and Management

Automation creates a greatly increased demand for engineers. Not only does the product or service to be automatically processed require better and more competent preliminary design, but so also does the equipment. Improved design for production is a must for economic reasons and for suitability to automatic processing. Greatly increased engineering time is inescapable in the design of automatic systems. Today, the engineering time and cost is paramount, the actual equipment construction cost becomes insignificant in comparison. The use of more widespread automation places a high priority on the supply of competently trained engineers and engineering technicians. Future rate of advance will be closely associated with their availability and the development of techniques and know-how. Demand for engineers in 1954 increased 45 per cent, and actually led the field by a wide margin. This demand, based on actual jobs opened, was mainly for electricals and mechanicals, followed by design specialists.

Along with increased engineering staff is engineering activity; automation requires a much closer co-ordination of top management and engineering. Successful application of automation principles necessitates full appreciation of all factors involved.

So many cases of real achievement on record, which stemmed from altogether unrelated causes, emphasize the need for careful management study of the over-all problem. To expect automation to develop "upward" from plant and engineering sources alone, may fail to produce the full potential.

Many automation programs being instituted today are set up so as to be sparked by management and fully controlled, since the effective climate for automatic operations includes many areas of the enterprise outside the sphere of engineering. Thorough search of management can often reveal the presence, absence or adaptability of factors necessary for realization of automation benefits.

In studying the character of automation, the need for special management consideration and organization becomes apparent. From the functional engineering standpoint, the basic technology of automation is horizontal across an array of vertical specialized areas. There is the need to correlate all the specialized knowledge of machine design; electrical, hydraulic and pneumatic controls; handling; sensing and measuring; instrumentation; drives; power, etc., to effect a complete system. Few engineers are well versed in all the necessary areas.

In addition, modern automation systems involve the interrelation of know-how and experience from many specialized areas of industry. Chemical processing, materials handling, packaging, food processing, metal-working, paper making, heating, textile processing and other specialized areas of manufacture must often be drawn upon to evolve the complete integrated system. Also, practical solutions to production problems known in one area of industry can often supply the answer to unrelated problems in another industry developing continuous systems. Innumerable cases of this nature have come to light in recent years.

The net result is a real need for organization to bring together a widely diversified group capable of engineering successful systems. Only through management's recognition of this problem can the desired results be attained.

Once the full perspective and high potentials of automation become apparent, proper application in suitable degree can result in real advance. The necessary engineering skill and knowledge can be developed and the needed practical elements of automation are available. The question today is not will there be automation, but how much and how soon?

Highway Problems in Ontario

W. J. Fulton,
Director of Planning,
Ontario Department of Highways,
Toronto, Ont.

The paper describes the reasoning followed by the engineers of the Ontario Department of Highways in deciding the number and location of limited access routes to be built in that province in the next few years. It may serve to dispel the too widespread idea that most provincial highways are built for political expediency.

In Ontario there are now approximately 74,000 miles of roads, exclusive of some 8,000 miles of streets in cities and towns. In "Old Ontario"—that part of the province which is divided into counties—there are 56,000 miles of this total. The 56,000 miles in Old Ontario, originated in two ways: trails which afterward developed into roads were here when the white man arrived and after his arrival he built roads to facilitate the movement of troops, to open new trade routes, to promote mining and lumbering and to replace those surveyed road allowances which he found impossible to follow.

These constitute less than 6 per cent of the total. The remaining 94 per cent of the 56,000 miles is the by-product of subdividing Ontario into townships. In laying out these townships, it was considered desirable for the lots to be rectangular in shape. The roads arbitrarily following these boundaries encounter obstacles which might easily have been avoided. They are subject to correction jogs in the township surveys and they vary radically in direction from one township to another.

But the fact that these roads were fitted together without any plan and without considering topography is not nearly so important as the fact that Ontario authorities found themselves confronted with a system of highways greatly in excess of the needs of the population so far as mileage went, but along which development had taken place, and with a popular demand that these roads remain where they were to serve this development and to encourage further growth.

The primary purpose of this great mileage of roads was to furnish access to land, but this was not their exclusive function, because very early we find that a limited mileage was separated from the 56,000 miles originally administered by the townships and placed under the jurisdiction of the counties. This was in 1874 and it marked the beginning of the county road system. Almost all roads were still unimproved then and of necessity all road travel was of short range.

With the advent of the automobile a road construction program began and some years of unsystematic building followed, until finally the builders awakened to the hopelessness of ever joining the disconnected roads these years had produced. Then they began to realize the need for classifying the road network and of giving priority to the improvement of portions of the greatest potential use. This resulted in 1916 in the designation of what was then known as the "Provincial Highway System." The roads selected as provincial highways were the most important ones in the 56,000 mile system.

The chief problem of the engineer then was road surfaces. New surfaces were generally placed on the old dirt road without change in location or with only slight revisions. Steep grades and sharp curves were accepted to keep costs down and were not inconsistent with the requirements of slow moving traffic. Engineers and the authorities were concerned with getting the motorist out of the mud. This was a generally wise and useful policy for the time. Its mistakes lay in its acceptance and fixation of obsolescent road alignment and in its failure to anticipate the need for rights-of-way of greater width than those theretofore considered ample.

These were pardonable mistakes. When they were made high-speed motor vehicles were generally unforeseen and probably unforeseeable. The standard of alignment required today would have then been considered fantastic. The great increase in vehicle registration and in traffic volume was anticipated too late, but, even if it had been foreseen earlier, lack of the necessary legal and popular sanctions would have prevented the forehanded acquisition of the wider rights-of-way and the introduction and enforcement of regulations required by widened and controlled-access highways.

Our most important highways were the ones which suffered most because of these mistakes. The explanation of this paradox is that

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these roads, in recognition of their prime importance, were among the earliest to be durably improved. Structurally, many of their improvements are still embarassingly sound, but in location, in traffic capacity, and in lack of most of the features of modern design that make possible the safe operation of vehicles at high speeds, they are lamentably obsolescent.

This was realized during the 1930's when the department attempted to meet the situation by developing No. 2 highway into a four-lane road in its present location from Windsor to the Quebec boundary. Work was undertaken on four sections of this road and the right-of-way was widened at considerable cost in moving buildings. Two east-bound and two west-bound lanes were built, separated by a median strip 20 to 30 feet wide. Although the new construction was a definite improvement, inability to control development along the widened right-of-way allowed these roads to deteriorate, so that they are now simply side streets with a thirty-mile speed limit.

A repetition of experiences of this kind indicated that we were approaching the end of the last stage of the pioneer period of road construction, so far as our main trunk roads were concerned, and that an important feature of any new modern highway would be control of access. It was apparent, of course, that the majority of roads would still give access to land and would permit the owners of abutting property to develop their holdings with unlimited right of entry into the highway. However, a small mileage of trunk roads, incorporating control of access, would have to be built to divert as much traffic as possible from these general purpose roads.

The first road of this new type built in Ontario was the Queen Elizabeth Way. It had just been completed when world war II began and normal highway improvement ceased. As a consequence the mileage of road no longer adequate for the traffic carried, and difficult to maintain in service, grew through the war years, so that, when peace was declared, a serious reconstruction problem confronted the province.

Before undertaking the program of this work it was essential that a better understanding of the traffic trends and the travel habits of the motorist be obtained so that former mistakes in planning, location and design might not be repeated. For instance, it had been widely accepted that adequate accommodation for the King's Highway traffic would necessitate the construction of by-pass routes around the cities. In the absence of statistics, it was believed that a large part of the traffic on the roads approaching the cities was "through traffic", i.e., traffic bound to points beyond the city and it was thought that this traffic should be accommodated by routing it around, rather than through, the city. Such routing was also believed desirable from the standpoint of the city, since its streets would then be relieved of a substantial volume of traffic.

Table I. Traffic Capacity - Vehicles per Day

	Annual average daily traffic capacity	
	2-lane	4-lane
Passenger vehicles only	5,750	19,250
90% passenger, 10% comm.	5,200	17,500
80% passenger, 20% comm.	4,800	16,050

To test this belief and to ascertain what volume of traffic such by-pass routes would serve studies were undertaken, and it was found that for a large city the destination of 95 per cent of the traffic on its approach roads was the city itself and only 5 per cent wanted to by-pass. For smaller cities, the by-pass traffic increases, i.e., it is inversely proportional to the population.

We knew that all highway traffic is a composition of long range and short range movement, but, until recent studies disclosed the facts, we did not know the relative percentages of these two movements; about 85 per cent of all trips are of less than 20 miles and only about 2 per cent are of more than 100 miles. Traffic is predominantly short range movement.

Also, as might be expected, it was found that the cities were most important as the origin and the destination of traffic. Analyzing the traffic on the King's Highway, it was found that about 50 per cent had *both* its origin and destination in the cities, an additional 37 per cent had its origin *or* its destination in the city, while only 13 per cent of the traffic on our highways has both its origin and destination in rural areas. From these origin-destination, or "OD" surveys as they are called, we derive a great deal of information.

To make an OD survey a road block is set up on the highway that will effectively stop all vehicles, but at the same time allow any vehicle that should not be stopped to get through (e.g., ambulances, police cars, etc.). The interviewers endeavour to question as many as they can of the drivers of vehicles passing the station in a 16-hour period. The questions are not intended to be personal and, if the driver cooperates, the time spent asking and answering the questions does not require more than 20 seconds.

These data are sorted mechanically. When the results are compiled they give us, among other information, "desire lines", which in effect are straight lines joining the major origins and destinations. These lines are then plotted on a map of the area, their weights being in direct proportion to the number of people with the same desire.

By using these desire lines we can indicate the location of the highway which would best provide the greatest service. We can also predict, approximately at any rate, the volume of traffic which will use the highways when it is built and determine where we will require traffic interchanges, what width of roadway is necessary and the like.

We have also made studies on highway speeds and have found that on the King's Highway only a scattered few travel faster than 60 miles per hour. The studies afford no justification for the design of highways to accommodate speeds in excess of 70 miles per hour under any conditions.

Studies also indicated that to permit the desired clearances of commercial vehicles, a 24-foot pavement is required on our major roads and that obstacles within six feet of the edge of a traffic lane influence the position of traffic in that lane to some extent.

Another study was made on a highway three miles east of a bridge. Here 76 per cent of the traffic was in its own lane, 15 per cent in the passing lane and 9 per cent was straddling. However, on the bridge, only 18 per cent was in its own lane, 21 per cent in the passing lane, 51 per cent straddled the centre line of the west bound lane and 10 per cent was half on the west bound lane and half on the east bound lane. This was because cars veered away from the bridge hand rail.

We also made some studies of the hill-climbing abilities of commercial vehicles and found that they will slow up traffic on hills unless grades are reduced to 3 per cent or less, or engine power is more than doubled, or gross vehicle weights are reduced excessively. Except on the highest type of highway, where 3 per cent grades may perhaps be easily obtainable, any combination of these three conditions to obtain a safe and efficient flow of traffic would be costly to all interests involved and are practically impossible of attainment in the foreseeable future.

Tables I and II give the department's standards for estimated traffic capacity and for sight distances.

Table II. Sight Distances - Feet.

Design speed, m.p.h.	Stopping 2-, 3-, and 4-lane roads	Passing 2-lane roads Desirable	Passing 2-lane roads Absolute	Passing 3-lane roads Desirable	Passing 3-lane roads Absolute
30	200	600	500		
40	275	1100	900		
50	350	1600	1400	1100	900
60	475	2300	2100	1500	1300
70	600	3200	2900	2000	1800

The studies I have mentioned and others similar to them have been responsible for the development of improved highway standards and have had a considerable influence on the reconstruction program of the department.

The Highway Improvement Act was amended in 1939 to permit the Minister of Highways to designate a King's Highway as a divided highway. This name was later changed to "controlled access highway," a term more nearly descriptive of its character. This amendment gave the Minister power to set up regulations prohibiting or regulating the opening into controlled access highways of private roads and entrances, to prohibit or to regulate the use of this type of highway by any class of vehicle and to prohibit or to regulate the erection of buildings or other structures upon intersecting roads within 600 feet of their intersection with the controlled access highway. Upon approval of the Ontario Municipal Board, it gave the department power to close any county, township or other road which intersected a controlled access highway.

From the operation of the Queen Elizabeth Way the department engineers learned much, which knowledge was incorporated into the design when the department built the next controlled access highway from Toronto to Barrie.

Up to now our chief problem has been to decide the characteristic features of the type of road to be built. This having been determined by our experience with the Queen Elizabeth Way and the Toronto-Barrie roads, the problem now is where to locate this additional mileage so that it will do the most good, keeping in mind the fact that this type of road costs from three to eight times as much per mile as an ordinary highway, and that our objective is to build a more serviceable, rather than a more extensive, highway system.

Just to get the picture in perspective we may arbitrarily divide Ontario into three parts; the southwestern, the southeastern and the northern sections. In the southwestern section there is 68 per cent of the province's population in only 5 per cent of its area; in the southeastern section there is 17 per cent of the population in 3½ per cent of its area and in the northern section there is 15 per cent of the population in 91½ per cent of its area.

There is 74 per cent of the motor vehicle registration in the southwestern section, 16 per cent in the southeastern section and only 10 per cent in the northern section, so it is obvious that any controlled access highways that may be built will almost certainly be in the southwestern and southeastern sections.

Traffic flow charts show that our most heavily travelled road is No. 2 highway from the Quebec boundary to Windsor, except for No. 11 north of Toronto and No. 2 and 8 from Toronto to Niagara Falls, which are now supplemented by controlled access highways.

It has already been established that the practical working capacity of a two-lane road is 5,200 vehicles per day, composed of 90 per cent passenger cars and 10 per cent commercial vehicles.

Checking the daily traffic volume on No. 2, we find that many sections of this highway are carrying traffic in excess of its practical working capacity, so that some relief is necessary now. When we estimate the increase in traffic volume in the next few years, it is evident that this highway will be unable to carry its future load efficiently.

To obtain further information as to where improvements on No. 2 should be made an origin-destination survey was carried out. During the three summers while this survey was in operation, 378,770 drivers were stopped and interviewed on the highways between Windsor and the Quebec boundary. When the information from the interviewers was processed, we were able to plot the major desire lines of travel. These desire lines were combined to represent the general path of the majority of the highway users.

This path was then laid down on existing maps and the routes were photographed from the air. The photographs were vertical, taken with sufficient overlap both in the direction of flight and at right angles to the line of flight, to enable them to be used in stereo pairs. Viewing these stereo pairs, one can study the topography of the ground and so lay down on the pictures a line which not only fits the topography of the country well, but which also approximates as nearly as possible the major desire lines.

From the pictures a map on a scale of 400 feet to the inch is prepared which shows all the cultural detail. From information obtained from registry offices and township assessors' books, real estate boundaries can be plotted on this map, which covers a width of about a mile on each side of the projected line.

The line which was laid down on the photographs is then transferred to this strip map and a survey party, guided by the pictures and the plan, establishes this line, or lines if there are alternatives, on the ground.

(Continued on page 243)

DISCUSSION

of Technical Papers

Is Effective Town Planning Possible?

S. D. Lash, M.E.I.C., Head of the Department of Civil Engineering, Queen's University, Kingston, Ont.

The Engineering Journal, February 1956 issue page 116.

J. D. Lee, M.E.I.C.[1]

Dr. Lash is to be complimented on his thought provoking paper on a very difficult subject. There is no doubt that if planners and the public could agree upon the detailed objectives of planning there would be greater opportunity for an effective process of planning being developed soon.

While running a risk of being dubbed "know-it-alls" or worse by the general public, planners must agree upon *detailed* objectives and processes if planning is ever to have a semblance of a rational and scientific professional enterprise.

As a basis for argument let us state certain detailed objectives and then see how they may be achieved.

1. Assume that all urbanization is planned to occur in groups called towns or super-neighbourhoods which will support a senior secondary school. Such an area might occupy 1,500 acres of land and be separated from its adjacent neighbourhood by a "green belt" used to carry feeder lines of utilities and a limited access arterial highway.

2. The super - neighbourhood groups would be separated into neighbourhoods which would support primary schools. They might occupy 150 acres and be separated by a 160 ft. right of way supporting a main roadway of the limited access type, and service roads. The street system layout in neighbourhoods would encourage traffic to use the main roadways which would be in the separation zones.

4. Within the exterior framework of neighbourhoods areas could be allocated for major shopping centres, for general business activities, for major recreational facilities and so forth.

5. Groups of super-neighbourhoods (again not rigid as to exact size or shape) could be fitted to the topography and major communication and utility systems to form metropolitan areas.

The process of development envisaged above can be worked out within our present framework of legislation and municipal organization but it requires super-planners, super-aldermen and a little sheer magic to get from the nice plans to actuality. Experience has shown that the development of the type which fixes the character of the future municipality occurs in our townships. The townships and villages do not have a sufficiently complex municipal structure either elected or appointed to achieve the end results of planning, even if they thought they had the resources to carry out the processes of planning.

It is evident that good planning can be best achieved where a large area is involved, and in which the pattern of land use and development can be fixed several years before the pressure of local development is felt. There seems to be at least one way to achieve this without making serious changes in present legislation or political structure:

(a) Recognize that county councils should be elected and that there should be no separated municipalities.

(b) Unify leadership in our provincial government through the departments of planning and of highways and with the aid of a grant system induce responsibility on the local level to promote planning in advance of need *and* a continuing project of land acquisition to promote the securing of public land for green belts between neighbourhoods, for schools, for major parks and for a major street system. The price of such land would be fixed by its use as agricultural land and not by hope for what Professor Lash so aptly calls an "unearned increment of value."

It is my belief that public recognition of the need for compensation to individuals whose rights are affected by planning activities is already here. The history of most cities records the fact that the municipality always gets the worst of any bargaining in land transactions and so forth. This makes councils loath to establish mechanisms on a general base for making compensation payments a prerogative of the city hall staff. It is to be expected that the practice will become well established in the redevelopment of existing cities, and will be avoided by proper planning in the new.

I wish to take exception to Dr. Lash's comment that planning has been relatively ineffective. Rather let us say that a mis-choice of political division within our provinces has made it something we did without. Our troubles are so fundamental that until recently there has been no planning, and unless we divorce the primary control from the strictly local government it will never be successful. A well known rule of business is that responsibility and authority go together. Let us then give our county units both, "un-separate" our so called separated towns and cities (in regard to planning at least), embody all of the potential adjacent urban land in the single county unit and forget regionalism as a trade name for the process.

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[1] J. D. Lee and Company Limited, Consulting Engineers, Kingston, Ont.

C. E. Campeau, M.E.I.C.[2]

One of the main reasons why town planning has encountered so many difficulties up to now in its acceptance by the public at large is probably the fact that too much insistence has been put on its aesthetic aspects. Scientific rules and norms have been neglected as secondary, although no artist has ever been found who had not mastered first the science on which his art is fundamentally dependent. Efforts should be made by all planners to intensify research on basic requirements and on scientific approaches to the solution of standard problems. As soon as the science of town planning is well established, then and then only will the art of town planning become more easily accepted and applied. There is an urgent need for all universities and practitioners of town planning to develop the scientific basis of town planning.

It would be ridiculous to limit the role of town planning to the "revival of the lost art of civic design". Town planning is primarily concerned about people so that the sites on which they live be provided with the facilities required for their physical and spiritual betterment. There is no mysticism, but only crude reality, in measuring the dimensions and qualities of such facilities in the light of well established social desires.

There is a very important field which has been neglected by our Canadian planners, namely capital expenditure programming. Without an effective program of capital expenditures, official planning has not much meaning. Most of the American cities have now introduced, within their administrative procedure, the obligation for the town planning organism to prepare a capital budget program for three to five years. Such a program has to be approved by the city council and the budget of the current fiscal year has to include 1/3 or 1/5, as the case may be, of the total amount of the approved capital expenditures program. This procedure should be investigated very thoroughly by our Canadian planners since, in its absence, no major planning objectives can be easily attained.

There is a great need everywhere of streamlining legislation in accord with our modern conceptions of town, metropolitan and regional planning. It would be very useful for our town planners to study the existing laws more carefully so as to find ways and means of implementing their plans under existing conditions. However, there is no doubt that effective town planning requires the establishment of scientific standards, recognized by an adequate legislation. Such a legislation should be conceived according to local needs and customs, if it is to be successful.

The role of education cannot be overlooked. Professional associations have to be supplemented by amateur groups, whose role is too often minimized. Planners should never forget that planning is for the people, who should be convinced that they need planning.

[2] Director of the City Planning Department, City of Montreal.

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W. C. Miller, M.E.I.C.[3]

I discuss Dr. Lash's paper for the most part from the point of view of planning in the smaller city of 40,000 population and under. The problem in the smaller city must be handled in a manner that differs considerably from the techniques used in larger metropolitan centres. In the smaller units we have more compact arrangements which have a very close application to the interests of almost every citizen. In larger cities there is a tendency for the average citizen to think only of those measures that have a particular application to his own section of the city.

There is a current tendency toward divorcing planning from the agency in which it has been carried on for many years, and the setting up of another agency or board. The city's most important elective body, the council, with the final responsibility, has been, over the years, deprived of many functions for which it should be the co-ordinating group, and is forced to work in an atmosphere of competing commissions, boards, etc., each concerned with its own problems and frequently responsive to very few efforts at coordination. The tendency is a product of the sedulously cultivated theme that all public service is "ipso facto," inefficient, and all privately directed enterprises are the reverse. According to this philosophy, therefore, we should set up quasi business bodies to administer the various parts of the city's work. We have public utilities commissions, industrial boards, boards of health, hospital commissions, recreation commissions, boards of education, etc., all requiring the council's financial backing, all directing parts of the municipal business structure, and with little or no coordination with the council or with the other boards.

Now, councils will generally look upon the planning board as "just another board," even if it is supposed to be purely advisory. It will provide another opportunity for council itself to stop consideration of larger policies with respect to the city's growth, and in the end neglect them altogether, and make decisions that should rightfully be dealt with first by the board, because it is not kept in close touch with the various studies being made. Council ought to be close to these things constantly, so that it may be always reminded of the effect of a current problem on the city's development.

The work of the planning board is almost entirely concerned with that part of the engineer's work which has been frequently called "functional design." This functional design, particularly in the smaller cities, must always precede the technical design, if the latter is to be effective. I am not sure that I agree with Dr. Lash's description of the role of the municipal engineer in his example of the bridge. It has been my own experience that the municipal engineer is first concerned with the bridge location and its function as a traffic-carrying feature. The functional design has always preceded the technical considerations, which, important as they are, are a secondary detail. The careful preliminary studies of location, of grade, approaches, the effect on traffic, etc., are all an integral part of the bridge design.

The same thing will apply equally to the design of roads, their width, their location, channelization of difficult intersections, and many other similar details which must be studied before the type of the pavement is established. Similarly, the municipal engineer must foresee the most likely loca-

[3] City Engineer, St. Thomas, Ont.

tion of future developments in his city, and plan trunk sewers and watermains accordingly.

This functional design merges into what is now considered as "planning" by the professional planner. The municipal engineer who is content to start only at the level of technical design is only doing part of the job that should be expected of him. He has to be at once an idealist and a practical realist. His determination of most of these basic data and their presentation to his council in an intelligible way is most important if his council is to establish its policies adequately. In a smaller city, this planning function is most effective, in my opinion, when it is a recognized part of the engineering function. It is one part of what we have formerly called engineering economies, and may usually best be done by the municipal engineer who has been well described as civil engineering's 'general practitioner'.

This argument will at once be eountered with the question "What municipal engineer has the time to devote to this kind of planning?" This is perhaps fair criticism, but it also points up the simple solution of the addition to the staff of a junior engineer, who may devote his time to many of the details, enabling the chief to indulge in the valuable occupation of municipal strategy. Such a procedure would also be less burdensome to the budget, and the coordination with the operating departments would be complete.

It should not be assumed that because there is no planning board there is no planning being done. Planning may be carried on in a very close relationship with the other municipal functions and it will give the Council the feeling of being a part of it. Someone has said, concerning methods of administration of cities, that "self-government is to be preferred to good government". So with planning. It must keep closely in step with council and keep council in close step with planning.

Dr. Lash shows in his paper that he is familiar with the frustrations of the planner, and is well acquainted with the reasons therefor. However, in the matter of planning in the older existing city, the planner must always be satisfied with approaches only to the solutions that the planning authority believes in. The only part of the municipality where the maximum application of planning in principles would be found, is in those areas where a new city is being created from unimproved farm land. Here all of the rules may have the maximum of application. In the older parts of the municipality, especially in the smaller city, there is simply not the money available for large schemes of civic improvement. Any official who has been through the process where a development involved acquisition of land, will know the frustrating effects of compulsory land acquisition. When these cases go to court or arbitration, one is shocked at the free rein of imagination given and accepted as evidence in the proceedings.

On the outskirts of the municipality, or in the "fringe areas" there has usually been a lot of uncontrolled development across the town limits, where the suburban areas are looked upon by a predominantly rural council as mere "assessment." Later, when the rural council finds that this added assessment is becoming an obligation for additional fire and police protection, more school rooms, urban style refuse collection, sewers, storm drains, etc., the pressure is placed on the urban area to annex, after that area has been ruined by uncontrolled development, and when it requires expensive redevelopment which the rural area is unwilling to undertake because of the expense involved.

Definition of Town Planning

In most papers on town planning, a thesis is built up on the basis of the definitions that we use. A very simple definition of town planning is simply "organized municipal foresight." If we do consistently practise this foresight, we approach in the established smaller city, even though we never actually achieve it, better "health, safety, economic opportunity and efficiency, aesthetic and cultural satisfactions" and all of the other considerations that must be studied as to their place in the growth of the city and the welfare of its inhabitants. The municipal engineer who does not consider the social problems related to his work is only practising the technical half of his profession. He is neglecting that "trusteeship" that Dean Young always tried to impress on student engineers in his school, as being the distinguishing feature of the "professional" engineer. Professor Hardy Cross, in his delightful little book on engineering philosophy "Engineers and Ivory Towers", is constantly referring to his theme that engineering, too, is more of an art than a science.

Professor Lash does well to emphasize that one of the greatest single problems of effective municipal planning is the question of municipal boundaries. The remedy must usually be solved on political levels and the solution of the troublesome problems of annexations must always be based, not on the effect of the proposed annexation on the general economic structure of either the gaining or losing municipality, but on the question of the greatest good for the persons in the area concerned.

Now, after expressing an almost complete disagreement with the modern concept of the way effective planning should be carried out, and after considering Dr. Lash's thesis as to how effective planning can be, let me apply my own principle and say that planning as it is presently carried out is an approach only to effective procedures. Dr. Lash has set forth some of the difficulties and the problems, and with his philosophy no one would seriously disagree. If we continue to realize that perfect planning will only be done under an autocracy, and that in the English-speaking world at least, this will never replace our modern concepts of democracy, and if we realize that we are striving toward a goal which we will never reach, but where every nearer approach to that goal is an improvement, then, I think, we may appreciate that town planning, ineffective as it may be in its larger concept, does produce further satisfactions for both the "planned-for" and the planner. In that steady improvement we may see a real accomplishment and not frustration.

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Eric W. Thrift[4]

At the outset, in answer to Dr. Lash's question "Is Effective Town Planning Possible?" I think briefly the answer is yes, a little better than he would lead us to believe in his article.

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[4] Director, Metropolitan Planning Commission of Greater Winnipeg.

There may be many interpretations of what constitutes success in planning and while the article appears to deal largely with the implementation of public and private works, this is really only one aspect of the successful application of planning. It is, in fact, the physical expression of a broader plan which also involves sociological, legal and economic questions about which the people of any community have ideas and opinions that must be respected. In order to respect these opinions, of course, the civic administration and the planning function in that administration must know and understand them. We should be careful that in a desire for perfection in the physical application of our plans we do not tend to involve ourselves in political conditions of which we would not approve. We do not want to see physical perfection of our communities at the expense of political freedom. Competent civic officials including planners understand that in the operation of democracy there must be a good deal of unavoidable compromise. There can be no one authority that knows all the answers.

To return to the text of Dr. Lash's article, in the section dealing with town planning and civil engineering, there is argument that most of those in planning practice in Canada are inadequately trained academically. I should like to suggest however, that unless we were able to get a complete review of the training of those in planning practice in Canada it would be difficult to substantiate that many of these people have not had adequate planning training. In carrying on with this section he compares engineering design and town planning. While they may be compared for the purpose of gaining the understanding of the engineer, I think what is more important is the relationship between the design and execution of an important public work such as a bridge, and the sound planning of the community in which it is located. The relationship may be created by the fact that the bridge is the implementation of part of an overall plan worked out for the community and many of the initial decisions with respect to location, connections and many other aspects of basic requirements of that bridge are tied up in the planning function of the local government.

Turning now to the discussion of objectives, certainly the planner's objectives are not as neatly expressed by formulae and statistics as the engineer's when he sets out to design a particular structure to meet a particular specified need, but the planner must have objectives or he is no more good than any other person who doesn't really know where he is going or why. His objectives are a little more difficult to define because as Dr. Lash says, 'he deals with people rather than things'. In fact, he deals with both and the broad relationships between them. In this respect the relative values that people put on certain aspects of their community development are important to the planner and he must know as well as he can what these relative values are. These are some of the things that help him to determine with more precision what his objectives are for the particular community with which he is working.

Because the planner's objectives appear to be less clearly defined than those of the engineer, Dr. Lash points out that the planner, therefore, has much more difficulty in having any part in the realization of the plans which he helps to prepare. Many planners, however, have played extremely effective parts in implementing plans which they have had a hand in preparing. The implementation of these plans or ideas, of course, does not always involve public works or construction projects. For example, the planner considers implementation to include better use of vacant land, the management of city owned property, control of damaging land use, improvement of circulation, more economical development of industrial areas or residential areas, improved recreational facilities, removal of blight or slums and sound redevelopment and so on and on. All these may be regarded as examples of the effective results of a planner's work.

In the short section on "The Ineffectiveness of Planning" Dr. Lash makes what appears to me to be a rather all inclusive statement and I am afraid I'm not prepared to agree with it completely. A great deal has been accomplished through planning, not always in terms of major construction that we can gaze upon in admiration, but in terms of gradually improving methods for meeting problems more effectively as they develop and of getting better and better understanding of the aspects of our community life and economics. This will in turn, of course, affect what we do with physical improvements and construction.

The reasons given for the ineffectiveness of planning are not unalterable conditions. They are common problems for which solutions are being found in different ways in different places. He is quite right in stating that his reasons have had a detrimental effect on planning operations in various communities throughout Canada. There undoubtedly is room for improvement in all of these respects, but the need for improvement varies in degree and extent depending upon the locality and its particular problems.

Dr. Lash provides us with a set of objectives which are quite clear and fairly comprehensive. He explains briefly the work involved in reaching each of the several objectives.

With reference to civic design, I think it is hardly a lost art but perhaps one that is not as much exercised in many parts of Canada as it could be.

Planning and Local Government

Turning now to the relationship between planning and local government there are a number of extremely sound ideas expressed here and I think most practising planners working with local government would confirm his convictions. However, I think the wide breech between the planning operation in many towns and cities in Canada and the local government is narrowing and in many places it is disappearing altogether.

At the same time it seems to me that we might use some caution in summarily condemning the use of planning commissions and boards. They have been and in many places continue to be a vital element in the planning process. The kind of change of relationship which Dr. Lash suggests is probably better if it is carried out in an evolutionary way rather than revolutionary way. Local planning agencies must often build confidence in their operations. This confidence has been gained in many places in Canada but very often planning commissions have been instrumental in gaining it.

In the discussion of the size of planning areas, I think the need for a larger planning area is quite evident and again the points made are unquestionably valid. Perhaps, however, we find some conflict with the previous suggestion that the planning function be integrated as part of local government.

Creating larger planning areas will not solve the problem alone. We need jurisdictions of a governmental character with a wider area under their supervision and with which the regional planning function can be integrated in the manner that Dr. Lash suggests. This has in a measure been achieved in the metropolitan area of Toronto and perhaps this is really the only place where we can see this in operation at present. While this is a technique to aim at I do however believe that there are a number of jurisdictions in Canada in which planning is being handled on a metropolitan or regional basis but which do not, at the present time, have a parallel level of government. Success such as has been achieved has been due to the fact that the local governments, their planning boards and their planning technicians have approached their common task with a good deal of interest and goodwill and certainly with an intent to cooperate wholeheartedly.

In going on to discuss the possible relationships between a wider regional planning authority and local government, Dr. Lash expresses the opinion that the municipal act in Ontario will continue to be a handicap in this connection and suggests a regional planning authority which might "delegate some of its powers to local municipalities within its jurisdiction".

It seems to me that a planning authority is not a government and it therefore has no authority to delegate powers, because it has none except those which may be delegated to it from local government or from the provincial government. Dr. Lash mentions the Alberta legislation and experience, with its provisions for regional planning authorities. Success in their application is due in part, it seems to me, to the fact that the local governments still exercise a good deal of their own authority and the regional planning body only has such power as the local government may be prepared to assign to it. Dr. Lash points out, however, and this point is extremely important, that "The approval or the rejection or modification of plans must be the responsibility of local government". I don't think we can avoid this, and we would be unwise to try.

In discussing appeals, his statement is quite brief and it seems to me too all inclusive about a subject which can be quite complicated and difficult. Again, brevity may be due to the fact that this was an address given within a limited time.

Dr. Lash makes a brief reference to public relations which again seems hardly adequate in such an article as this. I suspect that the Community Planning Association of Canada with its various branches throughout Canada would have a good deal to say on this subject. There is also the aspect of public relations that has to do with the acceptable application of planning. Even though there may be a thoroughly effective planning operation in being in a community, sometimes good public relations are required in order to make sure that this aspect of the relationship between government and people continues to be understood. The planning commissions, moreover, have also had an important part to play in this connection in many North American cities. We cannot ignore their value in this respect.

In discussing compensation with which is coupled betterment, Dr. Lash points out that this is a broad and difficult field and further that its administration may appear insuperable. The British in using it apparently found that in fact it was insuperable because it has been abandoned in the face of the administrative difficulties. The fact that it seemed to fly in the face of what may be considered common human nature may also have contributed to its abandonment. As Dr. Lash says at the beginning of his article, it is people we must deal with, and we must consider carefully the view they take of the handling of the property they own and the values they attach to it.

Dr. Lash states the case for compensation and betterment rather simply and it would, therefore, appear to call for a rather simple solution, but it appears to me anyway, that there are too many unstated factors.

Dr. Lash makes use of a provision for caring for the costs of compensation and property acquisition which is common to many other difficult aspects of local government particularly where cost is involved. He suggests that the costs of such operations should be the responsibility of the provincial government. I think provincial government officers would confirm that this is commonly an apparently easy way out of a municipal financial difficulty. It seems to me that this touches a much more fundamental problem, that of the relationships among federal, provincial and municipal governments and their relative responsibilities and resources. Since this is a subject about which volumes could be written alone one cannot enter into a long discourse on that subject here.

Toward the end of the article Dr. Lash deals with planners and I think he couldn't expect to make the statement that present planners are 'a pretty motley crew', without being challenged by some.

No one would argue with the statement that we need adequate educational and training standards, but it seems to me to be doubtful wisdom to put all of the current planners in Canada, particularly, the home-grown ones into the limbo of the half-trained with doubtful abilities. Many of those in the field today in Canada are quite competent people.

I am always afraid of the word "compulsory". It seems to me that if a planner or the planning function of any community is doing a good job and is capable of pointing out the validity of its recommendations and ideas, that is part of its responsibility. If it does not and cannot do so then it is the responsibility of the community and its government to get a planning operation that can and will. If the people of our communities are convinced that they want good, sound communities as pleasant places to live and to work in economical and comfortable circumstances it should be up to them to decide that they want it so, and no official, it seems to me, should have the power to push it down their throats. He can help them establish their standards and goals, point out the consequences of various kinds of action, legislative or otherwise, and when the community's decisions are made, help to maintain standards and labor toward the achievement of its goals.

E. G. Faludi, M.E.I.C.[5]

Dr. Lash's statement that planning is a process aimed at creating the best possible urban environment with the available resources and that town planning is concerned particularly with health and safety, economic opportunity and efficiency, and with aesthetic and cultural satisfaction, will be met with wide agreement.

In addition, planning means the application of wisdom of organizing and regulating the relations between people and people, people and nature, people and the machine.

Planners are not just designers nor beautifiers. They closely resemble efficiency experts. They study carefully the social and economic problems of a community before they recommend physical improvements. As Dr. Lash says, it is important that we appreciate the differences between town planning and engineering design.

Planning is a process of compromises rather than an instrument of doctrinaire philosophy or a weapon of personal ambition.

It is an astonishing fact that in a century dominated by the idea of efficiency, the uneconomic organization of our cities has caused so little concern. Partially built up areas and ribbon development which causes cities to spread out in all directions, result in inefficient and uneconomical servicing.

The reasons for ineffective planning given by Dr. Lash may be augmented as follows:

(1) lack of public understanding concerning the objectives and procedures of planning

(2) political interference with regard to the proper place of planning within the structure of municipal government

(3) unsatisfactory administrative procedure.

(4) lack of trained personnel, especially senior men

(5) lack of money.

In addition, the increase in urban population and the increase in the number of automobiles on our city streets present significant problems to the planners.

The automobile, invented as a means of locomotion, has become a means of congestion. A bedroom takes up 80 - 100 sq. ft. and the space that need be provided for parking a car is three times this amount. Car parking space is required at home and on the street in a city centre. City centres are congested, have some narrow streets, traffic snarls and insufficient parking areas.

The population of Canada in 1975 is estimated to be 25,000,000. We will have twice the present population to accommodate in our cities and it is necessary to prepare for this.

The specific objectives in urban planning have been discussed by Dr. Lash and these may be summarized to include:

(1) cleaning out and redeveloping slums and blighted areas

(2) reserving land for parks

(3) planning industrial and residential areas with iron clad by-laws to ensure that they will be so used

(4) controlling haphazard fringe development by regulations

(5) widening streets and constructing traffic arteries capable of handling tomorrow's traffic as well as today's

(6) providing additional and up-to-date commercial airports.

The basis of sound national planning is regional planning. Nature has divided the land into regions according to climate and resources. No single community within such areas can plan its own improvements if it concentrates on its own legal territory and ignores the regional peculiarities that so vitally affect its welfare.

Regional planning areas should be established on the basis of economic, social and geographic factors, not just on a basis of population density and economic feasibility as Dr. Lash suggests.

Research is essential to effective planning. We can build for the future when we understand exactly the problems we have to deal with, the conditions we have to meet, and the materials available.

Legislation to control development and to ensure that the plans will be put into operation is also an essential.

Effective town planning can only be achieved with the cooperation of the common man. Opposition to planning is mainly the result of misunderstanding. It is only fair that people should know what is being planned, why it is needed and how it will answer the need. Plans must be explained and discussed openly if the necessary co-operation from the citizen is to be had.

[5] Managing director, Town Planning Consultants Limited, Toronto.

HIGHWAY PROBLEMS IN ONTARIO

W. J. Fulton

(*continued from page 237*)

Considerable care is taken to adjust the line so as to do as little property damage as possible. All necessary topographic and soils surveys are made to obtain the information for designing the road and the structures and for preparing the estimates, etc.

As a result of its incorporating the most modern of highway design standards, a controlled access highway, such as is proposed for No. 2, will permit the motorist to benefit economically from a saving in time, from a saving in fuel consumption, from a saving in vehicular wear and tear, and from a reduction in personal injury and property damage accidents.

The mileage of fully controlled access highway built, being constructed, or proposed to be built in Ontario is 672. Because it has been established that cities and metropolitan areas include the sources and destinations of much the larger part of the heavy flow of traffic that moves over the highways of the province, this system of controlled access highways, within the limit of the mileage adopted, connects as many as possible of these cities and metropolitan areas.

It is believed that this mileage of controlled access highways will serve a larger proportion of the total highway traffic of the province than it is possible to attract to any other system of the same extent. As an example, it may be noted that No. 2 highway is in the centre of a band 20 miles wide, within which live 3,000,000 people, or 66 per cent of the population of the province, holding about 70 per cent of the motor vehicle registrations. It is estimated that, although the proposed system of controlled access highways represents less than one per cent of the mileage of the entire highway and street system of Ontario, it will serve more than 15 per cent of the total traffic in the province. ✓

ABSTRACTS . . .

OF RECENTLY PUBLISHED ENGINEERING LITERATURE

THINKING AHEAD

An Editorial, *Harvard Business Review*, November/December 1955.

Automation necessitates extensive planning operations within the plant if costly mistakes are to be avoided. But the new mechanization also poses considerable questions in other fields. In the area of industrial relations for instance, will it lead to more jobs or, as many fear, fewer jobs? Will it create a need for more skill in the work force, as generally assumed, or less? Will it increase maintenance costs? Again, what significance will automation have in the field of small business? Will the effects be as severe as many writers have anticipated?

In 12 out of 13 of the plants studied, the number of people employed is higher than it was prior to automation. Many changes in materials, processes, and product design produce as much displacement as automation, or more. More often than not, the machine had assumed most of the skill requirements of the job and the production systems required less skilled labor than before. Automation seemed to lower training requirements for the *majority* of the workers.

Automation has one notable impact on the character of the maintenance force: the new skills demanded of plant electricians. Indeed, it seems we need a new class of plant electricians, "Electronic technicians." Yet there are definite indications that *maintenance costs in some kinds of plants will actually drop under automation*, because automation has reduced the total amount of machinery in the factory.

To a certain extent, the very logic of automation will operate in favor of small business's survival. *In general*, automation reduces production flexibility — thus automation may well prove a blessing to the small business man who is fast on his production and sales feet. But he will have to make his living by producing the fastest or the finest.

Although there are many production advantages as a reward, automation means much more worry for management. The question for management is, therefore, "shall we buy this much trouble; and if so shall we buy it *now?* Shall we pioneer . . . or shall we wait till it is perfected a bit more? As one topnotch manufacturing research man points out: "The firm that rushes into this thing blindly is going to lose its shirt. The firm that doesn't go in at all is going to lose its market."

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GLASS COATINGS PROMISE LONG LIFE FOR STEEL STACKS

Power Engineering, v. 59, n. 8, August 1955, p. 63.

Glass-lined smokestacks have been on test for nearly two years and are just now being marketed. Such stacks are made of a mild steel with two coats of fused glass. A 20-month test recently completed showed a loss of surface gloss to be the only effect of exposure to a highly corrosive flue gas for this full period.

It is not claimed by the developers of these stacks that they will last forever, merely that they will last much longer than steel stacks without glass protection. Specifically, a life of 25 years (as compared with 10 to 12 years) is forecast, and is considered conservative.

There is more to be considered than length of service, however. Corrosion protection of this calibre permits the elimination of that extra margin of steel provided in unlined stacks expressly to allow for corrosion. Where plate thicknesses of $\frac{1}{4}$ in. are required for structural reasons, it is customary to allow another $\frac{1}{8}$-in. of steel which can be eaten away before the stack becomes unsafe.

Many steel stacks subjected to corrosive duty are lined with brick, and the steel plates must be heavy enough to support the brick as well as their own weight. Compare the weight of five inches of brick in a conventional lining with the 0.012-in. (±0.002-in.) coat of glass. It should be obvious that weight savings of this magnitude will affect the requirements for foundations and for structural steel supports, where stacks are mounted on boilers or buildings.

It might appear that this would be pertinent only where the reduced structural requirements could be accommodated in new designs. It presents another possibility, however; stack replacements with the lighter stacks can be taller than the conventional stacks they replace, without increasing the investments in supports. Plants faced with ultimatums from air pollution groups could make good use of this characteristic to discharge their gases higher, possibly going to a smaller-diameter stack with higher velocities at the same time. The smaller stack diameter would, of course, permit an even greater increase in height if proper guying is practiced.

This leads us to another consideration. How high can a glass-coated stack be made before its own weight leads to base loading to such an extent that the glass fails? What about the natural sway of the stack? Would this cause glass failure?

Tests conducted on this type material indicate that glass failure occurs after the deformation stress of the metal is reached. Since any structural use of metal calls for stresses well below those at deformation, we have reason to believe that the exercise of elementary design practice is all that is required to avoid such stress-failures of the glass coat. The glass, in other words, is tough.

Glass-coated steel can be drilled and cut much as other steel. Should some small boy try out his new rifle on the stack, it is possible to flame-cut out the affected area and bolt on a coated patch. Holes may be drilled also for attaching ladders and other hardware. Special bolts with glass-coated heads extend the protection of glass throughout the stack and could be used to patch holes small enough to be covered by their heads.

Until research devises some way for welding sections together without damaging the glass, stacks will be supplied in flanged sections and will be bolted together. High-temperature plastic coatings protect the exposed parts of fasteners, such as the bolt threads, from atmospheric corrosion.

Selection of a class-coated stack would mean paying about 50 per cent more than for a conventional unlined stack, but conservative estimates predict a 100 per cent increase in life.

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CANADA IS VITAL

Engineering, v. 180, Dec. 1955, pp. 842

British manufacturers have tended to neglect the Canadian market for long enough. While British exports to Canada have recovered from the low levels reached in 1955, they represent only 8 per cent of the goods entering Canada from abroad, compared with the pre-war share of 20 per cent (and a post-war high of 11 per cent). During the first ten months of 1955 our exports to Canada remained the same as in the corresponding period of last year, despite a 9 per cent rise in the Canadian gross national product. Meanwhile, Continental competitors have been stepping in, and the United States has also increased its share. Yet Canada says that it wants to "Buy British"—and not necessarily from any feeling of sentiment. It is in their own interest to develop their export markets and the United Kingdom is Canada's second largest customer. There are large markets for all types of capital goods—particularly machinery and equipment for the big new mining developments, and naturally the demand for consumer goods is rising consequently. Why then has Britain lost ground in the Canadian market?

It has been suggested that United Kingdom manufacturers are unable to offer short delivery dates due to rising investment demand at home and in other countries. The proximity of the United States is quoted as offering lower transport costs and hence lower prices, even though British manufacturers have been assured that they have nothing to fear in this direction, since United Kingdom prices are often as much as 25 per cent less than their competitors. Such excuses, however, cannot explain German success. The real answer probably lies in a remark made by Mr. Marc Boyer, a member of the recent mission to Britain from the Canadian metal mining industry. "You cannot sell in Canada from a desk in the United Kingdom. You must be on the ground over there." Mr. Boyer condemned the apparent lack of aggressive selling and recommended British manufacturers to appoint their own representatives and selling organizations in Canada, the warehousing of stocks for immediate dispatch, and the establishment of assembly plants. Certainly, the majority of British concerns who have penetrated the Canadian market on any scale have found the experiment rewarding. Another recent suggestion was that companies should co-operate to reduce the expense, share the risk, and by this means present a wider and more attractive range of goods and thereby secure better representation in Canada, as has been done over the St. Lawrence project.

Opportunities there certainly are. In 1955 the amount spent on construction work on new houses is said to be 200 million dollars. Output of base metal (copper, nickel and zinc) this year is estimated to be 12 per cent above the total in 1954, while output of aluminum is increasing steadily. A most significant indicator is electric power. The gross generating capacity of electricity stations is planned to reach 16.6 million kw. in 1958 compared with 13.1 million in 1954. These are signs not only of boom but of long-term expansion.

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DOWN COME ALUMINUM CASTING COSTS

W. G. Patton, *Iron Age*, v. 176, n. 26, December 29, 1955, pp. 61

A simplified method now makes practical the production of large, comparatively short run aluminum castings in permanent molds. Castings up to 70 lb. have already been made and it is apparent that castings weighing 100 lb. can be produced by this method at competitive prices. Castings weighing only a few ounces have also been produced by this method at rates as high as 6000 per day.

Successful use of the process centres around a unique, low cost casting machine. It has many features of a diecasting machine except that metal is hand poured instead of being injected at high velocity into the molds.

Another important difference is the use of gray alloy iron molds that are precision cast to required tolerances. Except for minor polishing or touch up, and machining of the parting line, molds are used as cast. The comparatively low cost of molds is a major reason why this new process can compete with gray or malleable iron casting, or diecasting, for many applications.

While the process is particularly suitable for medium and long-run large castings, the production of comparatively large runs of small production castings is possible. Tooling for small parts, may be simplified by making a single master part and using this single part as a pattern to produce all other cavities in the mold. As many as 20 or even 30 parts can be included in a single permanent mold.

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CAN'T BE DONE? . . . THEY'RE SLUICING ASH UPHILL

Power, v. 99, n. 9B, Mid-September 1955, p. 68.

When Interstate Power decided to add another boiler and turbine-generator, they also decided to do something about the ash-disposal system—mainly because new boiler needed space taken by the boiler-room sluice pit. That's when one of the operators came up with his payoff idea: "Forget about the first sluice pit, pumps, discharge lines and clinker grinders. Just plain sluice it right into the second pit." Initial reaction: not practical . . . would take too much power.

But the chief engineer, trying to prove the point, set up a test section of the sluice pit, borrowed hose from the local fire department to feed flushing nozzles. Hoisting test-section discharge with locomotive crane to a 15% rise, he turned on nozzle-flushing water, duplicating sluice conditions. The test rig worked. It picked up water, ash, cinders and hurled them far over a 20-ft. pile of cinders.

The uphill sluice line went in. High-pressure water-injection nozzles, at eight points along the 110-ft. inclined sluice, flush ash uphill, into an outside pit. Locomotive crane piles ash alongside the pit. Local contractors, using ash for fill or other purposes, haul it away.

Since modernizing, maintenance costs have been a meager $50—for one sluice liner, two nozzles and installation labor.

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AEROFALL MILL FINDS INCREASING APPLICATION

Mining Engineering, v. 7, n. 9, pp. 842/845, September, 1955.

The basic feature of the Aerofall mill is continuous dry crushing and grinding of ore upon ore, combined with classification of the ground material by passing air through the mill at a controlled rate.

Combinations of these ideas — dry grinding, autogenous crushing, and large diameter mills — have been attempted before but the results were inconclusive. In some cases development was interrupted, in others success came only in specialized applications. In the face of this background the first Aerofall mill installations represented considerable engineering courage. The designer was putting all his eggs into one basket, into a unit that promised to both crush and grind.

Changes in ore character and in moisture content have been problems in autogenous mill design. It is stated that the Aerofall mill can tolerate up to 4 per cent moisture without effect upon capacity or product. With heating apparatus for the air intake, the mill has reportedly ground ore up to 12 per cent moisture. Flexibility as to feed make-up is also supplied, if necessary, by adding a ball charge of up to 2.5 per cent of total mill volume. With such a charge ball consumption figures range less than 0.05 lb. per ton.

History of the Design

Aerofall mill development had its beginning in the late 1930's. Despite the depression which was then almost at its worst, so far as the base metals industry was concerned, the management of Consolidated Mining & Smelting Co. of Canada started a comprehensive program of research for the purpose of testing various theories of comminution. The objective was to improve performance of the then existing mill equipment. During this program, which was interrupted by the onset of World War II, much was learned about the nature of comminution which formed the basis for new theoretical approaches to the problem.

Serious development work on the Aerofall mill was begun following World War II at the Canadian Bureau of Mines in Ottawa. The mill used in this work was 5 ft. diam. and capable of reducing 10-in. feed to as fine as 75 pct-325 mesh.

First commercial installation was at a gold mine in northern Canada. The plant operated only a very short time because it was found there was insufficient ore to maintain production. However, much valuable data was obtained so that correlation between the test and commercial units could be started.

Other commercial units followed, and in 1950 the largest unit constructed to date, a 17-ft. mill was built for a large asbestos producer. This unit went into operation in 1951 and gave fairly complete information on correlation of capacities of the various size units. Many of the problems in air handling and mill control were solved from this installation.

After this installation other commercial units were gradually built, installed, and put into operation. The diverse materials handled by these installations created new problems, but the Aerofall mill is now handling nearly every type of ore, and under widely varying conditions.

GUN KILLS OR FEEDS TREES

Paper Trade Journal, v. 139, n. 39, September 26, 1955, p. 80.

The development of a new and efficient method of injecting substances into trees, their roots, or the soil, utilizing a gun with gunpowder or other propellant in a cartridge, has been announced. Main implement of the process is a gun, similar mechanically and in operation to a shotgun, but equipped at its muzzle end with a combination metal and resilient shield.

In outward appearance the cartridge used is similar to the ordinary shotgun shell, although somewhat longer. The cartridge contains in addition to the firing or priming cap, gunpowder or propellant, a primary charge of tree poison which usually is in particle or powder form. The primary charge may also contain insecticide, preservative, stain, seasoning agent, or debarking chemical. The forward end of the cartridge is a slug or projectile which may be hollow. The hollow projectile in addition may be filled with a secondary tree poison or a combination of other substances already mentioned for the primary charge.

To operate, the gun is held against a tree or the ground and fired. The projectile punches a hole in the bark allowing the poison charge and expanding gases to enter. The explosive force lifts the bark and distributes the poison over an area of two square feet or more. Following the charge, the bark collapses substantially to its original position, leaving the poison in intimate contact with the cambium, phloem, and zylem cells, which is absorbed into the circulatory system of the tree, killing it.

Many different substances may be injected into a tree this way, with a single shot. The advantage of this process is that when harvest time approaches, the dead, peeled, seasoned and otherwise conditioned trees are cut down with several of the usual mill operations already completed, partly by nature.

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FRETTING CORROSION

The Chartered Mechanical Engineer, v. 2, n. 7, Sept. 1955, pp. 334/35.

Since fretting corrosion was first noticed in 1911 it has continued to excite interest, largely because of its association with fatigue failure. It is defined as the particular kind of damage which occurs when two surfaces in contact experience slight periodic relative movement of a few micro-inches. It can occur under very diverse circumstances, but it is encountered most commonly where a hub or bearing housing is press-fitted on to a loaded rotating shaft, and in riveted assemblies which are subjected to vibration. The removal of material from the surface can lead to loss of fit of the two components, or if the debris cannot escape, it may cause seizure in a case where they are occasionally required to move.

Particle Size

The particle size of the debris estimated in the electron microscope of Cornelius (1944) and Wright (1952-53) is of the order of a few hundred angstroms. On mild steel in air it has a characteristic red colour and X-ray diffraction has shown that it is α-Fe_2O_3. On aluminium it is black and consists of particles of aluminium coated with a transparent film of alumina.

Influencing Factors

The most important of the factors that influence fretting corrosion is the relative movement or 'slip' between the mating surfaces. The surrounding temperature also influcnces the amount of damage. It increases as the temperature falls, rising sharply at 0 deg. C. This rise has been attributed to the freezing of adsorbed films of water (present on the metal surface and on the debris particles) which act as a lubricant, but there is a possibility that it is connected with the transition from ductile to brittle fracture of steel in this temperature region.

The composition of the atmosphere has some effect on the amount of damage and on the chemical composition of the debris. In pure nitrogen the damage on mild steel is very much less and the debris is metallic iron. If the supply of oxygen is restricted by the presence of a lubricant, the debris is black and consists of γ-Fe_2O_3 or Fe_3O_4. An increase in the humidity leads to a decrease in the amount of damage. At very low humidities the debris is black but is α-Fe_2O_3. The influence of the humidity may be to provide a lubricant film of water to alter the composition of the debris with the formation of a hydrated and less abrasive oxide.

Possible Mechanisms

Three possible mechanisms for fretting corrosion have been suggested:

(1) the removal of metal from the surfaces in a finely divided form by a mechanical grinding action, or by the formation of cold welds at the points of intimate metallic contact which are subsequently ruptured with tearing of the surfaces.

(2) The removal of metal particles which are subsequently oxidized to an abrasive powder which continues the action.

(3) Oxidation of the metal, which, in the absence of mechanical action, soon becomes very slow, but which will be maintained indefinitely if the oxide film is continually being removed, exposing fresh metal, probably in a highly deformed state.

Preventive Methods

The numerous methods which have been applied, most of them successfully, to the prevention of fretting corrosion, may be divided conveniently into five groups.

(1) Prevention of relative motion.

(2) Reduction of the coefficient of friction.

(3) Increase of abrasion resistance.

(4) Exclusion of the atmosphere.

(5) Increase of the distance of separation.

Fretting corrosion is a condition in which a large number of factors play a part. Before a particular remedy is tried, a detailed analysis should be made of the conditions producing the damage, so that an enlightened selection of the most effective cure can be made.

Annual General and
of The Engineering
In association with The American
Sheraton-Mount Royal Hotel

PROGRAM*

Industrial Power Distribution:

J. R. Auld, M.E.I.C., Supervising Engineer, Power Services, Du Pont Company of Canada Limited.

General Design of the St. Lawrence Seaway — Montreal Area:

D. M. Ripley, Jr. E.I.C., Senior Assistant Engineer, Hydraulics, St. Lawrence Seaway Authority.

Application of Welded Design to Hydraulic Turbine and Valve Manufacture:

J. G. Warnock, Head, Hydraulic Department, English Electric Company, Limited, St. Catharines, Ont.

A Rapid and Accurate Method for Calculating the Transient Temperature in Composite Slab:

W. F. Campbell, M.E.I.C., Division of Mechanical Engineering, National Research Council.

The Growth and Development of Large Electric Power Systems:

W. R. Way, M.E.I.C., Vice-President and Chief Engineer, Shawinigan Water and Power Company Limited.

The Use of Hydraulic Models in the St. Lawrence Seaway Design:

Duncan McIntyre, Senior Assistant Engineer, Hydraulics, St. Lawrence Seaway Authority.

- Thirty outstanding papers
- Two panel discussions
- Special tours of the St. Lawrence Seaway (26 May)
- Special ladies' program
- Advance registration forms will be mailed early in April

The Kaplan Turbine in Canada:

G. D. Johnson, Mem. ASME, Chief Hydraulic Engineer, S. Morgan Smith Company, York, Pa.

Lateral Rigidity of Building Frames:

J. L. de Stein, M.E.I.C., Associate Professor, Department of Civil Engineering, McGill University.

Cross Suspension System, Kemano-Kitimat Transmission Line:

H. B. White, M.E.I.C., Power Transmission Engineer, Aluminum Company of Canada Limited.

Experimental Work on Coal Burning Gas Turbines:

D. L. Mordell, M.E.I.C., Chairman and Professor Department of Mechanical Engineering, McGill University.

The Mechanical Design Features of the St. Lawrence Power Project:

Otto Holden, M.E.I.C., Chief Engineer and P. Pemberton-Piggott, Asst. Mechanical Engineer, Generation Department, Hydro Electric Power Commission of Ontario.

Bersimis Power Development:

F. P. Rousseau, M.E.I.C., Chief Engineer, Power Development Division, Quebec Hydro Electric Commission.

Air Pollution Control Problems:

E. A. Allcut, M.E.I.C., Head, Department of Mechanical Engineering, University of Toronto.

The Metal Bonding of Aircraft Assemblies:

J. J. Waller, Chief Materials and Process Engineer, Canadair Limited.

*Subject to minor changes.

Professional Meeting
Institute of Canada
Society of Mechanical Engineers
Montreal, 23-24-25 May, 1956

PROGRAM*

The Trans-Canada Radio Relay Telephone System:

A. J. Groleau, M.E.I.C., Area Chief Engineer, The Bell Telephone Company of Canada Limited.

How the Mackinac Bridge was Designed for Aerodynamic Stability:

D. B. Steinman, M.E.I.C., Consulting Engineer, New York, N.Y.

Current Developments in Air Pollution in the United States:

L. C. McCabe, President, Resources Research Incorporated, Washington, D.C.

The Challenge of Progress:

R. C. Sebold, Vice-President, Engineering, Convair Division, General Dynamics Corporation, San Diego, Cal.

Co-Operative Research in the British Electrical Industry:

Jerzy Miedzinski, A.M. I.E.E., The Electrical Research Association, Greenford, England.

Survey of the Hamilton River:

E. N. Webb, M.E.I.C., Consulting Hydro Electrical Engineer, British Newfoundland Corporation Limited.

The Control of Air Pollution in England:

S. G. G. Wilkinson, Ministry of Housing and Local Government, London, England.

Automation, Men, and Machines:

J. J. Brown, Consulting Engineer.

The Canadian Atomic Power Program:

I. N. MacKay, M.E.I.C., Manager, Engineering Civilian Atomic Power Department, Canadian General Electric Company Limited.

High Speed Photography in Chemical Engineering:

A. I. Johnson, Professor, Department Chemical Engineering, University of Toronto.

*Subject to minor changes.

Automating the Engineer's Task:

Josef Kates, President, K.C.S. Data Control Limited.

Modern Alloys for Industrial Use Above 1200 Deg. F.:

J. P. Ogilvie, M.E.I.C., Shawinigan Chemicals Limited.

Mechanical Design and Equipment of Labatt Brewery, Montreal:

R. E. J. Layton, M.E.I.C., Chief Mechanical Engineer, T. Pringle and Sons Limited.

Moving-Bed Processes:

E. H. Lebeis, Catalytic Construction Company, Philadelphia, Pa.

Long Range Planning in an Atomic Age—Management Panel Discussion:

Chairman, L. F. Urwick, C.I.Mech.E., Management Consultant.

Mass Transportation in Cities—A Traffic Panel Discussion:

Chairman, George S. Mooney, Director of St. Lawrence Municipal Bureau.

Special Lecture:

Production Engineering Research in Britain:

D. F. Galloway, M.I.Mech.E., Director, Production Engineering, Research Association, Melton-Mowbray, England.

Chairman: J. W. Barker, Mem. ASME, President, American Society of Mechanical Engineers.

SPECIAL VISIT

On Thursday afternoon, 24 May, there will be an exceptionally interesting visit to the Canadair plant, at Cartierville, where open house will be held for inspection of aircraft and production facilities. An air show, in which the R.C.A.F. will also take part, will highlight the occasion.

Report of Council

FOR THE YEAR

1955

Together with Committee and Branch Reports

In Times like these it is to be expected that any organization will show from year to year an increase in activities and an improvement in finances. So it is with the Institute again for 1955.

The "vital statistics" shown herein, indicate a substantial increase in membership, the total being for the first time in excess of 16,000. The strength of the Institute financially has been increased substantially by a great number of transfers to senior classifications. The loss of members by death is still a substantial figure, but this is not surprising in view of the large membership, and the increasing years of the society.

It is surprising to see the number of new applications that are required to offset the losses through resignations, removals and deaths. It is surprising too to see the number who are leaving Canada to take up residence elsewhere. Many of these are senior men who have retired and are moving to a more equitable climate. In the light of these things it is hoped the branches will continue and even expand their efforts towards getting new members.

The Institute has had a good year—perhaps the best in its history, but these results are but a spur to greater achievements in 1956.

BRANCH VISITS

The president, like his predecessor, Dr. D. M. Stephens, did not plan to visit every branch. However as it worked out he did visit 36 out 47, which is substantially more than the 50 per cent basis upon which presidents are now supposed to be working.

On top of this he attended three meetings of American societies, at Boston, New York, and Chicago, and the annual meeting of Engineers' Council for Professional Development at Toronto. In October he flew to England at the invitation of the Institution of Mechanical Engineers to attend an international conference on power.

The office of president has required Dr. Heartz to be away from Montreal for approximately 120 days. Also there were many days, which although spent in Montreal, were spent on Institute business. A rough estimate of the distance covered by Dr. and Mrs. Heartz would be twenty-five thousand miles Truly the post of president of the Institute is no sinecure. It is perhaps the greatest tribute received by the Institute, that a member is willing to make such sacrifices in the interest of the society.

CONFEDERATION

This subject continued to be one of the most interesting before the Institute and the membership. Considerable progress was made by each committee, and at a meeting of both committees. Negotiations and discussions are still being pursued actively, and the farther these go, the more encouraging the picture becomes. It is hoped that shortly an informative report can be made that will indicate specifically the progress that has been made. It is not possible to make an interim report inasmuch as no decisions can be final until all or nearly all points are settled.

However it is clear that real progress has been made, and that the road to confederation has been traversed for a great portion of its length and over many of its rough spots.

PROPAGANDA

During the year a new pamphlet was issued and distributed for the attention of students. It is called "So you're going to be an Engineer". It told of the advantages there were in the Institute for students and young engineers.

Another membership pamphlet was prepared during the year. but it was not ready in time to go to the printers by the end of the year. It will be distributed early in 1956. Its contents are in the form of twenty-five answers to the question — "Why should I belong to the Institute?" It is hoped this publication will meet the need so often expressed by branch officers, for background material useful in recruiting new members.

TECHNICAL ACTIVITIES

Much thought has been given to expanding the amount of technical material brought to the attention of members. Council has before it, proposals for setting up groups at the branch and at the national level, who will give leadership in a program of activities that will enlarge substantially the technical content of branch and Institute programs.

Such a development is now needed because of the great increase in highly technical matters in several fields such as electronics, nucleonics and aeronautics.

It is expected that the proposed action will result in an increase in the number of branches with technical divisions. Already some branches are canvassing their members to see if and how they would like to set up one or more such divisions. Council looks upon this development as being of vital importance and has authorized the addition of a department at Headquarters to assist the branches in proceeding along these lines. It is likely the year 1956 will see a lot accomplished in this field.

FILMS

The reception given the film Leonardo da Vinci would seem to suggest that branches would welcome more material of this kind. Since the Fall programs of the branches have been underway, all four copies of Leonardo have been almost continuously "on the road".

Many branches have arranged to have the film shown to audiences other than their own, such as universities, high schools, libraries, service clubs, women's clubs, church groups, boys' clubs and so on. As the main purpose in purchasing the film was to give the public some idea of the origin of engineering, thereby increasing their appreciation of the profession, it is gratifying to see such a broad distribution being made.

LIFE MEMBERS

The number of Members now free of dues, because of their long membership, totals 640 as of the end of 1955. These "seniors" have an organization of their own through which they raise a substantial amount of money each year to do things for the Institute. Already they have helped materially in sharing the cost of the Leonardo da Vinci film. The group in the Montreal area meet together from time to time to renew old friendships and to discuss ways and means of helping the Institute.

REPORTS

Most of the activities of the Institute are covered by the annual reports of committees and departments of Headquarters, which are an important part of this overall report. Members are urged to read them as they are one of the best means of acquiring a good knowledge of what the Institute has accomplished in 1955.

REPORT OF THE FIELD SECRETARY

During the year the field secretary has met the executives and special committees of the following branches: Brockville, Calgary, Edmonton, Hamilton, Huronia, Kingston, Kitchener, Kootenay, Lakehead, London, Nipissing and Upper Ottawa, Niagara Peninsula, North Eastern Ontario, Port Hope, Saskatchewan, Sault Ste. Marie, Sudbury, Toronto, Vancouver, Victoria, Whitehorse and Winnipeg; and orphan groups at: Brandon and Flin Flon (Manitoba), Prince Albert and Saskatoon (Saskatchewan), Medicine Hat (Alberta), Kitimat, Ocean Falls, Port Alberni, Prince George and Prince Rupert (British Columbia) and in Ontario: Barrie, Collingwood, Gravenhurst, Huntsville, Marathon, Meaford, Midland, Nobel, Owen Sound, Penetang, Red Rock, Temiskaming and Terrace Bay.

The field office was in touch with the nine Professional Development Courses operated during 1955, at the following branches: Belleville, Halifax, Hamilton, Kootenay, Saguenay, Saskatoon, Ottawa, Toronto and Winnipeg. In April, 28 representatives from six branches who were interested in Professional Development Courses in Ontario, met in Toronto and discussed plans for the coming season. The success of all courses depends upon the efforts of a few enthusiastic young men such as these. Total enrolment across Canada was close to 500, and the expense to the Institute was nil. The costs have been met by small fees from the members enrolled, donations from the branches concerned, and the personal generosity of a member of the Toronto branch.

In employment the field office has a record of 142 assisted during 1955, and we advised at least another 20 or 30 men whose names we did not list. We did not keep any record of numerous calls from employers. During the last three months of the year we did not have as many requests from newcomers to Canada, due to less immigration and to more positions being advertised in the daily papers.

This office has been impressed with the desire of many university students to meet informally with older men to talk over such matters as choice of openings after graduation and their future careers generally. Such requests seem to favour first a meeting with one or two engineers who have graduated within the last five years, after which they sometimes ask for another meeting with an older man. Groups should not be larger than a dozen, so that there is every opportunity for individuals to ask questions of the visitor. It is recommended that this form of counselling be considered by all branches in university towns where this is not already being done.

I take this opportunity of thanking the officers and executives of the branches for the warm welcome and hospitality which I have received.

L. F. Grant, hon. m.e.i.c.,
Field Secretary

ROLL OF THE INSTITUTE

The membership of all classifications now totals 16,070. New names added for the year amount to 1,272, but deaths, resignations and removals amounted to 473, making a net gain of 799.

During the year 1,195 candidates were elected. These were classified as follows: Members 253, Juniors 90, Students 850, Affiliates 2. Seventy-seven reinstatements were effected. Life Membership was conferred on eighty-three members under By-law 26.

Transfers from one grade to another were as follows: Junior to Member 286; Student to Member 3, Student to Junior 543, a total of 832.

Removals from the Roll

There have been removed from the roll during the year by resignation and for non-payment of fees: Members 164, Juniors 180, Students 43, Affiliates 2, a total of 389.

Deceased Members

During the year the deaths of 84 members of the Institute (including five Honorary Members) have been reported as follows:

Honorary Members

Allan, John Andrew
Grant, Alexander Joseph
Hungerford, Samuel James
Sexton, Frederic Henry
Wallace, Robert Charles

Members

Anglin, Douglas Gould
Balfour, Reginald Herbert
Beer, Alfred Netlam
Bissett, James Randolph
Bolger, Edmund Joseph
Boyle, Robert William
Brown, LeRoy
Brown, Rex L.
Butler, Ernest
Cameron, Norman Keith
Clarke, George Calbraith
Clarke, Wilfred Ernest
Clossey, Emile Guillaume
Cowie, Frederick William
Dickson, George Leslie
Donald, Alexander Stuart
Dyne, William John
Ellis, Douglas Stewart
Fife, Walter Maxwell
Finch, Gordon Holbrook
Fletcher, William Jessiman
Fowler, Frank Scott
Fox, Charles Harry
Gibeau, Henri Adelard
Gray, John James
Hawkins, Hubert John
Herr, Arthur George
Hewitt, Herbert Eugene
Hinton, Eric
Hopper, Alfred Edward
Hustwitt, Sydney Arthur
Hutchison, David
Jackson, Thomas Bell
James, Alan MacKenzie
Joncas, Joseph Pierre Paul
Kydd, George
Lake, Henry Morton
LeBel, Paul
LeBel, Raymond
Linney, John A.
Loane, George Herbert
Marble, William O.
Mattson, Ragnar John
Medlar, George Elmer
Merrett, Joseph Stephen
Morris, John William
Muntz, Eric Percival
Norvid-Neugebauer, Mieczyslaw Szczesny Kazimierz
Olesinski, Jozef Stanislaw
Patterson, Arthur L.
Philips, Hector Somerville
Pinhey, Charles H.
Quintal, Robert
Reid, John Alexander
Richards, Alan Paul
Rimmington, Harry Stanley
Rogers, Casimir S. G.
Ruddick, James
Rush, Walter Albert
Scales, William
Smith, John Archibald Lloyd
Storrie, William
Sutherland, Gordon Alexander
Talman, Stephen Goldwyer
Tanski, Jozef
Taylor, Bruce Smith
Troop, Stewart
Vaughan, Rupert Henry
Watson, Robert George
Wood, Charles Osborne

Juniors

Boucher, Jean-Paul
Crowell, Roy Basil
Heath, John Charles
Heine, Roland Wallace
Simola, Henry Oliver
Watson, Arthur John

Students

Bedell, Willet George
Day, Walter Marshall

Affiliate

Leigh-Mallory, George Edward

TOTAL MEMBERSHIP

	1954	1955
Honorary Members	33	32
Members	7,083	7,408
Juniors	5,735	5,938
Students	2,357	2,630
Affiliates	63	62
	15,271	16,070

Respectfully submitted on behalf of the Council—

R. E. Heartz, m.e.i.c.
President

L. Austin Wright, m.e.i.c.
General Secretary

REPORTS OF COMMITTEES

Admissions Committee

During 1955 the committee held eight meetings and examined 1,544 cases. These consisted of:

Applications for Admission ..	258
Applications for Transfer	238
Applications through Professional Associations:	
(a) Admissions	204
(b) Transfers	69
Student Applications	760
Special Cases	15
	1,544

In the report of Council will be found the number of members admitted to each class during the year.

E. D. Gray-Donald, M.E.I.C.,
Chairman

Canadian Chamber of Commerce

The undersigned, your representative on the Executive Council of the Canadian Chamber of Commerce for several years, wishes (prior to impending retirement from that post) to make several observations in addition to the usual report of the Executive Council's activities.

Your representative has learned during the past few years that, despite the tremendous growth of the Canadian Chamber of Commerce movement in this country, a considerable number of our engineers, particularly the younger ones, are unaware of the structure of the Chamber and its broad objectives. As Canada grows, the Chamber of Commerce grows, making its vigorous contribution to community, provincial and national progress. Canada being, in truth, an engineers' country and a country in which engineering activity continues apace, no engineer can ignore the work that is being carried on by the Chamber, indeed it is very much to his personal interest that he be well aware of it; the Chamber needs his support and, on analysis, it must be admitted that the engineers need the Chamber's support.

What is the Canadian Chamber of Commerce? It is the national federation of more than 730 Boards of Trade and Chambers of Commerce in all ten provinces, the Yukon and the North West Territories. The objectives of the Canadian Chamber include the stimulation and maintenance of a vigorous Canadian national sentiment; the promotion and co-operation among Boards of Trade and Chambers of Commerce, increasing their efficiency and extending their usefulness to all provinces; the development and presentation of an informal public opinion and the securing thereby of effective action by the national government upon questions relating to economic and public welfare; the support and development of the Canadian system of representative government; the preservation and further improvement of Canada's economic system, based upon private initiative and individual enterprise; and, finally, the maintenance of fair relations among labour, management and capital.

From the above it can be seen that this non-sectarian and politically non-partisan movement consists of a vast army of volunteers working together unselfishly for the general good. Because of this cellular structure it is equipped to present to governments at all levels the views and opinions of Canadians on all subjects affecting the economic and public welfare. Its record of achievement on the local, provincial and national levels merits the support of all engineers, indeed, all citizens who are interested in Canadian progress and development. It should be a matter of considerable satisfaction to engineers that many of the senior members of the profession are deeply interested in the movement generally, and actually from year to year are members of the Executive Council.

The activities of the Executive Council during the past year have, as in previous years, been widespread and have reached into all of the important phases of our national economy. Particular concern has been evinced about the effects of high taxes and government spending and it is in this field that the Chamber over the past year did an outstanding job. The Chamber continued to urge the kind of tax system which will encourage individual thrift and incentive and which will afford industry an opportunity to grow. Well in advance of "budget night" a Chamber delegation spent some time with Ministers of Finance and National Revenue presenting a set of public finance and taxation guide tests following weeks of documentation and careful study by a committee of experts. The brief strongly urged the government within the limits of its expenditure requirements to ease the heavy burden of taxation in those areas which would be most conducive to personal and corporate incentives.

Administration of the method of collection of sales tax is a matter of concern to the whole business community and it is interesting to note that the government recently set up a small committee of experts to review this question. This is also in line with a Chamber recommendation.

The Chamber also welcomes the setting up of an Estimates Committee to review estimates of government departments in advance of their being considered by Parliament.

Canada's biggest customer today is the United States and the Canadian Chamber is conscious of the fact that dependence on any one country for a major part of foreign sales is dangerous. Consequently, the Chamber feels that some effort should be made to keep Canadian exports in better balance between our two major customers, the U.S. and the U.K. This is one of the reasons behind the Canada and U.K. Committee, which held a meeting last June in England. Top Canadian and U.K. businessmen discussed such widely varying influences on trade between the two countries as convertibility, capital investment flow and imperial preferences.

Another important part of the work to increase selling opportunities abroad was a June meeting in Montreal with a group of Mexican business men. This was a follow-up of the Chamber Trade Mission to Mexico last year. Then, too, five directors of the Chamber participated in the bi-annual congress of the International Chamber of Commerce in Tokyo last May.

The Canadian economy is so dependent upon foreign trade and the engineering activity of this country is so bound up in the production of materials for export and the construction of plants in which these materials are produced, that such activities of the Chamber, as above described, should be a matter of vital interest to every engineer.

This report is the last of a series of yearly reports to be made by this representative. It has been a high privilege as well as a great pleasure and honour to have represented the Engineering Institute of Canada in the Councils of the Canadian Chamber.

J. B. Stirling, M.E.I.C.,
Institute Representative

Nominating Committee

Chairman ....(to be named)

Branch	*Representative*
Amherst	J. N. Ritchie
Belleville	C. R. Whittemore
Border Cities	C. G. R. Armstrong
Brockville	J. S. Waddington
Calgary	K. W. Mitchell
Cape Breton	G. W. Ross
Cent. Br. Columbia	R. L. Bigg
Corner Brook	H. B. Carter
Cornwall	B. T. Yates
Eastern Townships	Marcel Bourque
Edmonton	N. J. Allison
Fredericton	D. J. Brewer
Halifax	A. R. Harrington
Hamilton	N. A. Eager
Huronia	B. C. Lamble
Kingston	S. H. Rochester
Kitchener	A. J. Girdwood
Kootenay	W. K. Gwyer
Lakehead	W. Donald MacKinnon
Lethbridge	E. A. Lawrence
London	D. M. Jenkins
Lower St. Lawrence	Marcel Lanouette
Moncton	G. E. Franklin
Montreal	R. F. Shaw
Newfoundland	G. E. Knight
Niagara Peninsula	C. G. Cline
Nipissing and Upper Ottawa	J. Millar
North Nova Scotia	R. S. Morrow
North Eastern Ontario	C. R. McIntyre
Northern New Brunswick	G. P. Milton
Ottawa	T. Foulkes
Peterborough	B. Ottewell
Port Hope	W. S. Raynor
Prince Edward Island	E. K. MacNutt
Quebec	Jean St. Jacques
Saguenay	O. Gislason
Saint John	H. P. Lingley
St. Maurice Valley	A. H. Watier
Sarnia	J. W. Graeb
Saskatchewan	A. Tubby
Sault Ste. Marie	R. A. Campbell
Sudbury	R. L. Snitch
Toronto	C. D. Carruthers
Vancouver	W. O. Richmond
Vancouver Island	Jack Alton
Winnipeg	T. E. Storey
Yukon	H. L. Meuser

Board of Examiners

The Council of the Institute elected eight Members and three Juniors during the year 1955, subject to examination and while most of these were referred to their respective provincial bodies, the Board of Examiners after a careful review recommended the admission of two Members on the basis of oral examinations.

The Board also examined the curricula and examination standards of ten well known engineering schools in countries outside of Canada. All of these were found acceptable by our standards and recommendations were submitted to Council for their names to be added to the list of engineering schools recognized by Council.

J. L. de Stein, M.E.I.C.,
Chairman

Life Members' Committee

At the end of 1955 there were 640 Life Members. Of these 574 reside in Canada, 19 in the Commonwealth, 44 in the United States and three in foreign countries.

During the year 27 members died.

A "Life Members' Night" was held in February at headquarters. Light refreshments were served from 5.30 p.m. to 7.00, after which the film "Leonardo da Vinci" was shown. This film was purchased by voluntary contributions of the Life Members. A total of 60 were present. Consideration is being given to having another "Night" in March, 1956.

Voluntary contributions were continued, starting in September. At the end of the year the fund had been increased by $1,392. This money is to be used to establish an engineering film library. These films will be sent to branches as requested. Life Members will be notified of purchases as made.

J. A. Freeland, M.E.I.C.,
Secretary

Committee on Professional Interests

The main problem that this Committee dealt with during the year 1955-56 was that of unionization of engineers. No overall meetings of the Committee were held, but considerable correspondence was exchanged between the members and one meeting was held wherein as many members as possible, principally from Montreal, attended. The Committee does not feel that any particular report concerning the unionization of engineers can be drawn up at this time, but nevertheless it feels that a very careful and close watch on developments affecting the establishment of unions among engineers in Canada must be maintained. Your Committee has followed the literature published in various American journals and technical publications and in the newspapers concerning the developments in unionization of engineers in the United States. At the moment, there does not seem to be any great trend towards the unionization of engineers in Canada.

Late in the year, this Committee was requested to advise Council concerning the desirability of the presentation of a brief to the Royal Commission on the Economic Prospects of Canada. The Committee recommended to Council that the Engineering Institute of Canada should prepare a brief, but that the scope of the brief should be limited to the shortage of engineers in the profession.

E. B. Jubien, M.E.I.C.,
Chairman

Committee on the Training and Welfare of the Young Engineer

The formation and operation of Professional Development Courses for Junior members of the Institute continued during the year. Courses are presently active in the following Branches—Belleville, Halifax, Hamilton, Kootenay (Trail), London, Ottawa, Saguenay (Arvida), Saskatchewan (Saskatoon), Toronto and Winnipeg. Discussions relative to the setting up of further courses have been held in Kingston, Montreal, Niagara, Nipissing and Upper Ottawa, Orillia-Huronia.

Copies of the Minutes of the Third Annual Conference of Professional Development Courses held at Toronto on April 23, 1955, together with reports from the courses which operated during the 1954-55 season, were mailed last spring to all Branch secretaries with a letter of transmittal from Colonel Grant, field secretary. We hope the many copies thus distributed have been circulated among Junior members for the reports reveal the enthusiasm of young engineering graduates for the types of Professional Development Courses initiated in Canada during the past four years by Colonel Grant, immediate past-president of Engineers' Council for Professional Development, who has organized the whole of this work assisted by his secretary, Mrs. Lillian Robertson. We thank them heartily.

Committee members have collaborated in policy discussions during the year, however no recommendations for changes or additions were proposed. The committee's purpose is to continue to sponsor the formation of Professional Development Courses and Branch executives will be urged to approve the setting up of courses by Junior members in their respective communities on the pattern of the published reports mentioned above.

The following members resigned from the committee during the year: J. Benoit, J. N. Finlayson, R. DeL. French, and A. Jackson. We wish to record our sincere thanks for their loyal support during many years.

J. F. Muir was appointed a new member of the committee.

George B. Moxon, M.E.I.C.,
Chairman

Employment Service

To quote from last year's report "In general 1954 has been noteworthy, not only for the activity in the last few months, but also the promising outlook at the year end for 1955", the promising outlook was predicted correctly. The department listed approximately 550 vacancies, although only 125 known placements were made. Graduates were required in all branches of engineering. With the limited supply of candidates seeking a change of employment, the department was forced to depend on its advertising facilities for possible applications and with more prosperous employment conditions existing in The United Kingdom, employers were not able to count on this source of supply as in former years. The bulk of vacancies required the engineer with one to five years' experience. Although many listings did require senior engineers. Noteworthy was the increasing demand for civils for every type of construction project.

The department acknowledged 2,229 letters. However the greatest volume of correspondence received was in answer to the "Wanted Section". Some applicants were contacted by 30 or 40 employers over a period of one to two months.

Throughout the year the Employment Bulletin served its intended purpose. It brought to 1,600 employers and employees up-to-date employment information. However it should be noted that a number of applications received for vacancies were returned or readdressed to similar jobs, because the one applied for had been filled. The pages appearing in *The Engineering Journal* are printed directly from the employment bulletin and in most cases notification of the position being filled was received too late to delete it from the classified section. All information concerning new vacancies listed was also made available monthly to our Toronto Office.

As a result of the contact made with the department, a number of undergraduates found interesting summer employment. The bulk of vacancies received were from organizations located in Eastern Canada, therefore it was difficult to make successful contacts for young students not easily available for interview. The service will be maintained during 1956.

The department canvassed 1,000 employers of engineers in December 1955 to obtain, if possible, more precise information. To date approximately 400 have reported 550 unfilled jobs in 1955 due to a lack of available personnel. They hired 2,008 engineers in 1955, and anticipated hiring 2,922 engineers in 1956; of this number 1,395 will be recent graduates.

The shortage of engineering manpower continues with unfilled vacancies from 1955, augmented by new listings and anticipated needs for 1956.

(Miss) A. Summers,
Employment Service

Committee on Prairie Water Problems

Some 141,000 acres of additional land have been brought under irrigation on the St. Mary's Milk River project through the combined efforts of the Prairie Farm Rehabilitation Administration of the Federal Department of Agriculture and the Province of Alberta. The P.F.R.A. has continued its program of reconstruction, repair, and extension of the Bow River system, extending still further the acreage under irrigation.

The members of your Committee have been keeping in touch with the situation, but in view of the progress being made, and as no problems arose in which your Committee could be helpful, no meeting was held during 1955.

G. A. Gaherty, M.E.I.C.,
Chairman

Canadian Standards Association

The expectation voiced in the closing paragraphs of the 1954 Report has certainly been fulfilled during the year now coming to a close. 1955 has been a successful and busy year. A great many new standards have been published, several under the general heading of the Canadian Electrical Code, and others concerning a wide variety of subjects, such as plywood boxes, solid rivets, regulations for the inspection of boilers and pressure vessels, plastic floor tiles, etc. In addition to the standards actually published, there are a very large number under consideration and in various stages of development, so that at the moment. 11 are in the hands of the Technical Council, which under the new constitution, is the final authority for revision and approval previous to publication. There are 17 proposed standards which have reached the sectional committees, having been fully developed in working committees, and there are 12 others at present in the hands of the working committees and over 100 more in various preliminary stages ready for classification and for consideration by either specification committees or by those making the policy of the Association, that is to say, the board of directors and their executive committees.

There are at least ten new specifications that have been authorized by the Board and are at present being processed through the proper routine, and these cover such diverse subjects as venetian blinds, atmospheric pollution control, names for the pesticides, a brazing code, the marking and grading of lumber, linoleum products, both in sheet and tile form, identification systems for motor vehicle lighting, and so forth. The list, while not complete, will serve to emphasize the wide variety of subjects to which the Association now gives its careful attention.

This last year has been an election year for the Association's officers under the new constitution, and also for the managing boards of the subsidiary divisions of the Association, namely, that dealing with approvals and that dealing with welding. Our new president is J. S. Cameron, M.E.I.C., of the Northern Electric Company, Montreal, and the vice-presidents are Dr. J. M. Thompson, M.E.I.C., of Ferranti Electric Company, Limited, of Toronto, and R. S. Eadie, M.E.I.C., vice-president of the Dominion Bridge Company, Montreal.

One noteworthy event of the year has been the award to James C. Morrow, M.B.E., past-president of the Association for many years, by the American Standards Association in recognition of his service in the general field of industrial standardization. The Association has increased its activities during the year in the international field, both as a member body of the International Standards Organization, and as the Canadian unit in the International Electrotechnical Commission. Increased interest has been taken in the technical committees of these bodies, so that the Canadian Standards Association will be all the more widely recognized.

During the 12 months period, the board of directors have met five times, but the various working or specification committees have held a very large number of sessions at which the real production work has been carried out. Other committees, such as the sectional committees and the Technical Council, have provided their services by review and criticism, and finally by voting as to the acceptability of the drafts and their readiness for publication.

The new approvals laboratories outside of Toronto, which were opened in 1954, have settled down to business and have been fully occupied during the year in all the various branches. The new facilities and the additional equipment are appreciated by all concerned.

The general financial situation of the Association is very satisfactory, the head office and each of the subsidiary divisions having been operated successfully from every point of view. It can be truly stated that the Association continues to serve usefully, both Canadian industry and the general public in the matter of testing, certificating and specification, with a view to achieving maximum safety in the installation and use of all electrical equipment and devices, as well as other systems and materials, methods and conveniences which lend themselves to the general policy of simplification and economy through standardization.

P. L. Pratley, M.E.I.C.,
Institute Representative

Library Report 1955

Once again there has been a general increase in most phases of the library's activities. Over 6,000 people made use of the library facilities during the year. All enquiries, especially those received in the mail, are handled as quickly as possible, but members are asked to give as much information as they can when placing requests so as to avoid delay.

Some 3,000 items were circulated outside the library, and 5,000 used in the reading room. Many libraries in the Montreal area made use of our facilities, borrowing almost 700 items. Requests were also received from many parts of Canada and the United States.

The library continues to order books for members, and to place subscriptions for publications of other engineering societies. In all, over 500 orders were filled.

During the year 357 books having a value of $2,600 were received for review, and 64 were purchased. Members of the library staff wrote 257 reviews for inclusion in the Library Notes section of *The Engineering Journal*, while the remainder were provided by the Engineering Societies Library in New York. Short reviews of Canadian, British and United States standards were also published. The library contains a complete set of Canadian standards, which may be purchased through the library.

The library now receives regularly over 500 periodicals in engineering and allied fields, many coming in exchange for *The Engineering Journal*. The value of material received on exchange now totals nearly $1,000.

In December it was decided by Council that various changes would be made in the library regulations to take effect January 1, 1956. The most important of these was the abolition of the $5.00 deposit which had previously been required before books could be borrowed from the library. In addition, members now are required to pay return postage charges only, and not both ways as previously. It is hoped that these changes will render use of the library easier for all concerned, and that more members will make use of the unique facilities which are provided for their convenience.

(Miss) Shirley Courtis,
Librarian

Library and House Committee

Your Library and House Committee met once during the year, on December 13, 1955. It reviewed present library regulations covering the loan of books and periodicals to members. As a result of its deliberations, the Committee recommended to Council new library regulations, with the expectation if Council saw fit these might be adopted at the beginning of 1956.

F. L. Lawton, M.E.I.C.,
Chairman

Papers Committee

Working in co-operatioan with the headquarters staff this Committee has the specific purpose of arranging for suitable papers for presentation at the seventieth annual general and professional meeting of the Institute to be held in Montreal in May, 1956.

Members of the Institute were advised by Council in the November, 1955 issue of *The Engineering Journal* that the Committee would welcome worthwhile papers for consideration in the annual meeting program. In addition to these, the Committee also considered proposals by members of the Committee, and by the headquarters staff who are in close contact during the year with authors and who are conversant with topics specially in demand.

Since the 1956 annual meeting is scheduled to take place in Montreal, it was felt that a fair proportion of the papers should be of particular interest to members in the Quebec area. Some valuable suggestions in this connection were presented by the Toronto member, W. H. Paterson.

The Committee met four times between November 2, 1955 and January 18, 1956, making its report to Council on January 20, 1956. In this report a program of 33 papers and two panel discussions was recommended. The recommendation was approved by Council at its Montreal meeting on January 27, 1956.

This year the Committee succeeded in arranging the program earlier than in previous years so that manuscripts could be made available to headquarters staff in sufficient time to facilitate arrangements for discussion, and for publication.

W. H. Gauvin, M.E.I.C.,
Chairman

Publications Committee

The year 1955 was the thirty-seventh of publication of *The Engineering Journal*. Over 202,000 copies were printed and the average monthly circulation was 16,497, the highest comparable figures to date.

Reading material totalled 1,261 pages, a monthly average of 105, and technical papers occupied 476 pages, an average of 40 a month.

The ratio of technical and other editorial material to advertising space increased to 54:46, contrary to the usual prevalence of a minority of editorial matter in most Canadian technical publications.

The 75 technical papers published dealt with some 36 different subjects or fields of industry. A further analysis shows the following divisions.

	No. of Papers	Number[1] %	Pages[2] %
Chemical	8	10.7	9.4
Civil	22	29.3	25.3
Electrical	10	13.3	13.2
Mechanical	12	16.0	24.4
Mining	2	2.7	4.5
Miscellaneous	21	28.0	23.2

(1) Per cent of total papers.
(2) Per cent, by length, of total pages.

The committee extend their thanks and appreciation to all authors, correspondents, and advertisers.

The interest shown in the technical papers is reflected in the total of 25,200 reprints ordered, an increase over the previous year of over 18 per cent.

The policy of building an adequate reserve of technical papers has been continued, and articles on subjects of particular topical interest will be commissioned as necessary to maintain a wide editorial coverage.

Many papers were read during the year on various aspects of nuclear energy, and your Publications Committee recommended a policy of covering this subject, particularly the production of power from nuclear energy, by a logical series of papers that should follow the major developments in the field without undue repetition.

The increase in general reading material is partly due to the introduction, in January, of a regular monthly section on the progress of the St. Lawrence Seaway and Power Project. Abstracts of engineering literature were also continued, and 65 abstracts (60 pages) were published. It is proposed to widen the scope of these abstracts still further by careful selection and control of length.

In June the editorial staff was augmented by the appointment of P. C. Bell as technical editor.

The findings of the sub-committee formed to study the advisability of publishing transactions are being correlated at headquarters and will be presented as soon as the work is complete.

The factors involved in the publication of a membership directory will be the subject of a separate report by a special committee of Council appointed to investigate this subject.

Results of the readership survey, which was carried out over a twelve-month period, were gratifying and showed a 43 per cent return. This survey is to be extended for one additional year to obtain a broader comparative coverage.

In common with most Canadian publishers, the gross cost of publication increased slightly over that of the previous year. The average cost was 90.6 cents per copy or $10.87 per year per subscriber.

Five meetings were held during the year by your committee. All were well attended by its members and by headquarters staff.

G. N. Martin, M.E.I.C.
Chairman

Legislation Committee

No matters concerning legislation came to the attention of the committee during the year, and as a result it has nothing to report.

Jacques Benoit, M.E.I.C.,
Chairman

Membership Committee

This Committee reports to Council that it has not, as yet, found any new ways of increasing the membership that are more suitable than those presently employed. The suggested methods advanced by the Committee do not seem practical under present conditions and nothing new has come to its attention.

H. R. Sills, M.E.I.C.,
Chairman

Ontario Division

The Ontario Division held one general meeting in 1955 at the Prince George Hotel in Toronto on May 13. The 23 members present represented eight branches in Ontario.

The chairman, Dr. A. E. Berry of Toronto, briefly addressed the meeting outlining the functions of the Ontario Division, and stating that the main purpose of the meeting was to review the scope of activities and the future plan of operation.

In the general discussion which followed, the consensus of opinion was that, while there were no matters requiring active attention at the time, it was considered advisable to maintain the Ontario Division in its present form. The view was expressed that there should be available an organization to represent the Ontario branches in matters requiring collective action.

At this meeting it was moved by W. H. Paterson and seconded by S. Sillitoe that the present officers continue in office: Dr. A. E. Berry, chairman, G. R. Henderson, Sarnia, vice-chairman; Major General G. R. Turner, Ottawa, treasurer; and G. H. Rogers, Toronto, secretary.

G. H. Rogers, M.E.I.C.,
Secretary.

Finance Committee

This report refers only to the highlights of the financial situation of the Institute as the details are covered in the Treasurer's report. It is pleasing to note that revenues for the year were $496,820.34 and expenditures $488,875.34, giving a surplus of $7,944.89, which is sightly greater than the surplus in 1954.

A comparison of the financial position of the Institute at the end of 1955 with 1954 must take into account that a directory was issued in 1954 which increased revenues for that year by $23,428.84 and also increased expenditures by $44,961.81.

Additions were made to our reserve funds of approximately the same amount as in the previous year.

The cash in hand of the Institute builds up during the early months of the year due to incoming fees. The Committee has put these temporary surplus funds to work by investing them in short term interest-bearing debentures. Any surplus funds for reserve have been invested as promptly as possible. This policy has resulted in an increase in our revenue from investments. All investments have been carefully reviewed by the Finance Committee after recommendations made to it by an Investment Sub-Committee.

Meetings have been held regularly to deal with financial matters and such other Institute affairs as are referred to them.

The Committee wishes to express its appreciation of the assistance of the General Secretary, the Chief Accountant and other members of the staff for their constant help in dealing with this phase of the Institute's activities.

R. L. Dunsmore, M.E.I.C.
Chairman

Treasurer's Report

It is a pleasure for your Treasurer to report that the finances of the Engineering Institute at the close of the fiscal year 1955 were in an excellent condition. Although the budgetted expense of operations was overrun slightly, the increase of revenue far exceeded this amount.

After paying all running expenses and setting aside all budgetted reserves, a surplus of about $8,000.00 is shown.

During the year there was added to the investment portfolio an amount of $54,716.50 consisting of high grade government and industrial bonds. This brings the total of our investments up to $192,375.80. An amount of $25,000.00 was also placed on call loan with the National Trust Company which is shown in our statement as Cash in Bank.

E. V. Gage, M.E.I.C.,
Treasurer.

The annual comparative statements of revenue and expenditure, and of assets and liabilities, are presented on the following pages.

Comparative Statement of

Revenue and Expenditure

Year ended December 31

REVENUE

	1955	1954
Membership Fees:		
Arrears	$ 8,124.25	$ 6,958.66
Current*	183,092.09	180,667.08
Advance	860.27	566.37
Entrance	2,428.46	6,931.56
	$194,505.07	$195,123.67
Publications:		
Journal sales	3,306,55	220.50
Journal advertising	290,769.29	295,856.82
Directory advertising	—	23,428.84
	$294,075.84	$319,506.16
Income from Investments	4,152.35	3,134.34
Refund of Hall Expense	3,863.50	2,488.50
Sundry Revenue	223.47	111.17
	$496,820.23	$520,363.84

*Membership fees include *Journal* subscriptions.

EXPENDITURE

	1955	1954
Building Expense:		
Property and water taxes	$ 2,560.73	$ 1,592.20
Fuel	1,153.05	1,047.91
Insurance	627.56	606.36
Light, gas and power	797.50	733.63
Caretaker's wages and services	1,924.70	1,950.00
Maintenance, alterations and repairs	1,810.44	1,518.09
	$ 8,873.98	$ 7,448.19
Publications:		
Salaries	32,717.91	30,104.71
Printing and sundry expense	150,454.46	144,605.55
Advertising commission	72,664.07	74,638.75
Directory expense	—	44,961.81
	$255,836.44	$294,310.82
Office Expense:		
Salaries	81,773.21	75,123.68
Telegrams and postage	4,521.57	4,445.58
Telephones	1,798.09	1,704.04
Office supplies and stationery	8,993.10	6,548.51
Audit and legal fees	620.00	500.00
Miscellaneous expense	8,630.76	5,128.70
Depreciation—furniture and fixtures	1,442.53	1,278.55
	$107,779.26	$ 94,729.06
General Expense:		
Students' conference	1,048.18	1,077.05
Council and annual meetings	6,474.47	5,091.24
Travelling	7,781.04	11,227.44
Institute prizes	567.91	464.71
Library salary and expense	10,892.43	8,583.04
Interest, discount and exchange	845.89	1,011.43
Committee expenses	1,533.97	1,017.71
Cost of membership in other societies	2,797.44	1,708.54
Sundry expense	1,361.50	1,415.68
Pension plan	4,623.58	4,875.63
	$ 37,926.41	$ 36,472.47
Rebates to Branches	27,423.58	27,273.78
Total Expenditure	437,839.67	460,234.32
Transferred to Reserve Funds:		
Building	27,000.00	24,000.00
Pension fund	10,000.00	10,000.00
Contingencies	5,000.00	8,000.00
Publications	8,035.67	10,000.00
Reserved for Bad Debts	1,000.00	1,000.00
Surplus Transferred to Surplus Account	7,944.89	7,129.52
	$496,820.23	$520,363.84

Comparative Statement of

Assets and Liabilities

December 31

ASSETS

		1955	1954
Current Assets:			
Cash on hand and in banks		$ 21,917.65	$ 10,751.50
Accounts receivable—less reserve		24,483.94	29,978.34
Arrears of fees—estimated		3,500.00	3,500.00
		$ 49,901.59	$ 44,229.84
Investments—at Cost:			
Property of The Engineering Institute of Canada		171,731.61	117,403.27
Property of special funds account —see contra (Approximate market value $203,142.00)		20,644.19	20,256.03
Sundry Advances		650.00	1,650.00
Deposit with Postmaster		500.00	500.00
Prepaid Insurance, Etc.		296.94	488.00
Library—nominal value		1.00	1.00
Furniture and Fixtures			
—at cost	$36,082.04		
less depreciation	23,099.27		
		12,982.77	11,506.94
Land and Building—book valuation		36,000.00	36,000.00
		$292,708.10	$232,035.08

LIABILITIES

		1955	1954
Current Liabilities:			
Accounts payable		$ 16,354.37	$ 14,050.07
		$ 16,354.37	$ 14,050.07
Special Funds:			
As per statement attached		20,644.19	20,256.03
Reserve Funds:			
Building		107,000.00	80,000.00
Building maintenance		1,500.00	1,500.00
Pension fund		30,366.50	20,366.50
Contingencies		18,000.00	13,000.00
Publications		22,000.00	13,964.33
Surplus Account:			
Balance as of December 31, 1954	$68,898.15		
Plus surplus for year as per statement attached.	7,944.89		
		76,843.04	68,898.15
		$292,708.10	$232,035.08

AUDITORS' CERTIFICATE

We have examined the statement of assets and liabilities of The Engineering Institute of Canada as of December 31, 1955 and the statement of revenue and expenditure for the year ended on that date and have obtained all the information and explanations we have required. Our examination included a general review of the accounting procedures and such tests of accounting records and other supporting evidence as we considered necessary in the circumstances.

In our opinion the above statement of assets and liabilities and accompanying statement of revenue and expenditure are properly drawn up so as to exhibit a true and correct view of the state of the affairs of the Institute at December 31, 1955 and the results of its operations for the year ended on that date, according to the best of our information and the explanations given to us and as shown by the books of the Institute.

PEAT, MARWICK, MITCHELL & CO.,
Chartered Accountants.

Montreal, Quebec, January 30, 1956.

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Reports from the Branches

For Membership and Financial Statements see pages 266-268

Belleville

During 1955 eight meetings were held, the minutes of which have been filed. Included among the eight meetings was the dinner arranged on the occasion of the President's visit to Belleville. During his visit, Dr. Stephens spoke on "Canada's Development and Handling of Resources". Among the subjects covered by the papers given during the year were "Instrumentation", "The Application of Electronics in the Toronto Stock Exchange", "Engineering Standards", "Pipe Organs", "Investments" and "Mineral Resources of Hastings County".

The October meeting took the form of a plant tour of the Canada Cement Company operations at Point Anne.

The second half of a Professional Development Course in business administration, consisting of a further 20 lectures sponsored by the Belleville Branch in co-operation with Queen's University, was held during the fall and winter of 1955. Approximately 50 people were enrolled in the course and attendance ran above 90 per cent on the average indicating its popularity.

The Branch sponsored a $25.00 prize to be given to the Grade XIII student at the Belleville Collegiate Institute and Vocational School who plans to take an engineering course and who had the highest standing in English, Algebra, Trigonometry, Geometry, Physics and Chemistry. This prize was won by Gary Hall and was presented by C. H. Lusk at the Commencement Exercises at the Collegiate on October 28.

Border Cities

Meetings were quite varied during the past year. Field trips were the most popular and therefore the best attended. Branch members toured the CKLW T.V. Station in January, and in February welcomed the president of the Institute on his visit in Chatham. Dr. A. E. Berry, sanitary engineer, was guest speaker at a dinner meeting in March; and R. N. Scott spoke on "The Port of Windsor and the St. Lawrence Seaway" at a dinner meeting in April. The last meeting before the summer months was a field trip through the Ford Motor Co. of Canada Ltd. engine plant.

In the fall the meetings began with a tour in September of the Canadian Rock Salt plant. This was followed by the annual dinner dance in October, and the showing of the Leonardo da Vinci film in November. The annual meeting took place in December.

The Ladies Auxiliary, with a membership of 94, has had a very successful year. The interest groups have progressed favourably and are accomplishing the goal of promoting friendship among members.

The Border Cities Branch has had active representation this year on the Senate of Assumption University, as well as on the Educational Council of Windsor. New representatives have been appointed to both of these offices.

Brockville

Nine meetings were held by the Brockville Branch during the year, including the annual meeting on December 8 1955.

On December 7, 1954, the annual meeting of the Branch was held in Prescott. The guest speaker on that occasion was Col. L. F. Grant, field secretary of the Institute.

The January, 1955 meeting took place at Phillips Electrical Co. Ltd. Dr. G. M. Mahoney of Montreal spoke on the place which psychology holds in industry. At the February meeting Dr. W. M. Campbell, director of the chemical engineering branch of Atomic Energy of Canada Ltd. discussed "The Chemical Factors in Atomic Power".

On March 10 Judge D. E. Lewis addressed the Branch members in Brockville on the subject "Town Planning"; and on April 19, R. W. Foster-Pegg of McGill University spoke to the Branch in Prescott on "Solid Fuel Turbines". At the May meeting in Brockville W. D. Sinclair of the paint and varnish division of Canadian Industries Limited discussed "Effective Use of Colour in the Home"; while at the September meeting Ian McNab of General Motors, Oshawa, addressed the meeting at the Maitland Works on "The Car of Tomorrow".

On October 15 Branch members and their families made a tour of the R.C.A. Victor radio and television plant in Prescott; and on December 1 they attended a showing of the "Leonardo da Vinci" film at the Maitland Works.

Calgary

The year 1955 was a very active one for the Branch. Eight evening meetings were held during the year, including a joint meeting with the Chemical Institute of Canada, and a joint dinner meeting with the Association of Professional Engineers of Alberta.

The annual smoker was held in the fall. As usual, this was a very informal get-together and was an excellent way to start the fall meetings rolling.

For the final meeting of the year the Branch was honoured by the visit of the presidential party, Dr. R. E. Heartz, Mrs. Heartz, and Dr. L. Austin Wright.

The annual "Slide Rule Soirée" was held again in February and was once again a tremendous success with about 330 in attendance. This annual dance has become one of the highlights of the activities with the members and their wives pooling their talents to put on a lively and amusing floor show.

The regular Monday luncheon meetings were as successful as ever with both interest and attendance at a high peak.

Cape Breton

During 1955 seven gatherings were held, four of which were regular dinner meetings in the Isle Royale Hotel in Sydney, N.S. The average attendance at the regular dinner meetings was approximately 35.

Highlighting the year's activities was the ladies' night on the occasion of the visit to the Branch in September of the president, Dr. R. E. Heartz. Accompanying the president were Mrs. Heartz, and the general secretary, Dr. L. Austin Wright. Unfortunately Dr. Heartz had to leave the meeting early to make flight connections.

In April the Branch was invited to a display performance by the local Reserve Army Engineers Corps, and was afterwards entertained in the officers' mess.

The annual lobster party was held in June and attended by 48 members and guests. Although the occasion was marred by poor weather, those who attended enjoyed themselves immensely and were grateful to the chairman, M. R. Campbell, for the use of his summer home.

At the first regular dinner meeting in March members heard an informative lecture on "T.V. Transmission and Reception" by R. J. Norton, chief engineer of T.V. station CJCB in Sydney, N.S.; while at the May meeting J. Russell, chief mechanical engineer of the Dominion Coal Company spoke on "The Dosco Downdraft Furnace". In November Mr. Hynes of E. W. Playford Limited, Montreal, addressed the Branch on "Industrial Applications of Electrical Heating". At the last meeting of the year H. N. Bacon spoke on "Segregation in Large Forging Ingots".

Central British Columbia

The Central British Columbia Branch covers the south central portion of British Columbia. Since the economy of the area is chiefly based on the primary industries such as agriculture, logging and mining, a large proportion of the Branch membership is engaged in fields of engineering connected with these industries.

There are four main centres of population within the area actively served by the Branch: Kamloops, Vernon, Kelowna and Penticton, and Branch meetings are rotated among these centres. The Branch also takes in a large area in north central British Columbia, but members in this area are not able to attend Branch meetings and are classed as non-resident members.

During 1955 five general meetings and four executive meetings were held with an average attendance at general meetings of betwen 25 and 30. All the meetings were dinner meetings and were held jointly with the Central British Columbia Branch of the British Columbia Engineering Society. In addition to Branch business, the meetings usually featured the presentation of a talk or film.

Cornwall

An attempt was made to diversify the type of meetings this past year. Meetings arranged included one luncheon meeting, a ladies' night, two buffet suppers, and full dinner meetings. Generally, this arrangement proved satisfactory with an average attendance of approximately 40 per cent of the total membership.

The membership of the Cornwall Branch has increased to 81 from the 1954 level of 53. This increase has been brought about mainly by the influx of engineers on the hydro development and by an increase in the number of Branch Affiliates.

High school students, expressing an interest in engineering as a profession, were permitted to accompany practising engineers on the job for one day to see for themselves what sort of work engineers do. Following this, special arrangements were made with the Hydro-Electric Power Commission for a tour of the power development site.

A committee has been established which has set up a bursary for high school students about to enter university. This is called the Colonel Magwood Bursary, and the administrating committee consists of D. Giles, T. Hawkes, W. Nesbit, and the Branch chairman. It is hoped that the first presentation of the bursary will be made in 1956.

The Cornwall Branch was invited to assist the Township of Cornwall in reconciling the many differences of opinion which arose from the necessity of relocating Highway 401 and the C.N.R. through-line. The Branch was able to make some contribution toward clarifying the situation.

Corner Brook

The year 1955 has not been a very active one for the Corner Brook Branch. Only one business meeting was held and that was not too well attended. We had one technical meeting when a paper on "Surveys of Power Potentials in Labrador" was presented by the late Eric Hinton, M.E.I.C. The meeting was well attended and thoroughly enjoyed by all present.

It is with regret that we have to record the death of Eric Hinton, one of the founders and the first chairman of this Branch. He was a great engineer, a fine citizen and a beloved friend.

On September 21, 1955 the Branch was honoured by a visit of the president, Dr. R. E. Heartz. Dr. Heartz was accompanied by his wife and the general secretary, Dr. Wright. Some 45 members, their wives and guests attended a dinner meeting at which Dr. Heartz was guest speaker. After the dinner the members and guests enjoyed a period of dancing. The visit was thoroughly enjoyed by all.

This Branch looks forward to a more active year in 1956.

Eastern Townships

The Eastern Townships Branch held eight meetings during the year 1955. The first meeting in January took the form of a tour to the St. Lawrence Corporation in East Angus in which 35 members participated. At the February meeting A. T. Roblin of Imperial Oil Co. Ltd. addressed a meeting of 40 on "The Future of the Oil Industry in Canada"; while at the March dinner meeting which was attended by 50 members Leo Roy of Hydro Quebec spoke on the Bersimis power development.

Two films were shown at the April meeting attended by 25 members. Both films, supplied by Canadian Ingersoll-Rand Co. Ltd. and International Harvester Co. Ltd. depicted engineering activities on the Kitimat project. The annual meeting took the form of a ladies' night which took place at Hovey Manor in North Hatley. Over 100 persons were present.

In October 30 members made a tour of the Lake Asbestos Corporation at Black Lake; and in November Lorne Wiggs, president of the Corporation of Professional Engineers of Quebec, addressed a joint dinner meeting of members of the Corporation and the Institute. Sixty-five were present on this occasion. At the December meeting 120 members and their ladies attended the showing of the "Leonardo da Vinci" film.

Edmonton

The Edmonton Branch held 14 activities during the year of 1955. These activities consisted of eight dinner meetings, three evening meetings at the University of Alberta and one plant tour; the average attendance of these twelve activities was 82. The two annual highlights of the year again took the form of the annual picnic where there were over 300 in attendance and the annual dance which had an attendance of 358.

Fredericton

Eight general meetings were held during the year. In February a joint dance was held with the University Student Engineering Society. In October a joint meeting was arranged with the Maine Section of the A.S.C.E. and was held at Loring Air Base, Limestone, Maine. Although a general meeting with the E.I.C. President was not possible, he did arrange to address the Student Society and have luncheon with the Branch Executive.

Total membership has increased during the past year.

Halifax

During the year several local speakers presented papers on subjects or projects of special interest in this area. There is room for some highly technical papers offering information helpful to engineers in local industry.

Meetings this year were held at various places throughout the city, rather than at a hotel exclusively. This variety in meeting places appeals to the membership.

There have been some resignations and a few removals due to non-payment of dues. Engineers in the Armed Services are increasing in number due to the greater technical nature of defence work. A closer liaison between these engineers and the Branch will doubtless stimulate interest in Branch membership.

A committee to establish by-laws or regulations to aid the Executive in carrying out its duties was formed. This committee, consisting of four members, was to submit its recommendations to the membership before the next annual meeting.

The year ended with finances in a good state. A budget was prepared during the year to serve as a guide in spending. Income was augmented by a surplus from the dance in honour of the president's visit.

The Engineers' Wives Association is well established. It is of great assistance in the social activities of the Branch which serve to maintain a high level of general interest among the members.

During the year a joint conference was held with some members of the Council of the Association of Professional Engineers in connection with public relations and publicity for the engineering profession in this area. This resulted in the formation of a committee under the chairmanship of R. F. McAlpine.

It is hoped that Confederation which is being given a good deal of study will come into being very soon. Fortunately, we have few, if any, differences to work out in this area with the Association.

Thanks are extended by the Branch to the various members of the Executive Committee for their fine co-operation this year, and particularly to executive members from out of town who attended most of the meetings. Special mention must be made of the work of the secretary-treasurer, W. D. Pippy, who revised the Branch files and methods to provide a better service for the members, and to the Branch news editor, F. H. Tremain, who handled all newspaper reporting and items for the Engineering Journal. The work of the various committees and their chairmen, and their assistance to the Branch and especially the Executive, is appreciated, as well as the help of the councillors and members who served with the Executive in an ex-officio capacity.

During the year 1955 the Professional Development Committee, in co-operation with St. Mary's University, sponsored a course in "Effective Public Speaking".

This course, which comprised a series of 12 lectures commencing on January 11 and concluding on March 29, had a total registration of 27 members. Although it was felt by the Committee that the type of course offered would prove to be quite popular with the members, average attendance throughout was approximately 70 per cent. However, this figure is partially offset by the fact that the weather on several lecture nights was extremely inclement, plus the additional reason that the particular work of some of the registrants from time to time required their absence from the city.

In summing up the Professional Development Course for 1955 there is every justification in stating that the course offered an excellent lecturer with first-class material which was presented with a good understanding of the group's immediate and future requirements.

Although it is realized that there are perhaps good reasons why the Branch should conduct its Professional Development Courses entirely as an E.I.C. membership group, it is felt at this time that there is too much to lose. Three or four years' experience in Professional Development work has indicated that by a large margin the courses most asked for are those covered by the broad subject of "Business Management". In our very first year of operation, when a series of lectures was held covering a variety of subjects, lectures dealing with Finance, Investment, etc., commanded the greatest interest by a wide margin.

For these reasons it is felt that by associating the Professional Development Course this year with St. Mary's the Branch may take advantage of the excellent opportunity afforded in their series, "Background for Investment". It is to be pointed out that some of the lecturers for this series will be men from other Canadian cities who would not normally be available to the Branch as an independent group.

Hamilton

During 1955 records show that Branch membership has increased slightly from 465 at December 31, 1954, to 474 at December 31, 1955. There was an increase in the Junior classification, but it is partially offset by decreases in Student and Member classifications.

Six meetings and a plant tour were held during the year and were well attended, with the exception of the November dinner meeting. It appears that Hamilton Branch dinner meetings other than the annual dinner meeting will not be successful either financially, technically, or socially, because of small attendance.

The Engineers' Ball held in October was again well attended and was financially successful in that the Branch almost broke even on it.

Seven committees deserve special mention this year: The Students' and Juniors' Papers Competition Committee was successful in providing an interesting Students and Juniors Night, with four contestants. The Ball Committee is to be congratulated for a very successful social function enjoyed by 186 couples. The Budget Committee produced a forecast which regulated spending and produced a surplus for the year's activities. The Professional Development Program Committee produced a very successful program attended by many Students, Juniors and Members, as well as by A.P.E.O. Members.

The Program Committee which arranged a very interesting and varied program of meetings and a field trip are to be congratulated for its work. The Technical Sections Committee is to be congratulated for its work in gathering information on the various Technical Sections operating in other Branches and for its work in preparing a questionnaire. The Attendance Committee is to be congratulated for reviving the Telephone Squad and obtaining attendance estimates for meetings. The Branch News Editor is to be congratulated for the excellent press, radio and T.V. coverage he has been successful in providing for the meetings.

The passing of H. S. Phillips and E. P. Muntz is here recorded with regret.

Kitchener

Membership in the Kitchener Branch has increased by ten per cent. Field trips create the most interest, along with good general technical papers on current engineering topics, such as the St. Lawrence Seaway project. The pattern of meetings has been fairly well established, and it is felt that this pattern will be adhered to for some time to come. Attendance at the general meetings has been quite gratifying, and if meetings continue to be of interest, attendance may be expected. Social functions have been quite successful.

Kitchener Branch members are keenly interested in the prospect of unification with the Association of Professional Engineers of Ontario and hope that it may be accomplished during 1956.

Kingston

The major activity for 1955 was a drive to enroll Queen's students in the Institute. This drive took the form of meetings with representatives of student societies, and also the writing and mailing of the pamphlet, "So You Want To Be An Engineer". As a result of this drive 94 Student Members were enrolled.

In addition, eight monthly meetings were held, the highlights being the annual general meeting in June and a joint dinner meeting with the Chemical Institute of Canada and the Kingston Metallurgical Society. Meetings were held at the R.C.E.M.E. School, The Royal Military College, and Queen's.

Kootenay

The 1955 activities of the Branch were highlighted by two plant tours; one through the Kaiser Aluminum Plants at Spokane, Washington; and the other, through the Canadian Pacific Railway Diesel Shops at Nelson, B.C.

The tour in Spokane started at 10 a.m. on April 16, 1955, at the Trentwood Rolling Mill Cafeteria where the members were welcomed by Marvin L. Lee, works manager, and shown a film "Take a Look at Tomorrow". The remaining part of the morning was spent in touring the rolling mill. At noon the members were guests of Kaiser Aluminum at a Luncheon in the Trentwood Cafeteria. After lunch, immediately leaving by car for the Mead Reduction Plant, members were again met by officials of Kaiser Aluminum, who conducted them through this part of their operations.

The members journeyed to Nelson by car, and were met at the C.P.R. station by George Fyke, divisional engineer, Canadian Pacific Railways, and W. S. Jackson, Nelson representative on the Branch Executive. The tour took in the various departments of the shops, and two of the huge diesel locomotives, which happened to be in the shops for routine maintenance checks. The tour was followed by dinner in the Round-Up Room at the Bus Depot, a short business meeting, and a talk by G. Fyke on the economic and engineering aspects of switching the Kettle Valley line from steam locomotive to diesel operation.

In addition to the above tours, a total of six regular dinner meetings, including one business meeting, and seven Executive meetings were held during the year.

The business meeting was a new venture, but judging by the attendance and interest shown, it will probably be a regular feature for the Branch, as it emphasized again that the members are vitally interested in the affairs of the Institute.

An advanced Professional Development Course was sponsored by the Branch for the first time. The course was a follow-up to earlier Professional Development Courses, and consisted of five meetings starting in October. Each meeting was devoted to a study of a case history in human relations, and proved very popular with those taking part.

While the Branch had a full and varied program, the members were, however, disappointed in not having a presidential visit this year, as it always seemed a fitting event to end a successful year.

Lakehead

During 1955 seven general meetings were held. The topics of addresses given covered a variety of subjects including the "Lakehead College of Arts and Science", "Cast Iron Pressure Pipe", and "The Influence of American Capital in Canada" and "Malting Processes". Two other meetings were cancelled due to weather conditions and will be held during 1956.

Professional Development Courses are still in the planning stage; however, they are due to start in the early part of 1956. Also group technical meetings in the electrical field are due to start in 1956 on a trial basis.

The Student Guidance Committee continued with programs similar to past years by giving papers and holding discussion periods with the High School students and the University students at the Lakehead Technical Institute.

Lethbridge

The Lethbridge Branch held during 1955 five regular meetings at which the average attendance was 40; two special meetings with an average attendance of 87; one field tour attended by 50; and six executive meetings with an average attendance of seven.

The year was highlighted by a joint meeting with the Montana Section of the American Society of Civil Engineers, and by a field trip to Calgary Power Limited Bearspaw Dam, a hydro-electric development near Calgary, and to the Imperial Oil Company's refinery at Calgary.

In April some 20 members of the Montana Section of A.S.C.E. from Great Falls, Billings, Helena, Missoula, and Tiber Dam, Montana, joined the Lethbridge Branch for a joint dinner meeting and ladies' night. Following the meeting a dance was held and the total attendance of 108 made it the largest Engineering Institute meeting held in Lethbridge in recent years at least. The following day the Montana engineers and members of the Branch visited St. Mary's Dam, a large irrigation reservoir and dam near Lethbridge which was constructed under P.F.R.A.

In September a number of the members and their wives visited two separate developments at Calgary. In the morning Calgary Power Limited conducted a tour of its hydro-electric generating station at Bearspaw which is at present the only large hydro development on the prairies of Southern Alberta. Following a luncheon provided by Calgary Power Limited, Imperial Oil Limited conducted a tour of its Calgary refinery. During both the April and September events the Branch was favoured by good weather.

A ladies' night was held in December. The attendance of 65 members and their wives during this busy season indicated the continuing popularity of these social, as well as cultural events.

Branch membership was reduced by some 11 members during 1955, due mainly to the transfer of P.F.R.A. personnel upon completion of certain projects in the Lethbridge district.

Lethbridge Branch meetings were all dinner meetings. Community singing and some special musical entertainment were provided at each meeting in addition to the main program. Mr. and Mrs. George Brown, who have been providing dinner music and accompaniment for the meetings for some 30 years, were again able to favour the Branch with their presence at every meeting during 1955.

Lower St. Lawrence

The Branch held three Executive meetings and four general meetings during the year.

On September 12 and 13 the President and Mrs. R. E. Heartz met the engineers of the Branch at two different meetings, one held at Seven Islands and one at Rimouski. Mr. and Mrs. Dunsmore, J. Martineau and the General Secretary accompanied the President to the meeting held at Rimouski. Mr. McLaren from Quebec City, our former president and Mrs. McLaren attended the meeting also. Refreshments were served at the Hotel St-Louis, followed by a banquet and a dance.

On November 29, the Branch members attended a presentation of four films loaned to the Branch by Georges Demers, M.E.I.C. These films were leased to Mr. Demers by "La Société des ingénieurs civils de France".

Moncton

During the year, a total of seven meetings, including the annual meeting, was held. On January 17, a paper on "Industrial Instruments" was read by Gordon Frey. "Civil Defence" was the subject of an address on March 21, given by Daniel Billing, co-ordinator of Civil Defence for the Moncton area.

Nomination of Branch officers took place at the meeting of April 18, and the annual meeting was held on May 16. M. E. Endicott spoke on "Oil Well Exploration in Albert County" on September 26. President R. E. Heartz and Mrs. Heartz and the general secretary, Dr. L. Austin Wright, were entertained by the Branch Executive and their wives on the evening of September 28.

"A survey of the Moncton Water Supply" was the subject of an address by William Godfrey on October 31. The final meeting of the year was held on November 21, and took the form of a mixed "Oyster Frolic". At this meeting the Leonardo Da Vinci film was shown.

Montreal

Program activity of the Montreal Branch has been held at a high level throughout the past year. Technical sections developed of recent years have maintained their vigour and individuality. Some 43 meetings have been held under the sponsorship of the various technical sections. The traditional program of Thursday night meetings devoted to the presentation of papers of broad interest was also maintained. Nineteen meetings of this nature were held.

The policy of maintaining close relations with Sister Societies by joint program activity with the corresponding Technical Section of the Program Committee was followed throughout the year. In addition E. R. Smallhorn was appointed by the Executive to represent the Branch on the local committee of the American Concrete Institute charged with the responsibility of arranging a regional meeting of that society in Montreal during 1956.

Branch membership now stands at 4,265, an increase of 116 over the previous year. This increase in membership is most gratifying. The Executive has been aware for some time, however, of a fall off in student enrolment and steps are being taken to offset it.

A consultatory panel for undergraduate engineers was established. The membership of this panel is made up of senior men in the engineering community who have indicated their willingness to provide advice and guidance on a private interview basis to those undergraduates who desire it. Approved procedures for judging undergraduate prizes and awards have been developed.

Three forums were held for high school graduating classes—one in English and two in French. A total of more than 600 students attended these meetings. In addition, career symposia speakers for Lower Canada College and Lachine High School were arranged.

Assistance was afforded the Junior Section with their efforts to formalize their by-laws. The task has now been completed. The status of Ex-officio member of the Branch Executive has been extended to the chairman of the Junior Section, thereby establishing him as a voting member. One of the changes in the organization will be an increase in the number of Councillors from six to fifteen. This step is being taken with a view to providing more assistance in the organization of its many activities.

During the year a new method of handling publicity was organized. Observation of results achieved lead to the view that the use of a retained publicity man, as had been done in 1955, should not be continued. The new form of activity for the Publicity Committee consists of achieving direct contact with most of the local newspapers and of writing the press communiques themselves.

The continued growth of the Branch and increasing complexity of its activities have made it apparent that the practice of holding Executive meetings between the close of the business day and dinner do not provide sufficient time to deal with the agenda. The Executive now has dinner together once a month followed by a full evening meeting. The results have been most gratifying. Attendance has improved, full discussion leading to prompt decision has been made possible, and in consequence, pending items have been reduced to a minimum.

The Entertainment Committee, under the chairmanship of Leo Scharry, has continued its usual excellent and efficient work. Two hundred and seventeen guests attended the Annual Dinner Dance. The Oyster Party, held this year under the joint sponsorship of the Senior and Junior Sections, was a huge success. A pre-Christmas reception for the more than 100 members of the many committees of the Montreal Branch was given by the chairman of the Branch. The Entertainment Committee provided refreshments and food for several meetings of the Technical Sections throughout the year as well.

Nipissing and Upper Ottawa Branch

During the year 1955, the Nipissing and Upper Ottawa Branch held seven business meetings and two plant visits.

In May a tour was made of the R.C.A.F. Depot at North Bay, where the members were shown what Canada has in the way of air defence, the CF-100 fighter. In October the Branch paid a visit to the newly completed Otto Holden Generating Station (La Cave) at Mattawa. For those who are not employed by the Ontario Hydro it was very interesting and instructional.

The only other meeting worthy of note was the Students' Night. In March the Branch invited as guests the district high school students who indicated that they were potential engineers. During the evening several speakers outlined the various aspects of engineering and helped those students with their decision. It was felt that this should be an annual Branch affair.

The Branch is looking forward to a good year in 1956. There are prospective members in view. Meetings are becoming of considerable value to the members.

Niagara Peninsula

During the year eight general meetings were held. In January at the evening meeting in Niagara Falls, Charles Eder of General Motors, Oshawa, presented two films, "Look of Things", depicting the styling and designing of automobiles, and "Sand and Flame", illustrating the manufacture of glass. Mr. Eder discussed these films and other aspects of automotive design.

The March meeting took the form of a dinner meeting in Niagara Falls. The guest speaker was Jasper H. Ings who showed colour films taken during the time he was in Pakistan for H. G. Acres and Co. Ltd. In April the members were conducted on a tour through Horton Steel Works Ltd. in Fort Erie. After dinner they enjoyed an illustrated talk by C. A. McDonald. Interesting points of design with regard to flat bottom tanks, overhead tanks, and pressure vessels were discussed.

A dinner meeting was arranged in May in Niagara Falls. This was the annual meeting and Ladies' Night at which Mrs. Hazel Hardstone of T. Eaton Co. Ltd. spoke of the history and manufacture of chinaware. She brought with her a wide selection of china to illustrate the various types available throughout the world. In September an evening tour was arranged through the plant of Provincial Engineering Ltd. in Niagara Falls. Fabrication and hot dip galvanizing of steel transmission towers, T.V. towers and sub-stations were in progress. D. A. Barnum afterwards discussed the various aspects of the design and manufacture of the above products.

The October meeting took the form of a tour through the Port Colborne plant of Canada Cement Co. Ltd. After dinner in the plant cafeteria members were able to discuss points of interest with J. B. Hanly, plant manager, and with representatives from the technical sales division. A joint dinner meeting with the Niagara Chapter of the Association of Professional Engineers of Ontario was held in St. Catharines in November. A panel, including eight members of the Planning Board of the City of St. Catharines Planning Area, discussed various phases of town planning.

A joint meeting of the Hamilton, Kitchener, and Niagara Peninsula Branches was arranged at Hamilton to meet the president of the Institute on February 25. The Niagara branches of the Association of Professional Engineers and the Engineering Institute sponsored their second annual Engineers' Ball on October 7. It was a successful event.

Northern New Brunswick

The year 1955 can be expressed as successful for the Northern New Brunswick Branch. A total of eight meetings were held, five general and three executive with an average attendance of about 50 per cent. Membership, however, has shown a drop from a total of 71 to a total of 64, although it is believed that nearly 100 per cent of the eligible engineers in the area belong to the Engineering Institute.

The first general meeting of the year was held in Campbellton on March 11. Two speakers were heard during the evening, both Members of this Branch. The first was A. R. Bonnell, whose paper was entitled "Some Problems of Highway Design in the Province of New Brunswick". Following a discussion period, the second speaker, J. O. Flower, spoke on "The Care and Breeding of Tropical Fish"; this topic was also followed by an informative discussion.

The next meeting was held in Bathurst on April 29. At the conclusion of a short business meeting the members then joined invited guests at the showing of the film, "Leonardo da Vinci".

The Annual Meeting of the Branch, a "Ladies' Night", was held at Kent Lodge in Bathurst during the evening of June 11. This was a dinner meeting with a brief business session including the installation of new officers. The guest speaker, A. M. Glendenning, mine superintendent of Brunswick Mining and Smelting Corporation Limited, gave a detailed description of his Company's operations and future plans in the Bathurst area. A dance followed the dinner to complete a very pleasant evening.

Branch activities resumed in the fall with the occasion of the visit to the Branch of the Institute president, Dr. R. E. Heartz, and the general secretary, Dr. L. Austin Wright. This also was a dinner meeting and a "Ladies' Night" which was concluded by a dance.

The final meeting of the year included an interesting tour of parts of the R.C.A.F. Station at Chatham on November 4. Permission for the members to visit the Station was kindly given by Group Captain M. E. Pollard, the Commanding Officer. Following the tour those attending gathered at the local Golf and Country Club for a general meeting.

Due to the distances between centres encompassed by this Branch and also due to the difficulties encountered in travelling during the winter months few activities beyond Branch meetings were attempted this past year. Interest in the Institute remains high, and it is expected that 1956 will be another successful year.

North Eastern Ontario

Four Branch meetings were held in the year. In January Mr. Swindon of Inter-County Gas Line, and Mr. Woods, of Conversion Surveys Limited, spoke to the group in Kapuskasing on the problem of distributing natural gas.

A special meeting was held in May to hear a report from Councillor C. W. Boast on the progress toward Confederation.

Mr. Fowler, an electrical engineer with extensive experience in India, spoke to a Branch meeting in Iroquois Falls on his experiences abroad.

The annual Branch meeting was held in Iroquois Falls on October 8, 1955. A. M. Lount, a consultant in pre-stressed reinforced concrete design, spoke to the group on the place of pre-stressed concrete and its advantages. Prior to the meeting the large ice area, using pre-stressed concrete members, was inspected.

The Western Section (Smooth Rock Falls, Cochrane, Kapuskasing) had a particularly active Professional Development Group. Courses included invention and public speaking. The latter course is continuing. Western Section meetings presented a talk on statistics by R. H. Stafford, and a discussion of the principles and application of fluid drives in industry. Of timely interest locally was a paper, "Method of Increasing Rainfall by the Use of Silver Iodide in Ground Generators", by B. A. Powers.

A membership spread out over many miles, and relative remoteness from a source of speakers qualified to talk on subjects of interest to the members as a whole, remain the two major problems besetting the Branch.

Ottawa

In reporting upon the work of the Branch during 1955, the Management Committee must first record, with unusual regret, the passing of the Secretary of the Branch, Gordon A. Sutherland on December 5. The year took also a heavy toll of more senior members including past-Chairman J. L. Rannie (1924), and R. W. Boyle (1935).

The Branch has had an active year of operation, having held 14 reasonably well attended meetings. With its total membership now approaching 1,000, the

BRANCHES	Amherst	Belleville	Border Cities	Brockville	Calgary	Cape Breton	Central British Columbia	Corner Brook	Cornwall	Eastern Townships	Edmonton	Fredericton	Halifax	Hamilton	Huronia
MEMBERSHIP															
Resident															
Hon. Members	..	2	5	..	..	.	..	..	..	..	3	..	1	4	..
Members	22	32	57	25	281	43	28	15	32	27	282	71	284	167	21
Juniors	7	24	95	15	168	16	16	13	23	35	271	25	76	233	35
Students	4	10	11	7	23	4	..	3	8	12	79	68	67	56	7
Affiliates	..	2	..	..	1	1	..	..	..	..	2	..	3	.	..
Total	33	70	168	47	473	64	44	31	63	74	637	164	431	460	63
Non-Resident															
Hon. Members		1	2	..	..		..	.		..	..	..	..	..	..
Members	1	4	15	4	15	5	5	3	2	29	28	21	50	1	..
Juniors	1	5	11	..	30	4	8	4	2	30	37	10	24	3	..
Students	.	7	5	.	8	..	2	1		8	6	7	14		..
Affiliates	.	.	..	.	..	.	1	..	.		..	..	..	1	..
Total	2	17	33	4	53	9	16	8	4	67	71	38	88	5	..
Grand Total Dec. 31st, 1955	35	87	201	51	526	73	60	39	67	141	708	202	519	465	63
" " Dec. 31st, 1954	35	83	191	69	517	85	54	46	53	155	702	190	504	465	70
Branch Affiliates, Dec. 31st, 1955	.	3	2	6	46	24	15	.	9	22	6	..		9	9
FINANCIAL STATEMENT															
Balance as of Dec. 31st, 1954	96.19	328.33	648.36	66.37	726.01	482.58	294.61	138.01	120.65	†583.08	1,555.32	377.88	858.71	308.11	361.19
Income															
Rebates from E.I.C. Hq.	72.85	252.90	544.50	202.90	351.27	57.00	172.80	121.20	245.70	439.80	297.60	379.10	300.46	982.44	140.40
Payments by Prof. Assns.	61.20	.	..		1,101.02	162.60		.	.	.	1,324.07	.	965.65		
Branch Affiliate Dues	..	102.00	.	67.49	492.00	210.00	107.10	.	32.00	193.10	88.00	.		76.00	47.00
Interest	..	..	.	..	39.40	..			..	5.62	14.11	..	6.00	62.07	
Miscellaneous	..	234.25	468.73	237.91	148.94	1,066.55	..	201.85	..	803.22	2.00	784.43	873.15	29.37	.
Total Income	134.05	589.15	1,013.23	508.30	2,132.63	1,496.15	279.90	323.05	277.70	1,441.74	1,725.78	1,163.53	2,145.26	1,149.88	187.40
Disbursements															
Printing, Notices, Postage(1)	17.15	121.35	210.44	9.20	775.31	43.85	22.20	10.00	37.56	73.46	1,048.08	61.61	453.36	383.41	30.29
General Meeting Expense(2)	20.00	184.75	229.70	320.50	261.10		73.15	20.00			69.00	600.00	924.84	133.52	24.00
Special Meeting Expense(3)	75.85	243.80	468.00	.	227.48	1,520.90	.	317.08	63.70	1,289.75	279.54	331.63		311.37	
Honorarium for Secretary	..	.	..	.	83.10	.		..	..	.	100.00	75.00	237.50	25.00	
Stenographic Service	10 00	..	25.00	..	..	..	5.00	6.00	..	..	10.00	4.00	124.51	25.00	
Travelling Expenses(4)		..	30.00	35.00	.		..		13.15	..	.	..	.	.	.
Subs. to other organizations				..	.	76.00	.	.	.	20.00				.	.
Subs. to *The Journal*		34.00	.	8.00	36.00	.	48.00		.	53.75	8.00		.	16.00	16.30
Special Expenses	..	..	70.30	..	..	.	5.00	.		161.90	220.25	1.96	24.13	100.00	.
Miscellaneous	..	32.36	.	28.05	66.50	13.92	..	2.00	8.80	6.90	16.80	52.73	195.14	59.05	..
Total Disbursements	113.00	616.26	1,033.44	400.75	1,449.49	1,654.67	153.35	355.08	123.21	1,605.76	1,751.67	1,126.93	1,959.48	1,053.35	70.59
Surplus or *Deficit*	21.05	*27.11*	*20.21*	107.55	683.14	*158.52*	126.55	*32.08*	154.49	*164.02*	*25.89*	36.60	185.78	96.53	116.81
Balance as of Dec. 31st, 1955	117.24	301.22	628.15	173.92	1,409.15	324.06	421.16	105.98	275.14	419.06	1,529.43	414.48	1,044.49	404.64	478.00

(1) Includes general printing, meeting notices, postage, telegraph, telephone and stationery.

(2) Includes rental of rooms, lanterns, operators, lantern slides and other expenses.

(3) Includes dinners, entertainments, social functions, and so forth. (4) Includes speakers, councillors or branch officers. †Adjusted to correct revision of 1953 figures.

the Branches as at December 31, 1955

Kingston	Kitchener	Kootenay	Lakehead	Lethbridge	London	Lower St. Lawrence	Moncton	Montreal	Newfoundland	Niagara Peninsula	Nipissing and Upper Ottawa	Northern Nova Scotia	Northern New Brunswick	North Eastern Ontario	Ottawa	Peterborough
														..		
3	..	.	.	..	..	..	..	6	.	11	..	..	..	..	3	1
62	33	23	42	31	88	19	41	1,832	39	100	21	35	27	25	386	62
50	44	22	38	12	75	43	19	1,198	32	118	13	14	31	37	214	61
93	8	5	9	1	11	18	13	998	21	14	..	8	6	3	230	8
..	..		4	..	1	1	1	15	.	2	..	..	..	..	3	1
208	85	50	93	44	175	81	74	4,049	92	245	34	58	64	65	836	133
	.	.		.	..	.	.	..	..	..	..	..	..	..	..	
	..	12	17	22	9		..	76	9	2	5	..	..	..	32	3
1	..	13	19	13	10	.	.	78	16	1	8	1	..	..	67	4
1	.	10	7	1	9		..	61	10	1	5	..	..	..	33	1
.			.					1	..	..	..	..	..	..	..	.
2		35	43	36	28			216	35	4	18	1	..	..	132	8
210	85	85	136	80	203	81	74	4,265	127	249	52	59	64	65	968	141
219	80	92	145	91	210	75	86	4,145*	123	268	54	60	71	69	889	137
9	5	16	2	51	..	1	5	16	..	2	3	..	..	..	6	1
522.23	119.39	334.05	368.13	364.84	560.27	240.07	798.43	10,062.02	299.76	998.63	217.85	136.29	203.47	349.51†	1,109.49	305.57
513.00	278.70	251.85	392.40	85.00	654.98	144.90	205.10	8,163.83	319.40	629.69	144.00	47.70	131.40	135.00	1,668.35	369.60
..		.	.	170.50		-	.	..	..	..	..	137.70	30.00	..	..	..
72.00	50.00	130.00	12.00	117.00	..		28.00	28.00	..	.	42.00	..	..	..	70.00	2.00
.	2.30	..	3.00	..		.	31.17	252.50	..	20.80	..	..	..	1.72	56.29	4.15
163.56	310.05	331.00	802.21	138.19	458.08	45.00	298.85	2,275.00	532.00	227.00	409.15	6.00	343.84	..	69.50	..
748.56	641.05	712.85	1,209.61	510.69	1,113.06	189.90	563.12	10,719.33	851.40	877.49	595.15	191.40	505.24	136.72	1,864.14	375.75
67.54	67.67	14.79	83.72	105.46	345.07	8.25	38.54	3,550.61	81.46	209.63	75.43	1.65	46.00	34.65	576.81	118.37
386.00	56.55	30.00	96.20	14.87	..	5.00	5.05	218.28	41.70	15.30	..	10.52	27.85	56.56	24.50	20.75
63.15	285.26	456.98	998.09	322.70	779.79	96.85	440.05	4,153.17	883.67	314.15	441.25	19.00	368.50	17.48	615.62	88.14
..	.	..	22.00	35.00	.	..	50.00	900.00	..	75.00	..	..	..	25.00	75.00	..
	15.00	.	..			26.20	..	..	..	10.00	7.50	6.45	..	4.00	.	..
.		..		..		..	..	..	..	..	..	..	..	..	..	.
	.	..	..			.	..	..	..		..	..	..	..	350.00	..
.	12.30	56.60	4.15	.		.	20.15	8.00	..	.	12.15	.	..	..	24.00	.
5.32	.	..	36.50	..	..	15.00	..	982.56	60.90	50.15	..	.	..	..	914.00	30.00
..	.60	..	8.25	53.56	14.02	..	23.40	726.20	24.88	22.46	..	11.60	2.16	5.66	23.30	1.60
522.01	437.38	558.37	1,248.91	531.59	1,138.88	151.30	577.19	10,538.82	1,092.61	696.69	536.33	49.22	444.51	143.35	2,603.23	258.86
226.55	203.67	154.48	*39.30*	*20.90*	*25.82*	38.60	*14.07*	180.51	*241.21*	180.80	58.82	142.18	60.73	*6.63*	*739.09*	116.89
748.78	323.06	488.53	328.83	343.94	534.45	278.67	784.36	10,242.53	58.55	1,179.43	276.67	278.47	264.20	342.88	370.40	422.46

* For voting purposes only, there should be added to Montreal Branch an additional 746 members, 411 resident in the United States, 241 in British possessions, and 94 in foreign countries.

† Adjusted to correct revision of 1954 figures.

BRANCHES	Port Hope	Prince Edward Island	Quebec	Saguenay	Saint John	St. Maurice Valley	Sarnia	Saskatchewan	Sault Ste. Marie	Sudbury	Toronto	Vancouver	Vancouver Island	Winnipeg	Yukon
MEMBERSHIP															
Resident															
Hon. Members	1	..	..	..	.	..	..	1	.	..	2	..	..	2	
Members	13	16	143	66	68	74	76	393	23	38	837	314	89	277	14
Juniors	7	10	177	64	17	99	81	60	13	36	726	209	32	206	8
Students	5	3	210	21	12	42	14	140	4	7	157	177	3	233	1
Affiliates	..	1	2	.	1	..	..	..	..	.	7	1	..	3	..
Total	26	30	532	151	98	215	171	594	40	81	1,729	701	124	721	23
Non-Resident															
Hon. Members	..	..	..	..	..	..	..	.	..	..	..	..	..	..	..
Members	..	1	8	1	5	6	..	9	4	5	21	28	19	23	2
Juniors	..	2	9	1	2	8	.	23	9	1	36	53	13	41	1
Students	.	1	15	2	4	3	..	11	6	.	5	7	7	15	..
Affiliates	.	..	..	..	..	..	.	2	.	..	.	..	..	..	..
Total	..	4	32	4	11	17	..	45	19	6	62	88	39	79	3
Grand Total Dec. 31st, 1955	26	34	564	155	109	232	171	639	59	87	1,791	789	163	800	26
" " Dec. 31st, 1954	24	31	558	145	107	231	168	550	55	73	1,853	809	181	706	24
Branch Affiliates, Dec. 31st, 1955	..	..	..	4	11	..	..	..	8	8	7	1	..	32	10
FINANCIAL STATEMENT															
Balance as of Dec. 31st, 1954	205.08	85.43	690.85	647.95	590.44	494.61	439.01	552.11	822.85	509.83	3,295.05	1,000.21	445.16	2,929.52	167.36
Income															
Rebates from E.I.C. Hq.	100.00	105.90	827.33	535.50	204.90	586.50	490.20	142.67	157.50	256.20	3,451.85	1,330.33	357.81	600.00	100.00
Payments by Prof. Assns.	..	.	.	62.53	94.00	.		1,021.30	.	..	32.30	.		784.65	
Branch Affiliate Dues	..	..		54.00	132.00	..			36.00	92.00	10.00	.		229.50	35.00
Interest	..	..		5.52	..	7.23		.	1.32	3.27	64.78	23.48	.	36.00	..
Miscellaneous	..	187.45	100.75	742.59	35.97	402.00	504.96		295.80	63.00	1,245.55	518.29		50.40	4.00
Total Income	100.00	293.35	928.08	1,400.14	466.87	995.73	995.16	1,163.97	490.62	414.47	4,804.48	1,872.10	357.81	1,700.55	139.00
Disbursements															
Printing, Notices, Postage(1)	.	12.63	245.95	22.43	96.83	177.69	4.08	82.89	60.51	92.52	1,631.36	312.03	67.15	600.29	5.60
General Meeting Expense(2)	.	.	10.95	191.63	.	38.63		558.50	294.75	80.50	180.49	193.70	18.75	200.72	46.82
Special Meeting Expense(3)	..	197.82	404.78	882.42	206.53	604.33	554.90	.	60.60	165.00	2,112.50	925.80	69.52	186.20	76.60
Honorarium for Secretary	.	..	150.00	60.00	75.00	20.00		120.00	50.00	.	100.00	105.00	50.00	150.00	.
Stenographic Service	..	..	50.00		30.00	.		50.00	25.00	..	304.00	25.00		80.75	
Travelling Expenses(4)	..	..	..	.	.	..	40.00	123.75	.	..		14.30	.	256.20	.
Subs. to other organizations	.	..	..	.		..	.					37.29		3.00	
Subs. to *The Journal*		..	..	14.97	32.00	..	..	..	12.00	28.45	8.00			160.00	4.00
Special Expenses	.	..	.	..	.	43.65	109.92	..	15.00	4.00		293.63	120.00	30.00	
Miscellaneous	2.55	1.40	20.30	.	3.15	..	..	86.16	46.99	10.15	217.38	2.60	5.41	33.93	6.09
Total Disbursements	2.55	211.85	881.98	1,171.45	443.51	884.30	708.90	1,021.30	564.85	380.62	4,553.73	1,909.35	330.83	1,701.09	139.11
Surplus or *Deficit*	97.45	81.50	46.10	228.69	23.36	111.43	286.26	142.67	*74.23*	33.85	250.75	*37.25*	26.98	*.54*	*.11*
Balance as of Dec. 31st, 1955	302.53	166.93	736.95	876.64	613.80	606.04	725.27	694.78	748.62	543.68	3,545.80	962.96	472.14	2,928.98	167.25

(1) Includes general printing, meeting notices, postage, telegraph, telephone and stationery.
(2) Includes rental of rooms, lanterns, operators, lantern slides and other expenses.
(3) Includes dinners, entertainments, social functions, and so forth.
(4) Includes speakers, councillors or branch officers.

Branch cannot regard with complete satisfaction the ratio of average attendance at meetings to total membership.

Recent steady development in the pattern of meetings continued, aided by advice received from a personal telephone canvass of members by the Management Committee. One luncheon meeting (following the long established tradition of such meetings), and one evening meeting each month appear to meet general wishes. The experiment of having the evening meetings as dinner meetings at the Assembly Hall is considered by the Committee to warrant further trial, despite initial financial loss, in view of the many favourable comments from members.

The interests of out-of-town members of the Branch received further attention during the year, under the guidance of the vice-chairman. An informal meeting was held with members in Hawkesbury, to mutual pleasure, on February 28. It was found that this was the first such E.I.C. meeting to have been held there for at least 20 years. A field trip to Hawkesbury followed later in the year.

The Management Committee has continued to follow with sympathetic interest and financial support the steady development of the Junior Section of the Branch. They commend the work of these younger members of the profession to those more senior. The chairman of the Junior Section accompanied the president of the Institute on his official visits to the University of Ottawa and to Carleton College, both speaking on these occasions to the student bodies.

Completion of the memorial to Colonel By, first suggested at the annual Branch meeting of 1954 by Major W. S. Lawson, was an important event in the Branch year. The memorial was unveiled in appropriate ceremonies on October 5 last which were well publicized at the time. The president of the Institute, Dr. R. E. Heartz (accompanied by the general secretary, Dr. L. A. Wright) kindly arranged to pay his official visit to the Branch in order to preside over these ceremonies, in keeping with the adoption of the memorial as a project of the Institute as a whole. The absence of the chairman of the Colonel By Memorial Committee, Dr. J. J. Green, was generally regretted.

Following suggestions from earlier annual meetings, co-operation with other engineering and allied societies in the Ottawa area was fostered during the year. Concrete evidence of this is the monthly Calendar of Scientific and Engineering Meetings now being published by the National Research Council on behalf of all such local societies, as part of an effort to co-ordinate meeting times and dates.

The support of the Branch was given to the Community Planning Association of Canada, in its move to establish a local group. S. G. Frost was asked to represent the Branch for this purpose.

The Management Committee has followed with close attention reports given to them upon the meetings of the Council of the Institute by the Councillors of the Branch. Ten meetings of the Council were held during 1955 (five in Montreal, two in Toronto and in Hamilton, Charlottetown and Winnipeg). Seventeen individual attendances were made by Branch councillors at these meetings. This is a notable record since total attendance of members of Council was only 172 for the ten meetings. This represented a considerable personal effort on the part of Ottawa Branch councillors. The Branch is greatly indebted to them.

B. G. Ballard continued his service to the Institute as vice-president. Because of his transfer to Washington, Dr. J. J. Green had to resign as one of the councillors; T. Foulkes was appointed to serve for this unexpired term and kindly agreed to this further service as a councillor. W. G. Pennock was appointed to the Papers Committee of the Institute.

The movement towards Confederation has been followed with most careful attention throughout the year by the Management Committee. The Branch is fortunate in having one of its members, T. Foulkes, as a member of the small Confederation Committee of the Institute. It is greatly to be hoped that this vitally important development moves steadily towards fruition during 1956.

Prince Edward Island

For the year 1955 nine meetings were held, five of which were dinner meetings with various types of programs. Except for one, these meetings were well attended. The poor attendance for the one meeting was due to travelling conditions.

During the year the principal matter under consideration was the establishment of a Provincial Association of Professional Engineers and considerable work was carried out in this regard relative to by-laws, procedure and the setting up of the necessary machinery in compliance with the legislation passed at the last sitting of the Provincial Legislature. For the first time a representative of this Province was requested to attend the Dominion Council of Professional Engineers which meeting was held at St. John's, Newfoundland. This Branch went on record as being very appreciative of the invitation tendered by Dominion Council and has profited much by the information gained in setting up their own Association of Professional Engineers.

The annual picnic was held as usual at the north shore and was the source of much amusement and pleasure. All who were in the province attended and a good time was had by the engineers, their wives, and children. A few of the more adventurous spirits took advantage of the opportunity to go swimming and returned just in time to consume in ample quantity the various forms of refreshments offered.

This Branch was indeed honoured in the annual visit of the president this year. The visit of Dr. Richard Heartz, M.E.I.C. a native of this Province, took place on September 16 with an almost one hundred per cent attendance of local members and a very considerable representation of Council members from other Provinces. Dr. Heartz gave a very enlightening and interesting talk on the need for more highly qualified engineers. This meeting took the form of our regular annual meeting and the ladies were in attendance.

The fall meetings centred around considerable discussion on how this Branch could best organize and set up complete co-ordination and joint meetings with the Association of Professional Engineers presently being constituted in this Province. As such a large amount of work has been done in this regard, at our recent meetings, there was little opportunity for the entertainment committee to provide programs. However, a very excellent picture illustrating the development of Kitimat was shown and thoroughly appreciated by all.

Peterborough

The Peterborough Branch held seven technical meetings during the 1955 season. In covering a variety of topics, the Branch was most fortunate in obtaining excellent speakers. The average meeting attendance was 43.

The social highlight of the season was the annual meeting in January which honoured the ladies of the Branch at a supper meeting and dance.

The summer outing was held at the summer home of D. A. Drynan at Stony Lake. The afternoon of sports was supplemented by entertainment as daring members tried their skill at water skiing.

The Branch extended a cash prize to students in each of the three city collegiates. These were merit awards to boys in subjects which included English and Science. It was felt that this token would serve to bring the Institute and the engineering profession before the student body and indicate those subjects vital to the profession.

Québec

Le Comité exécutif a tenu sept séances avec une assistance moyenne de huit pour disposer des opérations régulières de la section et étudier les questions d'intérêt local ou national pour l'Institut.

Au cours de l'année écoulée, le Comité exécutif a rétabli le Bal annuel de la section et celui-ci a eu lieu le 21 janvier 1955, au Château Frontenac. Il a remporté un franc succès; près de 300 personnes y assistaient et une atmosphère de franche gaieté et de courtoisie a existé durant la réception.

En février, le Comité exécutif a reçu officiellement le Docteur H. H. Burness et M. Hickle, d'Angleterre, venus au Canada pour présider au choix des boursiers Athlone à Laval.

Le Comité exécutif a eu au cours de l'année une communication du Conseil de l'Institut avisant que le terme de membres "Junior" de l'Institut a été porté à neuf ans au lieu de sept ans, sans frais de transfert, ou de huit à dix ans avec frais de transfert.

Le Comité exécutif a pris l'initiative de préparer et de présenter une requête au sept "grands wardens" de Sons of Martha pour obtenir l'établissement d'un camp à Québec. Sept members de notre section ont signé ladite requête et nous espérons obtenir une réponse favorable bientôt. Cela nous permettrait de tenir régulièrement, une ou deux fois l'an, la cérémonie d'initiation à Québec, sans recourir aux "Wardens" de Montréal.

Le Comité exécutif a obtenu de nouveau, cette année, un octroi de $1,000 du ministère provincial du Bien-Etre Social et de la Jeunesse afin de permettre la poursuite des cours avancés ou de perfectionnement en structure. Le Comité se permet de souligner ici l'empressement avec lequel le ministre Jean-Paul Sauvé a accueilli notre demande et se propose de souligner la précieuse collaboration de l'Honorable Sauvé plus tard.

Le programme des réunions générales, cette année, a été le suivant: 21 janvier, assemblée annuelle de la section et bal annuel de la section; 30 janvier, réception conjointe avec les Anciens de Polytechnique en l'honneur de MM. Ludger Gagnon et Henri Béique; 10-17 février, visite individuelle d'un entrepôt de A. Deslauriers et Fils avec charpente de bois lamellée; 10 mars, conférence de M. Henri Audet, ingénieur régional pour Québec de Radio-Canada sur la "Télévision au Canada". Les membres de la section de Québec de l'A.I.E.E., de l'I.R.E. et de la C.I.F. sont nos invités; 23 mars, représentation de films sur la fabrication de l'acier et conférence par M. Robert David, de C.I.S.C. sur la "Protection des bâtisses contre l'incendie et son influence sur les taux d'assurance" et "l'Insonorisation des bâtisses"; 26 mars, jitney mixte de curling pour architectes et ingénieurs et partie contestée entre les as du curling dans chacune des professions; 14 avril, conférence: "Vapeur Barrier" et "The Magic Marble", par M. K. D. Hutchison et R. M. McMay, de Fiberglass Canada Ltd.; 26 avril, les membres de E.I.C. sont les invités de l'American Society of Metals, section de Québec, à une conférence de M. L. D. Richardson de Eutectic Welding Alloys Corporation sur "New Welding Developments". Un film sur la soudure est également projeté; 17 août, tournoi de golf de la Construction organisé cette année par les ingénieurs de l'E.I.C., section de Québec; 12 septembre, tournoi annuel de golf de la section de Québec au Royal Quebec Golf Club; 17 octobre, ouverture des Cours de perfectionnement en structure; 22 novembre, présentation de films; 24-27 novembre, retraite fermée à Villa Manrèse pour Ingénieurs Professionnels et Ingénieurs forestiers; et 30 novembre, banquet aux huîtres aux Voûtes Talon.

Le Comité exécutif déplore la perte d'un membre distingué en la personne de M. Paul Joncas, ingénieur conseil et professeur à Laval. M. Joncas était reconnu par son intégrité et sa compétence.

Le Comité exécutif se plait à souligner les charges importantes que certains membres de notre section ont remplies dans différentes organisations professionnelles, politiques, publiques ou charitables de Québec. M. G. E. Sarault, président du Comité des paroisses pour la campagne 1955 de la Fédération des Oeuvres de Québec. Il a été choisi président général de la Campagne 1956. M. Guillaume Piette, président du Comité des noms réservés pour la Campagne 1955 de la Fédération des Oeuvres de Québec. M. Piette a également été élu président de l'Association Conservatrice du district de Québec. Il est représentant de la région de Québec à la Corporation des Ingénieurs. M. Georges Demers, président du Dominion Council of Professional Engineers pour l'année 1955. C'est le premier canadien-français à occuper cette charge.

Un nombre important de membres de notre section ont apporté une contribution active dans la campagne 1955 de la Fédération des Oeuvres de Québec au niveau des paroisses. Plusieurs également ont grandement contribué au succès du Carnaval d'Hiver de Québec 1955 et continuent cette contribution dans l'organisation du Carnaval 1956.

A ceux de nos membres qui ont obtenu des promotions au cours de l'année, nos plus sincères félicitations.

Votre Comité a tenu à souligner de façon particulière la participation de M. André Bertrand, membre étudiant de notre section, aux Olympiques d'hiver, division du ski, à Cortina, Italie. Un souvenir lui fut remis au cours du banquet aux huîtres, le 30 novembre. Le même soir, votre Comité a signalé les dix années de M. Roger Desjardins comme secrétaire de la section de Québec et un témoignage tangible lui fut également remis à cette occasion.

Saint John

During the year six dinner meetings and three Professional Development meetings were held affording members the opportunity of hearing interesting talks on a wide variety of subjects.

The joint dinner with the Association of Professional Engineers of the Province of New Brunswick was held on January 27 at which time Brig. J. R. B. Jones spoke on "The Military Engineer".

The "Ladies' Night" dinner meeting was held on March 24 when the special speaker was T. Rogerson of Simpson-Sears Ltd. The subject of his talk was "The Background and Approach to the Opening of a Modern Simpson-Sears Store in Saint John".

On April 19 Dr. I. R. Tait, vice-president of the Engineering Institute presented a talk on "Plastics"; and on May 10 B. W. Fleiger spoke on the spruce budworm spraying operation in New Brunswick.

A mixed dinner meeting was held in honour of the president, Dr. R. E. Heartz, on September 29. His talk emphasized the need for more engineers in Canada.

The annual meeting and election of officers took place December 13.

Professional Development Programs were held on March 10, October 25 and November 22, the subjects being "Mortgages Pertaining to Industry and Housing", "Why Do I Work", and "Industrial Relations and You". There was no definite enrolment for these courses but the average attendance was 23.

On February 23 a plant visit was made to Atlantic Sugar Refineries Ltd. and on October 13 members were conducted on a tour through the plants of Automatic Sprinkler Co., Ltd. and Eastward Industries Ltd.

Saguenay

Close co-operation between the Saguenay Branch and the local chapter of the Corporation of Professional Engineers of Quebec was continued during 1955, and the membership expressed their approval of this by again electing a joint executive.

Activities included two technical meetings, with refreshments served at the conclusion, one field trip to a modern bakery, two social evenings or dances and the annual meeting. The Junior Section was active and sponsored one technical meeting, a film night, and was responsible as well for the Professional Development activities in the region. These took the form of study groups which met every two weeks; eight members participated in a course on principles of investment, while seven followed a chemical engineering refresher course.

The Membership Committee was quite active and although a number of new members were obtained, a slight decline in Branch membership occurred due to transfers out of the region.

St. Maurice Valley

During the year the Branch continued to operate under a system whereby meetings of both the executive and membership were held alternately in Shawinigan Falls and Three Rivers. Notices of meetings were sent to all members of the Branch so that they had the opportunity of attending meetings in either centre. In all, seven events took place in Shawinigan Falls and five events in Three Rivers.

The program during 1955 included talks of an educational nature such as "Management Responsibilities", "I.B.M.'s Electronic Computing Machines", "Stocks and Bonds and Investment Principles", "Hamilton River Power Possibilities", "The Plant Publication", "The Erection of the Halifax-Dartmouth Suspension Bridge", and an address by Dr. L. A. Wright on the E.I.C.'s services to its members.

One program night consisted of films on "Stock Exchange Operation", "Development of the Jet Engine", "Fishing and the Atom". The last meeting of the year consisted of the showing of the film "Leonardo da Vinci".

The annual dinner meeting was held in Shawinigan Falls on May 4 and the guest speaker dealt with the topic "Recent Developments in the Metallurgical Industry in Canada".

During the month of June a dance was held in Three Rivers at the Radisson Canoe Club. The other event during the summer months consisted of a golf tournament and buffet dinner held jointly with the A.I.E.E. and the C.P.E.Q. in the Three Rivers district.

Sarnia

Membership in the Sarnia Branch is 165, a decrease of three from the 1954 total. Eleven meetings were held during 1955, the average attendance for dinner meetings being 50, while that for other meetings being 30.

The Branch held a dinner meeting at the Colonial Hotel on January 27 at which Dr. G. A. Sinclair of Imperial Oil Limited spoke on "The Contribution of Industrial Medicine to Industry". On February 24 members of the Sarnia, London and Border Cities Branch held a joint meeting in Chatham honouring the visit of the president, Dr. D. M. Stephens, who spoke on "Confederation". At the March dinner meeting at the Colonial Hotel the members heard J. J. Legate speak on "Building a Better Sarnia".

The Sarnia branch of the Chemical Institute of Canada organized a joint meeting with the members of the Engineering Institute in April; while the Junior members of the Branch organized a visit to Detroit and a tour of the Edison plant in May. In June Sarnia Branch members attended the Eighth Annual Convention of the Michigan Society, organized by the Port Huron Branch.

J. E. MacLaren of J. F. MacLaren and Associates addressed a dinner meeting at the Colonial Hotel on "Water and Sewer Problems as Related to City of Sarnia" on September 22; and the Institute film "Leonardo da Vinci" was shown to members at the Sarnia Collegiate Auditorium on October 13.

E. G. deWolfe of the Sifto Salt Company addressed a joint meeting of the Sarnia Branch and the Chemical Institute of Canada at the Vendome Hotel in October. His subject was "Mining and Manufacture of Salt". On November 22 Dr. P. L. Pratley, consulting engineer, spoke to a Branch dinner meeting at the Vendome Hotel on "Bridge Design and Construction".

The year's activities were concluded by the annual business meeting held at the Colonial Hotel. At this meeting the election of 1955-56 officers took place, and reports by the chairmen of the various committees were presented.

Saskatchewan

Eight Executive meetings and the annual meeting were held during the year for the transaction of Branch business.

Professor A. H. Douglas was appointed to the Institute Nominating Committee in January, representing the Saskatchewan Branch for 1955.

Col. L. F. Grant, field secretary, visited Branch Sections at Saskatoon, Prince Albert, and Regina. He was main speaker at the annual dinner in Regina on February 18.

At the annual meeting, the president of the Student Engineering Society recommended that W. E. Wickenden's "A Professional Guide for Junior Engineers" be presented to students entering the College of Engineering. The Executive approved of presenting each graduate student with a copy of the guide, at an appropriate time in the spring, and with a suitable talk by a senior practicing engineer.

John E. Campbell, engineering student at the University of Saskatchewan, attended the Student's Conference in Toronto, May 9 to 14, representing the University of Saskatchewan.

Professor J. B. Mantle, was nominated E.I.C. Councillor representing this Zone.

The E.I.C. Prize was awarded to Donald Grant Fisher for 1955 at the University of Saskatchewan.

The president of the Institute, Dr. R. E. Heartz, and general secretary, Dr. L. Austin Wright, were present at the November Executive meeting where they reported, among other things, that a new department was being set up at headquarters to promote the formation of technical sections; that the Institute was participating in the activities of he Canadian Committee on Engineers and Scientists on the matter of guidance work and the shortage of engineers.

Sault Ste. Marie

The annual meeting for 1954 was not held until January, 1955, and that for 1955 was held in December of the same year when the officers for 1956 were elected. The new slate is composed of younger members and it is hoped that the Branch will continue to thrive under them.

Every assistance was rendered by the executive committee but special mention should be made of Mr. Tooley, as secretary, and Mr. Snell who was in charge of the papers. The papers were extremely interesting and varied, and did much to increase the attendance over past years.

The visit from Colonel Grant was, as usual, interesting and informative, and was enjoyed by all. In addition to the annual meetings, there were six regular meetings. Walter Mulfler of Algoma Steel explained the operation and products of the new bar and strip and the cold mills at Algoma. Capt. Jackson of the U.S.A.F. Station at Kinross, Michigan, described the work of turbo-jet planes in the Northern Defence Scheme and a representative of the jet manufacturer told about the design and operation of the engine. H. D. Ellis of the Mackinac Bridge Authority described construction detail of the deep water piers to carry the new bridge across the Strait of Mackinac. Some extremely interesting and clever photographs were shown in connection with this talk. W. A. Sweetman of Fairbanks-Morse talked on abrasives, their design, construction and uses. K. M. Clarke of Algoma Steel described the many details in the planning, to produce steel products, from the making of iron to the finished shape. G. M. Stevens, general manager of Algom Uranium Mines, spoke on rock structure and the extent of the uranium ore field in the Quirke Lake area (Blind River). The average attendance for the above meetings was 22.

In May the Institute's film on Leonardo da Vinci was presented in the Sault Armoury theatre and was much appreciated by the 147 citizens and members who attended. A small profit was sent to Headquarters to assist in the purchase of other films.

This year the president held a combined meeting of the Northern Ontario branches and Sudbury which was attended by three members of the Sault Ste. Marie Branch who were inspired by Dr. Stephens' remarks.

Sudbury

The Sudbury Branch held eight meetings during 1955 which included a visit from the president of the Institute, Dr. D. M. Stephens, and Mrs. Stephens, and Dr. L. Austin Wright, general secretary, on February 28. Members of the Branch took part in an interesting tour of the Western Properties of the Falconbridge Nickel Mines, and attended six technical meetings.

The varied technical papers included "Air Conditioning" presented by B. E. Judges of The Trane Company on January 6; "Servo-Mechanism" by W. G. Wright of the Canadian General Electric Company on February 3; "Recent Developments in the Petroleum Industry" by G. L. Green of the Imperial Oil Company on March 24; "Rural Electrification" by J. E. Twiss of the electrical engineering department of the International Nickel Company on March 24; "Principles and Practice of Management Control" by B. A. C. Hills, president of Urwick Currie Ltd. on November 3; and "Public Water Supply in Relation to the Municipal Engineer and the Medical Officer of Health" on December 6.

The annual meeting was held on April 25. At this meeting officers for 1955-56 were elected and reports presented by the chairmen of the various committees and by the Branch councillor, E. R. Eaton.

Average attendance at the meetings was 42 per cent of the Branch membership.

Twelve executive meetings were held to conduct the program for the year, at one of which Col. L. F. Grant, Institute field secretary, held a discussion.

The Professional Development Course comprised four lectures on the following subjects: House and Household Insurance, How Civil Liberties Die, Mental Health in Industry, and Municipal Engineering in Expanding Communities. Attendance for the course of lectures was approximately 15 per cent of the resident members.

Toronto

The Toronto Branch enjoyed many outstanding meetings during the year. The first general meeting was Students' Night during which the panel discussion was used with excellent results. In February Sir Claude Gibb presented his paper "Investigation into the Failure of Two 100 Mw. Turbo-Generators" before an audience of approximately 700. Sir Claude flew from England to present his paper in Canada. The Toronto Branch was honoured to be host on this occasion. The visit of the president, Dr. D. M. Stephens, in February was the occasion of an enjoyable meeting and social evening for the Branch executive and their ladies.

Three papers presented in March were "The Engineer and Industrial Management" by Charles R. Armstrong, assistant vice-president, employee relations, for the Bell Telephone Company of Canada; "Engineering and Political Aspects of the Abadan Refinery" by John Fulcher, chief mechanical engineer, design division, Directorate of Works (Army); and "Leadership with Engineers" by C. A. Morrison, vice-president of Canadian General Electric Company Limited. Mr. Morrison's paper was presented to a joint dinner meeting of the Toronto Branch and A.I.E.E. in Hart House. At the meeting prior to the Annual and Professional Meeting of the Institute, Dr. J. Kates presented a paper and demonstration on "Computing Machines".

Highlighting the Toronto Branch activities was the Sixty-ninth Annual and Professional Meeting of the Institute which took place in Toronto. The program of this meeting has been well described in the *Engineering Journal*.

After the summer months members of the Branch made a tour of the Maclean-Hunter Publishing Company plant in Willowdale, after which they were entertained to lunch by the company in the spacious cafeteria.

During October two papers were presented. The first was that on "Models", which was ably given and demonstrated by Dr. L. E. Jones; the second was "The Coal Burning Gas Turbine" by Dr. D. L. Mordell. Interest in Dr. Mordell's paper was clearly indicated during the question period which followed.

J. G. Lucas addressed a meeting in November on the subject "Paint—An Engineering Material" which evoked considerable interest. Later in the month a panel consisting of H. R. Burton, W. E. P. Duncan, W. J. Fulton, J. R. Walker, and John Chisholm, with H. W Tate as moderator, discussed "Toronto's Traffic Problems".

The final meeting of the year was held jointly with the Royal Canadian Institute in Convocation Hall, University of Toronto, in December. At this meeting Dr. Hueler spoke on "The Development of Colour Television" and demonstrated a colour T.V. transmission.

Further attempts were made to convene meetings at 6.30 rather than 8.15. These were successful. It is planned that as many early meetings as possible should be held, consistent, of course, with the equipment requirements of the speaker.

The Toronto Branch also sponsored Professional Development Courses. Two courses are now in progress, with an enrolment of about 70 in Group I, and six in Group II. About 20 weekly meetings are held for each group, two or three being joint meetings. In general, Group I has preferred topics unrelated to engineering and business such as public speaking, insurance, anthropology, sports, current events, etc., while Group II prefers to concentrate on business topics stressing case studies, making full use of group discussion. An outstanding joint meeting was one addressed by Assistant Commissioner J. B. McClellan of the R.C.M.P. on "Communism Inside Canada". There were many guests present including members from the Hamilton Branch who are sponsoring a very successful Professional Development program there.

Vancouver Island

The Branch held six technical meetings during the year, all of which were joint meetings with the Victoria Branch of the B.C. Engineering Society.

The first meeting of the fall season was in the form of a field trip to the Harmac Pulp Plant at Nanaimo. This was also a joint affair; and a luncheon with the "up-island" Members was held at Nanaimo.

On the occasion of the field secretary's visit a Smoker was held at the Pacific Club which proved to be a very successful evening.

The highlight of the year was the visit of the president, Dr. R. E. Heartz, and the general secretary, Dr. L. Austin Wright, who were entertained to dinner at the Princess Mary Restaurant Vessel.

There were five Branch executive meetings during the year.

Winnipeg

During 1955 the Branch held six meetings (including the annual general meeting) and the members participated in three plant visits. The total number in attendance at the meetings was 504, or an average of 56 per meeting.

In addition to this the Branch was favoured with visits from two presidents of the Engineering Institute. Dr Stephens was here in the spring of 1955 and in the fall of that year Dr. Heartz and Mrs. Heartz and Dr. Wright paid a visit. It was impossible to arrange a Branch meeting when Dr. Heartz was in Winnipeg because the length of his stay did not permit time to send out a general notice to the members. However, he had an interesting meeting with the Management Committee and he addressed the student section of the Branch at the university. The Electrical Section was very happy to have him as a guest at the annual dance.

The Civil Section held seven general meetings and two plant visits. The average attendance at these was 35. The Section has an enrolment of 235, which is about the same number as the aggregate attendance at the section's meetings. The officers of the Section hope for a higher average attendance at their meetings in 1956, and they are of the opinion that the total attendance in that year may be as high as 360.

The Electrical Section held eight meetings during the year (including the annual dance) and the average attendance at the meetings was 65. The Section has 181 members on its mailing list. The total attendance at the meetings was 516 and its officers anticipate approximately a total attendance of 700 in 1956.

The Brandon Section held eight general meetings during the year, one of which took the form of the annual dance, which was held in May. The Section Executive also held eight meetings during the year. The Brandon Section has an enrolment of approximately 40 and the average attendance at the meetings, exclusive of the annual dance, was 22.

The Brandon Section experienced a little difficulty in the matter of Executive operation during the year, for the reason that many of the Branch officers were transferred by the companies with whom they were employed. Nearly a full new slate of officers was required to take over, but despite this change in executive management during the year the section made satisfactory progress.

Care is taken to see that there is no overlapping in the matter of papers given at the Branch and at the Section meetings. Each of the Sections has a papers chairman and he maintains very close contact with the general papers chairman of the Branch, and by this method of co-operation, duplication is, to a great extent, eliminated. At the same time every precaution is taken to allocate papers dealing with the purely technical side of engineering to the Sections and those of a general nature and of particular interest to the public are arranged for Branch meetings.

Yukon

Six meetings of the Yukon Branch were held during the year. In January a National Carbon Company film was shown. During that same meeting a motion that the Yukon Branch of the Engineering Institute sponsor a Yukon Professional Engineers' Association was carried. In March a Yukon Professional Engineering Ordinance was passed by the Territorial Council in session, and later in the year the by-laws were passed. The matter is now under the provisional direction of the Engineering Institute executive.

At two meetings members heard interesting addresses by guest speakers. The first, in April, was a talk by T. Main who spoke on the Whitehorse Utilities project concerned with providing sewer and water facilities for Whitehorse. In June, Dr. Hans Froberg, consulting engineer with the Teck Exploration Company in Toronto, told of his impressions and experiences in Costa Rica.

The Branch was fortunate in having two visits from members of national headquarters. In March Col. L. F. Grant, field secretary, visited Whitehorse and addressed a meeting of the members. On November 25 the Branch was privileged to welcome the president, Dr. R. E. Heartz, and Mrs. Heartz, and Dr. L. Austin Wright, general secretary. On this occasion a dinner meeting of the members, associates and their ladies was held.

During the summer the members arranged an enjoyable trip on the sternwheeler *Tutshi* to Ben-My-Chree, an historic beauty spot situated at the head of Tagish Lake, one of the sources of the Yukon River.

The Maritime Professional Meeting

St. Andrews by the Sea, N.B.

September 5, 6, 7, 1956

Month To Month

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

The Seventieth Annual General and Professional Meeting

To be held jointly with ASME

This year our annual general and professional meeting will be held at the Sheraton-Mount Royal Hotel, Montreal, on May 23, 24, and 25 and as an added feature will be arranged in association with the American Society of Mechanical Engineers. Actually there will be not only some technical papers presented under the auspices of ASME Technical Divisions but several papers by members of the British Institutions from Great Britain as well.

Transportation

As usual, special reduced convention fares will be available for rail travel in Canada and the necessary certificate will be sent to all members requesting it at time of registration. Members are requested to make their own travel arrangements through local ticket agents.

Hotel Accommodation

The Sheraton - Mount Royal Hotel will be headquarters for the meeting and ample room accommodation for all members and their wives will be available there.

Advance Registration

Hotel reservation and advance registration cards will be mailed with advance copies of the meeting program, early in April. Room allotments will be made in the order of the receipt of reservation cards at Institute Headquarters. It is expected that all social functions will be fully attended, therefore members are urged to order tickets for dinners, etc., on their advance registration cards. Otherwise reservations cannot be guaranteed.

Annual Banquet and Ball

The meeting will end as usual with the annual banquet and ball to be held on Friday evening May 25.

Ladies Events

All events such as dinners and technical meetings will be open to the ladies. In addition, a number of special social events will be provided.

Special Features

On Thursday afternoon, May 24, all those attending the meeting are invited to visit the plant of Canadair Limited at nearby Cartierville, Que., following which a special air show and refreshments will be provided. Arrangements are being made likewise for special visits to the Montreal section of the St. Lawrence Seaway development, as well as the International Section of the joint Seaway and Power Development at Cornwall, Ont., on Saturday, May 26 for any who may be interested.

General

Some thirty technical papers as well as two panel discussions have been arranged for. There will also be some special entertainment features and particulars of these will be found in the advance program.

Muriel's Room

To members and their wives who have attended annual meetings in recent years, the hospitality dispensed by our Canadian industries through the E.I.C. hostess "Muriel" is well and favourably known. It is anticipated that her hospitality this year at our Montreal meeting will be in no way lacking.

Consulting Engineers Association

The annual banquet of the Association of Consulting Engineers will be held in the Sheraton-Mount Royal Hotel at 6.30 p.m. on Thursday evening May 24. More complete details will be announced separately.

Cover Picture

The cover picture shows dredging operations in the Lachine Section of the St. Lawrence Seaway.

(Photo Van Der Aa Studios)

Opportunities for Future Engineers

University of Sherbrooke

Ten years ago, before the foundation of the University of Sherbrooke, the School of Engineering came into existence through an extension of courses offered by the local Superior School conducted by the Brothers of the Sacred Heart.

In 1945, with the approval of the school board, the faculty of the Superior School, wishing to offer students an opportunity for further study in engineering, organized an extra year of study to meet university entrance requirements. Upon the completion of this last year the students were directed either to Laval, to Polytechnic School in Montreal, or to McGill University.

In September 1951 a first year course in engineering was inaugurated with quarters in the Superior School. This move was made possible through an understanding with and cooperation of the Sherbrooke Catholic School Board. Three years later, in September 1954, following the foundation of the University of Sherbrooke in May 1954, a second year engineering course was also introduced.

Turning Point

The ever increasing enrolment during the past five years created a classroom shortage. Larger facilities were needed. This problem was solved in January when Premier Duplessis announced that a $750,000 grant would be voted by his government for the erection of a school of engineering affiliated with the University of Sherbrooke.

Functioning

At present, the Sherbrooke School of Engineering has three classes in operation: an undergraduate, a first, and a second year engineering, already totalling 135 students.

The undergraduate course offers students a general training which prepares them to enter engineering or other specialized fields. A high school diploma is the minimum requirement for this undergraduate course. The curriculum includes philosophy, languages, mathematics, bookkeeping, economics, sciences, history and geography.

The following are the subjects offered in the first two years of engineering:

First year: algebra, calculus, chemistry, mechanical drawing, analytic geometry, applied mathematics, physics, bookkeeping, trigonometry.

Second year: algebra, surveying, calculus, chemistry, engineering drawing principles, analytic geometry, descriptive geometry, mechanics and physics.

It is essential that the student master the general principles underlying scientific work before commencing professional subjects. and greater importance is given to the study of all mathematics. particularly calculus and analytical geometry.

At the end of the second year. students are required to attend a two-week surveying project. A comprehensive training in surveying is added to this background.

Projects

Next fall, the faculty will be ready to begin a third year of engineering. Accommodations will be found outside the Superior School building. Subjects offered in the third year are designed to emphasize the fundamental principles of mechanics, strength of materials, design of structures, and hydro-dynamics, while at the same time affording an opportunity of applying these principles to practical problems in the field of civil engineering.

The New Building

The School of Engineering, first building to be erected on the Sherbrooke University Campus, will stand on a recently purchased property of five hundred acres on St. Catherine Road, just outside the Sherbrooke city limits and near the Montreal highway.

The school project consists of a modern two storey brick building, three hundred by two hundred feet, an area of forty thousand square feet. The new school will provide space for ten classrooms and lecture halls, a library, a drafting-room, a cafeteria, an auditorium, laboratories for physics, chemistry, mineralogy, hydraulics, electricity, strength of materials, and offices for general administration. The cost of the building will be about $600,000. Construction is scheduled to start early in April and it should be ready for occupation in January 1957.

This new School of Engineering. affiliated with the University of Sherbrooke, is under the direction of three members of the Institute: Dr. Armand C. Crepeau, M.E.I.C., dean of the Faculty of Science; Gaetan J. Côté, M.E.I.C., director of the School; Jacques Lemieux, M.E.I.C., chairman of the Eastern Townships Branch of the Institute and assistant-director of the School.

Plastic Design of Steel Structures

Recent years have seen the development of ultimate or plastic strength design methods for steel structures. Work on the basic theory was pursued initially in Europe and later in Great Britain and the United States, and the results published in a wide variety of periodicals.

A stage has been reached where plastic design methods are applicable — with advantage — to practical problems. These methods are being used in Great Britain under the provisions of the British Standard, The Use of Structural Steel in Building. The American Institute of Steel Construction is interested and a revision of the AISC code is anticipated. Under the new National Building Code of Canada, the use of plastic design methods would be permissible.

Because the methods used in plastic design are novel, and because information on the subject is so widely scattered in engineering literature, it has appeared necessary to introduce the subject in special short courses, where the advantage of first-hand presentation is obtained. The first course of this sort in North America was intended for educators, and was held at Lehigh University in September of 1955. It is now proposed to hold a similar short course in Canada, intended for practising structural engineers. In this course, emphasis will be placed on plastic methods of design, and it is expected that an intensive course of a week's duration will enable a designer, already experienced in elastic methods, to assess the opportunities offered by these new methods.

The course will be given jointly by The Royal Military College of Canada and Queen's University, assisted by the Canadian Institute of Steel Construction, during the period May 28 to June 1, in Kingston. It will include formal lectures, discussion periods and laboratory demonstrations. Methods for the plastic analysis and design of steel structures will be developed, and actual design examples will be worked to illustrate the theory. The laboratory demonstrations will consist of tests to destruction of real structural members and frames.

Because of the space requirements in lecture rooms and laboratories, the numbers attending the course must, unfortunately, be limited. Applications will be accepted up to this limit until May 1. No tuition will be charged for the course; however, there will be a $10 registration fee.

For application forms and further information, please write: Prof. J. W. Dolphin, Plastic Design of Steel Structures, Royal Military College, Kingston, Ont.

Canadians in Britain

In December a group of 1955 Athlone Fellows visited the Stanton Ironworks Company Limited near Nottingham, England. At present in postgraduate courses at the Imperial College of Science and Technology, London, the six Canadians were guests of the Company for the two-day visit. In the group are, left to right: L. Soderman (Manitoba, 1953), J. Campbell, S.E.I.C. (Nova Scotia, 1955), A. Bjornsson, Jr.E.I.C. (Manitoba, 1954), D. Shields, S.E.I.C. (Saskatchewan, 1955), K. Peaker, S.E.I.C. (Manitoba, 1955), and P. Langeman, S.E.I.C. (Saskatchewan, 1955).

Anniversary Clock

Last year the University of New Brunswick at Fredericton celebrated the one hundredth anniversary of the beginning of the first course in engineering ever given at a Canadian university. At that time the Institute in recognition of the university's achievement presented a clock.

Recently the opening of the new building for student activities has provided a suitable place for the clock to be located. It now sits on the mantel shelf in the common room of the students' union.

Through the courtesy of Dean E. O. Turner the Institute was able to get a photograph recently and *The Engineering Journal* is pleased to show it herewith.

The inscription reads as follows: "Presented to the University of New Brunswick by The Engineering Institute of Canada on the occasion of The Centennial of Engineering Instruction, February 15, 1854-1954."

At Whitehorse the Yukon Branch is host to the President on November 25. Left to right: Mrs. Kenneth Baker, Brigadier J. Meusier, Mrs. Heartz, John Phelps, Mrs. Phelps, Dr. Heartz, Mrs. Meusier, and Dr. L. Austin Wright, general secretary.

The President attends a dinner meeting of the Sault Ste. Marie Branch on February 8. Left to right: Mrs. H. M. Lang, E. C. Luke, assistant general secretary, Mrs. G. L. Brown, Dr. Heartz, Mr. Brown, chairman, Mrs. Heartz, Alderman H. M. Lang, and Mrs. D. C. Holgate.

K. E. Bentley, Sarnia Branch chairman, V. A. McKillop, president-elect, Dr. R. E. Heartz, president, and E. C. Luke, assistant general secretary, get together before the executive meeting begins in Sarnia.

At the Sault Ste. Marie Collegiate Dr. Heartz discussed the opportunities available to the Canadian engineer at a student assembly. Lower left: W. W. Fraser, principal; Catherine Nasi, vice-president, Student Council; Dr. Heartz; Mickey Contini, president, Student Council; W. D. Adams, of Algoma Steel Corporation, and E. C. Luke, assistant general secretary of the Institute. Below: G. L. Brown talks to Dr. Heartz, with W. D. Adams, and D. C. Holgate, general manager of Sault Structural Steel Company.

President R. E. Heartz and Mrs. Heartz are entertained at a reception at the home of the president-elect V. A. McKillop and Mrs. McKillop in London. Left to right, Mr. McKillop, Mrs. Heartz, Mrs. McKillop and Dr. Heartz.

The President and Mrs. Heartz, below right, together with Vice-President M. A. Montgomery and Mrs. Montgomery in whose car the presidential party travelled from Sarnia to Kitchener.

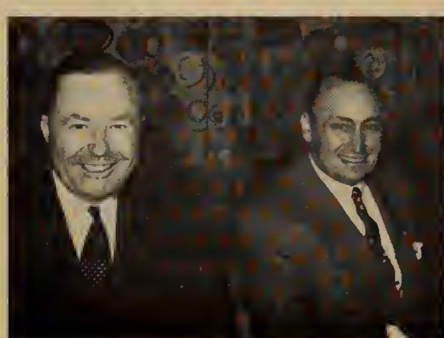
The President's Tour

Some scenes of the President's visits to the Branches in Kitchener, London, Sarnia, Sault Ste. Marie, and the Yukon.

Hugh Baillie (left) and Mayor William Anderson, of Galt, with the President before the luncheon meeting in Kitchener.

In Kitchener, Walter Runge, chairman, chats with Kenneth Tupper and Dr. Heartz.

At the luncheon meeting in Kitchener. Left: John Runge, vice-chairman of the Kitchener Branch, and E. C. Luke, assistant general secretary of the Institute. Below, Dr. Heartz with Vice-President M. A. Montgomery; Past-President J. A. Vance and President R. E. Heartz (right).



St. Lawrence Seaway and Power Project

The *Engineering Journal* reviews the progress of the St. Lawrence project.

Full scale operations commenced on the construction of new townsite No. 2 during January. The sewer and water-main contractor moved on to the site the middle of the month, and already had made outstanding progress in laying of sewers and water mains. Nearly 150 houses had been measured preparatory to moving to the townsite and for construction of new basements. Power and telephone lines were being installed in the new town and an access highway was being built to the townsite.

Meanwhile for townsite No. 1, numbering of houses had been completed in the original hamlets, staking of lots had been completed in the new townsite in preparation for moving operations. At Iroquois some 85 houses had been transported to the new town. Work was in progress for the new pumping station and installation of the intake was progressing rapidly.

Normal winter weather favoured construction operations throughout January and significant progress was made. The total work force was approximately 2,700 persons. Excavation for all project operations had reached 7.51 million cubic yards of material removed.

Progress by Ontario Hydro

Indicative of the important progress in the power-house area excavation, some 100,000 cubic yards of earth and 1,800 cubic yards of rock were removed during January. Rock excavation for the U-abutment base at the north end, where that structure will be tied into the dike, was started early in the month. Earth excavation was mainly in the south end of the power-house area, most of the earth removal in the north section having been completed.

Drilling and grouting operations also continued in the grout curtain area of the power-house. At month end virtually all the estimated 475 holes had been drilled, while some 445 holes had been filled with grout using about 170,000 sacks of cement.

Installation of equipment at the batch plant had been completed. The new 10-ft. dia. access tunnel had been completed, ready for the installation of the final section of the aggregate conveyor. Work on form panels for the U-abutment was well advanced, and work on construction of draft tube forms had been started.

Important progress was made in the Cornwall dike closure structure excavation. About 60 per cent of all the excavation had been completed in that area. In dike construction, stripping of the marine clay crossing in section 3 progressed well. Excavation was carried out by dragline and with caterpillar scrapers, pusher loaded, despite the extensive frost in the ground. Some stripping of the clay crossing in section 2 also was carried out by the contractor.

Extensive stripping operations were carried out at the aggregate quarry during the month. This will result in increased production of clean aggregate, and already heating equipment had been installed to thaw stockpiles.

At the St. Lawrence transformer station, installation of equipment was right on schedule. Hydro's construction division expects to meet the in-service date of April 1, 1956.

Ditching operations and placing of granular fill for the roadbed proceeded well on the Canadian National Railway relocation. A total of 24 miles of the entire contract in the three sections had been finished to sub-grade elevation, while a total of some 9½ miles had sub-ballast on it.

In channel excavation work in the Galop Island contract, an estimated total of approximately 1,600,000 cubic yards of material had been excavated at month end. During the month, four shovels were working in the main cut, but seepage around the shovels was giving some trouble.

Progress by NYSPA

During January, Barnhart Island was linked to the mainland by rail. The first trainload of equipment for the power-house crossed Barnhart bridge on January 19. Removal of the floating bridge was completed with the dismantling of cable towers. For the entire project more than ten and a quarter million cubic yards of excavation had been removed.

Due to lack of snow, frost penetration was deeper than usual, requiring blasting to allow excavation of frozen earth throughout the project. Construction plants were being built up during this period to enable all construction operations to proceed in accordance with the accelerated schedule during the coming season.

With most of the rock foundation of the power-house exposed, drilling and grouting operations were continuing, as nearly 150,000 cubic feet of grout had been pumped into the rock for consolidation and cut-off grouting. More than a million yards of common excavation had been removed from the power-house area. The delivery of construction material by railroad started on January 19. Placing of rock fill in the baffles on the upstream side of cofferdam C-1 had progressed to 75 per cent of completion.

Long Sault dam concrete pouring had been suspended for the winter as other essential activities progressed. A quarry was opened in the unwatered channel between Sheek and Barnhart Islands to supply rock for construction of a revetment along the embankment of Cornwall canal beside the rapids. Cut "F" was taking shape as excavation operations continued. On Barnhart Island, clearing crews were working along the locations of the north earth wing dike, Barnhart Island road and the left abutment of Long Sault dam.

Iroquois dam guide towers were set as pouring of concrete continued. Earth cofferdams were enclosing off-shore areas which were being unwatered and excavated. Steel cofferdam cells were being driven for the stage 1 construction.

Channel excavation at Red Mills Point had reached the clean-up stage with the remaining upstream cofferdams being removed. The south Galop channel was being excavated in the area between the islands and mainland. Cofferdams linked these islands to the mainland and the enclosed 150 acres of channel had been unwatered.

A contract was awarded on January 5 for 11,839,000 cubic yards of channel improvement work at Sparrowhawk Point of Toussaints Island. At Massena intake shovels were excavating for the structure about 30 feet below the water level of the canal.

Specifications were issued during the month for intake gate hoists for Barnhart Island power plant, 440-volt motor control centres and the electrical work at Barnhart Island power plant. The work of inspection and expediting of major equipment increased to meet the demands of the schedule. The work force totalled some 2,400 persons.

NYSPA Annual Report

In the absence of official press releases this month on progress by the St. Lawrence Seaway Development Corporation and the St. Lawrence Seaway Authority (Canada), the annual report of the New York State Power Authority, issued February 13, 1956, where it refers to the progress by the two Seaway Authorities, is quoted in part as follows:

"Barring unforeseen calamity, the St. Lawrence project will be completed on schedule in spite of severe winter and ice conditions, exacting requirements as to the maintenance of navigation, river levels and flows, insufficient labour market and housing for labour, shortage of strategic materials, numerous administrative and supervisory agencies, and conflicting laws, regulations and procedures involving two countries on national, state, provincial and local levels. We can report that the project is on schedule and that the first power will be generated in September 1958.

"The two seaway authorities are responsible for constructing the locks around the dams. These locks must be ready when the pool is raised because the old Canadian fourteen foot canal will be flooded out and discontinued. The United States St. Lawrence Seaway Development Corporation, with the Corps of Engineers as its agent, is building the Long Sault canal, including the Robinson Bay and Grass River locks. The Canadian St. Lawrence Seaway Authority is constructing the canal at Iroquois with one lock. These agencies are working very closely with Ontario Hydro and the Power Authority.

"We aim to leave the St. Lawrence area as beautiful as we found it and more accessible. Throughout the country, hydroelectric developments have been a magnet for tourists. We have combined visitor, park and recreation programs. Facilities provided pursuant to these programs will add to the benefits which will accrue to the North Country strictly from the power and seaway features of the project.

"Entering the second construction season, the Long Sault canal, under construction by the United States St. Lawrence Seaway Development Corporation, was well under way. During 1955, approximately eight million dollars was paid out for work, principally excavation, embankments and dike construction.

"Looking ahead to the 1956 schedule, the Corporation forecasts that thirty-five per cent of the work will be accomplished at an estimated cost of thirty million

Long Sault Dam. The south channel is covered with ice and construction in the dam area lies dormant until spring.

dollars, with substantial construction proceeding on the Long Sault and Grass River locks including bridges and other incidental improvements.

"The Corporation has scheduled completion of its work in time to provide for navigation for ships of 14-foot draft by July, 1958. This corresponds with the power schedule. Full scale 27-foot navigation is scheduled for the spring of 1959.

"The Canadian Seaway Authority has proceeded rapidly with the construction of the Iroquois canal, including locks for navigation around the Iroquois dam. Completion of the Canadian work has been scheduled for October 31, 1957."

Channel Improvement Before U.S. Senate

A $109 million federal appropriation to improve Great Lakes channels, already passed by Congress, is now up for U.S. Senate approval. A favourable vote is expected. The Great Lakes-St. Lawrence Association, strongest promoter of the plan, claims annual savings to the commerce in ore, grain and stone resulting from increased channel depths will exceed $280 millions over a 50 year period. The distance saved will be about 175 miles. Work will not be undertaken for a year or two.

In detail, $40½ million is earmarked for widening and deepening the St. Mary's River channels; $2¼ million for deepening the channels between Mackinac and Round Islands and at Poe Reef; $18.2 million for improving existing channels by widening and deepening and removing shoals at nine different locations in the Detroit River. Alternate and supplementary proposals would boost the total by a further $7 million. These include a six mile canal through Canada's Walpole Island in the St. Clair River.

An army engineer's report made 30 years ago on a possible canal to join Lake Michigan and Lake Erie is again up for consideration by Indiana Chambers of Commerce. The project, turned down as impractical in the "twenties," would have made use of the St. Joseph channel for part of the way across lower Michigan, thus allowing vessels to pass from Lake Michigan to Lake Erie and vice versa without sailing through Lake Huron.

Though the original scheme, to accommodate vessels with an 8 ft. draft, was turned down as costing more than the estimated benefits that would accrue from it, opening up of the Seaway might enhance the usefulness of such a project. The cost today would of course be considerably greater, built to a 27 ft. draft.

Shipping on the Seaway

Subsidy for U.S. Lakers

The U.S. Maritime Administration has made American ship operators on the Great Lakes eligible for government subsidies by declaring the ocean route between American lake ports and western Europe "essential" to U.S. trade and economy.

This opens the way for U.S. ship operators to apply to the Federal Maritime Board for an operating-differential subsidy of $750 per day for each, which in total is expected to cost the government some $8 million annually. Current increased shipping operations have made it necessary to consider and determine its essentiality under the law, well in advance of the 1959 scheduled opening of the seaway. However the subsidies will be immediately effective for small vessels of 14 ft. draft plying existing Canadian canals.

Under the program subsidized U.S. vessels may pick up and discharge cargo at any Canadian ports on the Lakes or between Windsor, Ontario, and Sept Isles in the Gulf, but not at Halifax or Saint John. Vessels plying the route could not stop and turn around at any Canadian port without completing the full round trip to or from Europe. When business warrants, similar subsidy programs will probably also be announced from U.S. Lake ports to the Caribbean, British West Indies, the Mediterranean and the West Coast of Africa.

This will provide stiff competition for Canadian vessels plying the same route. John Paterson, president of the Dominion Marine Association, speaking at the association's nineteenth annual joint convention with the Lake Carriers Association in January, stated the DMA stand on inland waterway competition by foreign ships had already been expressed before the Coastal Shipping Commission. Briefly, DMA asked that foreign flag ships, including British vessels, should be barred from carrying on trade between Canadian coastal ports along the seaway route.

At present foreign ships are restricted in trading along U.S. coastal waters and between U.S. ports along the inland waterway. In Canada there are no such restrictions, and DMA has been pressing for restrictive legislation.

General Manager J. W. Fisher of the Canadian Shipowners Association comments that "U.S. subsidies mean the seaway will become a beautiful highway for everybody but Canadians, though Canada put up the money for it." No Canadian vessels now operate between Lake ports and Europe, and U.S. ships carry only a small part of the trade, Fisher stated. But Canadian ships have considerable trade into U.S. ports carrying pulp, paper, lumber, ore and other commodities. American ships without full loads would now be able to undercut Canadian vessels in this trade, he observed.

New Trade Route Will Influence All Canada

"Prodigious resources of hydro-electric power will be produced in conjunction with enhancement of other resources," predicted President Lionel Chevrier of the St. Lawrence Seaway Authority, addressing members of the Montreal Geographical Society, at the University of Montreal recently." On the Seaway, wheat coming down will meet iron ore being shipped upstream to Great Lakes industrial centres. In making possible this transportation of iron ore and competitive freight traffic conditions for its carriage, the seaway will create a market capable of absorbing an annual production of 10 million tons. We know mining circles foresee already the sale of 20 million tons per year, double the present annual objective."

Stressing the prospects for development of the steel industry, the speaker pointed out this industry could benefit at the same time from the hydro-electric power made available, lower freight rates, an abundant labour force, proximity to conversion industries and to markets.

Thus the steel industry would directly feed the whole metals industry, thereby aiding the whole of heavy industry and the chemical industry including manufacturing of dyes, pharmaceutical products, synthetic fibres, etc. "Such is the promise which the seaway opens to us, which we must take every step to encourage," he declared.

Speaking of water levels in the Lachine Section, he continued: "The works undertaken by the Ontario Hydro will make a decided change in water level, but in the international section alone. It is precisely to protect the interests of those downstream from the international section that the control dam at Iroquois has been set up, the object of which is to protect downstream interests, particularly those in the metropolitan area. There will exist, none the less, variations of water level caused by nature, variations originating at the head of the lakes. But floods will be no greater and no less because of the works in progress."

He further pointed out that a favourable element would be the development of hydro-electric energy in the Lachine section. Another favourable element is the ice-breakers now at work between Montreal and Sorel and performing very useful work. They can reduce flooding markedly if the channel is freed from ice during the winter months.

Great Lakes Another 'Mediterranean'?

CNR Vice-President S. W. Fairweather, addressing the Canadian Fruit Wholesalers Association in February, predicted the seaway would create another "Mediterranean," greater by far than the economic empires that have grown up in the United States after linking up raw materials in various parts of that nation. The combination of tremendous resources and cheap power in the St. Lawrence river and gulf would produce an industrial empire which can hardly be envisaged.

He classed the ports of the world as either industrial ports which thrive on sea transportation for organizing materials of production, or liner ports engaged in general distribution of the world's goods to and from their hinterland. The Great Lakes lie right in the hinterland of the two main liner ports of the continent, he pointed out, namely New York and Montreal. Great Lakes ports would become industrial ports, not liner ports.

Other Seaway News

Manicouagan First, Lachine Power Later

Premier Duplessis of Quebec reiterated in the legislature February 10 that his government intends to complete development of power on the Bersimis and Manicouagan Rivers on the north shore of the lower St. Lawrence before harnessing the Lachine rapids. The Manicouagan is now only partly developed, has a power potential of two million horsepower, and may even exceed the giant Bersimis in capacity. Legislation would be introduced concerning it.

Referring to the Mercier bridge at Lachine, he indicated there was near agreement between federal and provincial authorities on the solution to problems connected with it. The lift span had now been abandoned in favour of a plan calling for a 4 per cent elevation of the south approach to the bridge, with divided one way traffic lanes, and costing an estimated $7 million.

Federal authorities, he stated, had outlined a tunnel project for passing under the Beauharnois canal between Melocheville and Beauharnois. Including approaches the proposed four lane tunnel would be some 3,000 feet in length.

Montreal Harbour

Montreal Harbour will get improvements costing more than $12 million in 1956. Extension of grain handling facilities tops the list of some 30 projects, which includes:

Galop Island, south channel. Looking upstream at the area, encircled by haul roads, which has been unwatered and is being excavated. The upper road follows cofferdams which were built between islands.

extension to wharves 58 and 61, $1,500,000; wharves 50 to 53, $1,950,000; Sutherland pier, $400,000; Laurier pier, $400,000. Another $2,419,000 will be spent on grain elevators. A further $990,000 is earmarked for widening Jacques Cartier bridge roadway and for altering the bridge approaches.

Lake Levels

Engineers will be able to control the level of Lake Ontario by 1958 to almost completely eliminate seasonal floods. General A. G. L. McNaughton, head of the Canadian Section, International Joint Commission, said controls being built as part of the seaway would make it possible to keep water levels within safe tolerances.

Trucking

Municipal Seaway Bureau Director George Mooney of Montreal told the Quebec Trucking Association in January that it was unlikely the seaway would make major inroads into the volume and established pattern of truck haulage. "It could, however, have a disturbing effect on certain long distance commodity shipments such as automobiles, and durable goods, especially those shipped from central Canada to eastern Canada or the west."

"However, if the seaway presented stepped up competition for the trucking industry, it will also provide a new volume of traffic for truckers. Development of new areas such as Ungava will create new demand for rail and trucking services. For five months of the year, water haul is stopped, and some shippers will prefer consistently available facilities," he said.

Land Values

Farmers whose land lies in the path of the seaway power project have established a scale of land values for bargaining with Ontario Hydro. A petition is being circulated amongst the farmers on Sheek Island listing the values, to be forwarded to Premier Leslie Frost to circumvent the 'horse-trading methods' being used by Hydro's land agents. Slash and woodland is listed for $50 an acre plus value of fuel or growing timber; pasture land is valued at $50-$150 an acre; unplowed land free of trees $100, and tillable land $150 an acre.

CCA Annual Meeting at Winnipeg

The 38th annual convention of the Canadian Construction Association was held at the Royal Alexandra Hotel in Winnipeg, January 15-18, 1956. Delegates were welcomed by His Worship Mayor George Sharp. Following secretaries' seminars for builders exchange representatives on Saturday, January 14, Sunday was devoted to registrations, a management committee meeting and a reception by President W. G. Malcom.

Committee Reports

The first general session was opened on Monday with presentation of committee reports. Chairman Roy Foss of the Apprenticeship Committee, noting that volume had roughly doubled since 1945, pointed out the increase in the labour force had been brought about by a large influx of workers of varying degrees of skill from other countries and of large numbers of Canadians from other vocations. Yet the number of apprentices trained in 1955 would only be about equal to the number trained in 1954.

Recalling the president's statement last September that the number of trade apprentices should be at least doubled, he emphasized it was necessary to bring in boys interested in learning trades and willing to practice these trades after leaving training centres.

Building Committee

With the growth of both the industry and of its national association had come strong feelings that the CCA should erect its own office building.

Past President Bob Drummond, AFFIL.E.I.C., chairman of the Building Committee, recalled the opening ceremonies held on October 17 and 18 last year. Welcomes had been extended to those present, including ten past presidents, special guests and representatives of all firms who had played a sizable part in executing the project, by President Malcom and Her Worship Mayor Charlotte Whitton. The guest speaker, the Rt. Hon. C. D. Howe, HON.M.E.I.C., had unveiled a plaque marking the occasion.

Construction Equipment Committee

Chairman H. R. Montgomery, M.E.I.C., expressed his committee's view that current practices of permitting equipment to be imported on a proportionate basis of 1/60 tariff per month on temporary six month importation, and of second-hand vehicles upon payment of full tariffs and sales taxes levied on assessed value at time of importation, were on balance detrimental to the interests of the construction industry.

Contractor Relations Committee

Chairman R. F. Legget, M.E.I.C., reported that four meetings of the committee had been held, and many informal discussions throughout the year. It was clear to the committee that serious problems still remain in the field of contractor relations, although real improvement in some directions during the year was noted and welcomed; that a number of developments (such as the Toronto bid depository scheme) were beginning to yield results of interest and probably of value.

Accordingly, the committee recommended that it be continued throughout 1956 in order to continue its studies with a view to submitting periodic reports to the Management Committee and a full report to the annual meeting of the Association in January 1957.

C.C.A. Housing Report

Referring to the fact that over 125,000 dwelling units were completed last year, with a record 80,000 carryover into 1956, Chairman V. L. Leigh emphasized the minute number of Canadians with incomes less than $3,600 who finance the purchase of $5,000 or more.

His committee hoped, he said, that the 90 per cent loan provision would be expanded past the present limit and that new appraisal values would correspond closely with actual cost. It was most desirable that loan applications continue to be assessed on their individual merits and that loans be granted in those cases where the 23 per cent ratio may be safely exceeded. Open end mortgages were also recommended, to permit small homes to be enlarged at the same mortgage rate. NHA mortgages should be made available to cover purchase of existing houses, thereby enabling "trade-ins" at reduced rates.

Labour Relations

On a national basis, 1955 hourly earnings of construction workers

The Canadian Construction Association's leaders for 1956: left to right: W. G. Malcom, Winnipeg, immediate past-president, T. N. Carter, M.E.I.C., Toronto, vice-president; A. Turner Bone, M.E.I.C., Montreal, president, and H. J. Ball, Kitchener, vice-president.

had risen about 3 per cent, the same as for 1954, which meant a gain in "real" wages, reported Chairman Allan C. Ross, M.E.I.C. Higher volume had resulted in more employment, contract settlements had been achieved with more harmony and the number of work stoppages had been reduced.

It would appear that the National Joint Conference Board could be usefully reconvened to give consideration to industry trends, jurisdictional problems and apprenticeship, he said. Now that the TLC had agreed to amalgamation with the CCL it might be that it would also be agreeable to sit down with the Catholic Syndicates (CCCL) from Quebec Province.

During 1955 amendments to the Unemployment Insurance Act had been made which seemed not out of line with changed conditions.

Legislation Committee

Chairman J. Hastie Holden, M.E.I.C., pointed out that as a national organization the CCA was most concerned with federal legislation, but also submits the industry's views to the provincial and municipal governments where necessary. He recommended that builder's exchanges, provincial road builders and general contractors associations affiliated with the CCA should consider the merits of annual submissions to their provincial cabinets.

With increased opportunities for bidding on overseas construction projects, Canadian contractors were finding they were handicapped in arranging credit for foreign work by lack of insurance to cover risk of non-payment by the owner. Such protection under the Export Credit Insurance Act had been advocated by the CCA management committee last September he said, but would require amendments to the act. A resolution advocating this was before the convention for consideration.

Membership Committee

Lorne Bain, chairman, told the meeting the new membership category system, whereby each firm's classification is based on its previous year's volume, was now fully established and working successfully. The fee structure remained unchanged at the 1946 level. A breakdown of present CCA membership was as follows:

General Contractors	339
Road Builders	65
Trade Contractors	251
Manufacturers and Suppliers	341
Affiliates	33
Allied Professions and Services	38
Total	1,067

Research and Education Committee

Chairman J. D. Allan recorded awards of prizes for the 1955 CCA construction thesis competition. Announcement was also made of a $2,000 annual fellowship by the CCA for post-graduate study in construction.

Publicity Committee

Chairman W. S. Sparrow reminded delegates that the CCA's first major publicity effort was at the 1955 annual meeting in Quebec City. Complete publicity arrangements had been handled by the association itself. This departure had been a complete success and so again this year convention publicity was being handled by the CCA staff.

Sales Tax Committee

Chairman G. A. Burnett recalled that the CCA had made detailed representations over a number of years that present exemptions to the federal sales tax be expanded to cover the remaining materials still subject to the tax. A more detailed submission had been made to Finance Minister Walter Harris following his appointment.

In subsequent submissions to the Department of Finance sales tax committee, changes were advocated. The committee felt that the Association should continue to press strongly for the extension of sales tax exemption to include all construction materials.

Standard Practices Committee

Chairman E. V. Gage, M.E.I.C., told the meeting that his committee's main achievement for 1955 had been completion of a lengthy revision of the standard cost-plus-fixed or -percentage fee contract form. The English form had been published jointly with the RAIC in July and a French translation had followed in January 1956. Engineers' versions of both the revised lump sum and cost-plus-fee contract was soon to be available. With these major forms revised, his committee was turning to revisions of the standard form of sub-contracts and form of construction tender.

The final draft of the "suggested guide to bidding procedure", developed by the CCA-RAIC-EIC joint committee on tendering practices in June 1953, had now been returned by the RAIC with deletions. An early meeting with the RAIC had been suggested for discussion.

Joint meetings had been held by the committee with officials of Defence Construction Limited and the Department of Public Works, at which problems were discussed fully and frankly, particularly the expediting of clean-up work on DCL projects. Later, meetings were arranged in a dozen cities between DCL officials and local builders exchange officials to discuss tendering and contract procedures.

CCA Office Reports

S. D. C. (Don) Chutter, whose appointment as general manager of the association had been confirmed last April, then outlined the activities of the CCA headquarters staff at "Construction House" in Ottawa during the past year.

Reviewing costs, he presented statistics showing that residential and non-residential basic construction costs had moved upwards about 2 per cent in 1955 after a year of relative stability, according to CMHC indexes. Both material prices and wage rates had advanced in 1955. Prices of non-residential building materials increased in almost every month up to November, the latest month for which the DBS indexes were available. Residential building materials prices rose throughout the first three quarters of 1955 but held firm in October and November. Average wage rates for construction workers in 1955 were about 2 to 3 per cent higher than the previous year compared to increases of 1 to 2 per cent in average building material prices.

President's Address

CCA President W. G. Malcom of Winnipeg, addressing delegates at the first day's luncheon session, remarked 1955 had been the first year any CCA president had been able to report the completion of over $5 billion of construction in the year just ended. Prospects for the 1956 volume would equal and probably exceed the 1955 total, with some 30 per cent of it in Western Canada, he said, though the total would possibly be limited by shortages of materials such as steel, rather than by shortages of investment capital.

The industry's post war operations had served to act as one of the most powerful stabilizing influences for our overall economy, giving $2 billions of purchasing power to over half a million Canadians, while spending of $3 billions for materials and equipment meant employment and pay cheques to an even greater number employed in manufacturing, transportation and merchandizing operations, he said. So much of the Canadian economy relied on the construction program that a sizable reduction in it would not only affect adversely the industry itself but also our general economy.

Legislation affecting taxation, depreciation, credit and interest rates, as well as policies concerning immigration and trade, might well influence the construction of even a greater volume of privately financed projects than is represented by our public works programs, he observed. Privately financed work amounted to over three quarters of total volume, and it was vital that governments give prime attention to encouraging a business climate that in turn would encourage individuals and organizations to invest in and build for the future.

The industry itself could also help, he pointed out, by maintaining costs at levels that would encourage investment, by increasing the current rate of production of materials and equipment, by a stepped up training program for tradesmen and engineers, by development of new techniques, materials, and labour saving devices, and by continuing to expand the length of the construction year by increased wintertime work.

Guest Speaker at Annual Banquet

The Hon. Milton F. Gregg, Federal Minister of Labour, the guest speaker at the annual dinner, pointed out that expenditures on construction accounted for a growing share of the national income, from 15 per cent in 1947 to 17 per cent in 1950 and to almost 20 per cent last year. This meant Canadians were willing to invest more and more heavily in their nation's future.

Workers had shared in the industry's prosperity, he stated, average weekly earnings had recorded a sharp rise in recent years, from $41.98 in September, 1950, to $63.35 in September, 1955, a gain of 50 per cent. Compared with this the gain for nine leading non-farm industries had been 38 per cent.

Industrial disputes, he declared, were seldom the major cause of lost work and income in industry. Seasonal unemployment by far overshadowed disputes as a cause of lost working time.

A cabinet directive to all federal departments and agencies last summer had instructed them to do all possible to create a maximum of winter employment. Steps designed to increase winter work had also been taken by many provincial governments across Canada. Efforts in this direction were not entirely focused on the construction industry. Educational efforts through posters and radio and articles in the press were being undertaken on a broad national scale this winter.

CPA President's Address

Tuesday sessions were devoted to sectional meetings of general and trade contractors, manufacturers and suppliers and road builders. The guest speaker at the second luncheon was Vernon Taylor, manager, Western Canada Regional Production Department, Imperial Oil Ltd., representing the board of governors of the Canadian Petroleum Association.

Outlining the spectacular oil and gas developments since the discovery at Leduc in 1947, he observed that in 1945, oil had supplied only some 30 per cent of Canada's energy requirements while today it enjoyed close to 49 per cent of the market. In 1945 natural gas had supplied only 3 per cent of the demand for energy, while today it enjoyed a 5 per cent share. In the next five years the gas share should be about 7½ per cent, or an increase of 50 per cent.

The provision of adequate outlets for gas, he predicted, would act as a stimulus to the oil industry which had, as it were, to fly on one wing due to the absence of an economic market for natural gas. By 1960 oil reserves, presently estimated at some 3 billion barrels, should be approaching 5 billion barrels. By that time the oil potential or maximum efficient rate of production could be in excess of a million barrels daily.

The second dinner meeting was addressed by the Very Rev. John Burton Thomas, D.D., Rector of St. John's Anglican Church, Winnipeg, Dean of the Diocese of Rupertsland and immediate past president of the Winnipeg Rotary Club.

Closing Day

With the issue to members of a statement of CCA policy was included a list of 13 draft resolutions approved for discussion by the Management Committee at its December meeting.

At the Wednesday luncheon the election and installation of officers for the ensuing year took place. Alan Turner Bone, M.E.I.C., of Montreal, was elected president, with T. N. Carter, M.E.I.C., of Toronto, and H. J. Ball of Kitchener as national vice-presidents. Following a joint meeting of 1955 and 1956 executive committees a reception and buffet dinner were held, ending with a "Western Jamboree."

Thirty-five Years Ago

Comment on the *JOURNAL* of March 1921

The farewell addresses of our retiring presidents have followed pretty much of a pattern, tinged a little by the personality of the author. Each speaker has felt that there were perforce certain topics with which he must deal—membership, finances, the continuing struggle for greater public recognition of the engineer as a professional man, more adequate salaries, engineering education—and the results have sometimes been pretty humdrum. And almost every retiring president has tried his hand at a little prophecy, with all the rewards prophets are said to receive.

But once in a while the Institute has been lucky enough to have for its president a member who was not only distinguished in the profession, but who was also widely informed in other fields. Such a man was R. A. Ross, whose presidential address is published in the *Journal* of March, 1921.

I knew Ross pretty well, because I worked intimately with him during his term of office. He had a keen engineering mind and his professional advice was sought by many. But he was also a fair Latin scholar and had a good command of at least three modern languages. His reports were models of accuracy and brevity, though I could never agree wholly with one of his axioms, "Never tell a client any more than you have to." He had an interest in the fine arts, but I do not recall that he practised any of them, even in an amateur way.

President R. A Ross

From such a man one might expect a presidential address somewhat out of the ordinary and that is exactly what we got. I wish the *Journal* had room to reprint it in full here, but since that is not possible, we shall have to be content with some excerpts.

He got his hearers into an amiable frame of mind by saying, "When . . . the president lays down his office, divests himself of his robes, his staff and his mitre, leaving his . . . blessing and his portrait behind in the Valhalla of the Institute . . . the occasion demands a swan song, the usual chorus from the audience being, 'How long, O Lord, how long'?"

He thought that engineers ought to apply "pressure of whatever kind most appeals to the politician" to secure appointments to public bodies where their training and experience were most needed. Further, he said, "One engineer . . . applying himself to . . . (public) problems will be of more service to the profession in determining its status than ninety and nine who devote themselves to purely technical matters."

He pleaded for some integrated organization which would bring together all from "the pure dreamer without practical sense," through the "speculative researcher," the "industrial researcher" and the "engineer" to the "industrialist." He was decidedly of the opinion that such a group should develop a class consciousness, because "no profession ever emerged until it had become self conscious and organized itself on a caste system and no profession ever will."

Mr. Ross thought we ought to angle for more associates and affiliates. I wonder if he hadn't something there. "Thus, we can draw to our side those industrial leaders . . . who loom largest in the public view. . . . We need the researchers who will someday rend the atom . . . and develop means for transforming atomic energy into commercial power . . ." Prophecy speaks here; remember that these words were written in early 1921.

"Those about to be born salute you. Have we not a house prepared for them with accommodation for all?" With this paraphrase of a familiar quotation Mr. Ross concluded one of the best and most thoughful presidential addresses we have ever had.

Toronto Annual Meeting

Of course, the presidential address did not fill the *Journal*. It had a running account of the Toronto annual meeting; compressed biographies of the new officers and chairman of committees.

Radio Then

Though not entirely prophetic, an address delivered to the Hamilton Branch was partly so. The vice-president of the International Radio Telegraph Co. spoke on "Progress and Achievements in Radio Engineering," saying that his company was broadcasting from Pittsburgh "concerts, news items and weather and market reports." This service . . . is . . . by radio telephone, so . . . knowledge of the Morse code is not required. . . . Musical selections are sometimes specially rendered for this service. . . . Every Sunday evening the . . . services of a church . . . are sent out. These have been listened to as far away as Texas, Maine and Ontario. . . . The day has already arrived when . . . (a) country household . . . can listen . . . to what is going on in the city, and it is easy to foresee the time when houses will have, beside a gramophone for entertainment, wireless telephone for both news and entertainment."

Highways and Harbours

There were two technical papers in this *Journal*: "Construction of the Toronto-Hamilton Highway," by H. S. Van Scoyoc, A.M.E.I.C., and "Toronto Harbour Improvements," by E. L. Cousins, A.M.E.I.C. Both projects had been much delayed by wartime restrictions, but the one was now completed and the other well on its way.

The Toronto-Hamilton highway was conceived partly as an unemployment relief measure. It was the first long stretch of concrete road in this country, and, it appears only the second example of concrete paving of any kind, some having been previously laid in Sarnia, Ont. Construction methods were crude by today's standards, but the results were nevertheless excellent. Compressive strengths at 28 days of concrete mixed more or less by rule of thumb ranged from 2700 to 4500 lb. per sq. in., if we omit one set of samples which were obviously too sloppy, not at all bad for those days.

The Toronto Harbour Commission was almost as much concerned with the reclamation of the lands within its jurisdiction as it was in the improvement of navigation and wharfage facilities, so a good part of Mr. Cousins' paper described the filling operations of an ultimate 1900 acres. Not all of this had been finished in 1920, but about 270 acres had been leased to industrial firms by that time and they had spent some $8 million in its development. Work has continued since 1920, so that now Toronto is perhaps as well prepared for the advent of the Seaway as any lake city.

Elections and Transfers

At the meeting of Council held at the Empress Hotel, Peterborough, Ontario, on Saturday, February 25th, 1956, a number of applications were presented for consideration and on the recommendation of the Admissions Committee the following elections and transfers were effected:

Members:

R. O. Beauchemin, *Montreal*
G. S. Grimmer, *St. Andrews*
L. J. Macdonald, *Montreal*
A. J. McLaren, *Kenogami*
H. Meier, *Toronto*
C. G. Miller, *Montreal*
C. M. Mitchell, *Calgary*
K. M. Oddson, *Winnipeg*
F. D. Ross, *Toronto*
R. F. Swain, *Halifax*
W. A. Webster, *Collingwood*

Juniors:

L. C. Laferriere, *Montreal*
A. Rozanski, *Hamilton*
H. W. Siemens, *Arvida*
J. R. Soy, *Shawinigan*
B. J. Swain, *Montreal*

Transferred from the class of Junior to that of Member:

F. D. Butler, *Corner Brook*
R. E. Crysler, *London*
W. L. Dodson, *Sydney*
G. B. Dowdell, *Toronto*
E. L. Fytche, *Rio, Brazil*
O. I. Johnson, *Trail*
J. D. Lambert, *Montreal*
R. E. J. Layton, *Montreal*
R. G. Meek, *Montreal*
B. F. Reimer, *Trail*
R. Westwood, *Chalk River*
A. G. Wilson, *Ottawa*

Transferred from the class of Student to that of Junior:

G. L. Genest, *Ottawa*
D. M. McLaurin, *Hamilton*
R. M. Moore, *Trenton*
K. D. Tuddenham, *Halifax*

The following Students were admitted:

University of Toronto

D. R. Baker — W. S. Melinyszyn
K. J. C. Harries — R. Olech
T. T. Heike — W. S. Pick
E. J. Levy — K. A. Selby
O. V. Martini — J. Waggott

Nova Scotia Technical College

L. R. Baril — F. R. MacMichael
I. P. Campbell — J. C. Maurais

University of New Brunswick

D. H. Baker — R. M. Nason
G. M. McDonald

University of Alberta

D. M. Mawdsley — L. J. Schneider
E. O. Olsen — R. D. Steed

University of Manitoba

W. Anhang — G. Manchur
M. P. Enders — T. D. Rooke

Dalhousie University

P. F. Adams — P. A. Ehler
D. H. W. Dibblee — R. G. Hill

Queen's University

G. W. Bracken — G. W. Browne

McGill University

K. C. MacKenzie

Mount Allison University

L. D. Johnston

Carleton College

G. N. Fulford

Graduates

M. Bloch, B.Sc. Civil, Manitoba, 1955
J. W. S. Marshall, B.Sc. Elect., Queen's, 1955
L. Marzec, B.Sc. Engrg. Physics, Queen's, 1955
L. P. Mendes, B.A.Sc. Civil, Laval, 1955
L. Itiniant, Student, A.P.E. of Ontario
L. A. J. Lalonde, Student, A.P.E. of Ontario

Applications through Associations:

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections have become effective:

ALBERTA

Members:

A. J. Arens — E. J. Burge
R. A. Vair

Junior:

G. D. Langereis

Extending Winter Work

As the result of a meeting in July, 1955, sponsored by the Department of Labour, an independent joint committee was set up under the chairmanship of Raymond Brunet, O.B.E., president of the Canadian Construction Association, to spearhead on a national level efforts across the country to increase the volume of winter-time construction work and so to reduce seasonal unemployment.

Represented on the committee are the Canadian Construction Association, Canadian Manufacturers Association, the Royal Architectural Institute of Canada, the Labour Congresses, National House Builders' Association, Canadian Chamber of Commerce, and the Engineering Institute of Canada. The National Research Council is also taking part in the project.

W. B. Pennock, M.E.I.C., has accepted the invitation of the Engineering Institute to be their representative on the committee.

News of Other Societies

Fifth World Power Conference (Canadian Committee, Room 500, 150 Wellington St., Ottawa 4, Ont.) . . . Vienna, June 17 - 23, 1956. The theme of the conference is "World Energy Resources in the Light of Recent Technical and Economic Developments". Main divisions of the program are as follows: I—The State and Development of Power Production and Utilization in Individual Countries; II—The Preparation and Conversion of Fuels; III—Utilization of Primary Sources of Energy; IV—Purification of Waste Water and Waste Gas in the Production and Use of Energy; V—International Collaboration in the Production and Use of Energy.

The General Program is now available, giving complete information about technical sessions, tours, and travel. The program contains instructions for participants, and forms which must be returned to the National Committee in the participant's country. The membership fee of 1,200 Austrian Schillings is to be submitted with "Form A — Application for Participation" to the National Comittee. "Form C — Travel and Hotel Accommodation" must reach a Cook/Wagon-Lits Travel Office not later than April 30, 1956.

For further information, programs and forms, please contact the Canadian Committee.

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Institution of Electrical Engineers (Savoy Place, London W.C. 2). . . . a convention on Electrical Equipment of Aircraft is announced for May 2-4, 1956 in London. Twenty papers to be presented.

American Society of Tool Engineers (10700 Puritan, Detroit 38). . . . Invites papers to be presented to the 25th anniversary annual convention, April 1957. ASTE membership is not required, and papers will be accepted for consideration until May 1, 1956. Outlines of proposed papers, with information about authors should be sent to L. S. Fletcher, program director of ASTE. . . . The 1956 annual convention will be in Chicago, March 19-23.

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The American Concrete Institute will hold its 1956 regional meeting in Montreal, October 24-25, in the Mount Royal Hotel. . . . E.I.C. members may attend on the same basis as A.C.I. members. . . . Suggestions for papers are invited and information can be obtained from M. F. Macnaughton, c/o Mount Royal Paving and Supplies Ltd., P.O. Box 2000, Rosemount, Montreal.

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Canadian Technical Asphalt Association (1166 West Pender St., Vancouver 1). . . . D. T. Willis of the Provincial Department of Highways was named the first president of the new Association in October.

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Operation Research Society of Toronto. . . . Growing Canadian interest in industrial operations research has led to the formation of this Society by Toronto industry, university, and research organizations. Officers are: president, Dr. Peter Sandiford; vice-president, Dr. Josef Kates; and secretary-treasurer, Eric Sorensen.

NEWS OF THE ASSOCIATIONS & CORPORATION

Information received through co-operation with the provincial organizations

Ontario

Brief on Canada's Economic Prospects

A recommendation that the facilities of Canadian engineering schools be expanded by almost double their present size to accommodate the growing trend in engineering student enrolment has been made by the 14,000-member Association of Professional Engineers of Ontario.

In its 2,500-word brief to the Royal Commission on Canada's economic prospects, the Association suggests that such an expansion program should begin immediately and continue for the next five years. It estimates the cost at $60 millions. At the same time, the A.P.E.O. also calls for $10 millions for providing additional research and laboratory equipment in the engineering schools to meet the increased enrolment.

The brief also recommends that a study be taken at once to seek ways and means of improving the position of engineering staffs with consideration being given to the following: staff salaries and loads; recruitment of senior staff; funds to permit graduate study in engineering schools of other countries by junior staff; introduction of some form of attractive tax deduction to encourage more liberal support of engineering schools by industry; expansion of senior technical schools facilities; that industry be urged to accord professional recognition to engineering staff.

According to the brief, the proportion of professional engineers to the total working force in Ontario in 1955 is 1 to 145. Ten years ago, it was 1 to 368. The brief forecasts that by 1965, the proportion will have been reduced to 1 to 100.

The increase in proportion is due in part says the brief, to the increasing complexity of technology in industry, and a very serious present shortage of professional engineers in the Public Service at all levels. This shortage is said to be the result of government's unwillingness to align its salary rates with those paid by industry.

"We feel that Canada is much more urgently in need of the highest level of technological manpower than most other countries. This is due to the fact that 25 per cent of our annual production is exported. In many lines of manufacture we cannot compete in the world market on the basis of labour costs and therefore must resort to other devices . . . such as excellence of engineering in design, production and invention. That Canada is capable of such technological pioneering is evidenced by our contributions in atomic fission and jet plane development.

In its reference to professional recognition, the Association's brief points out that it is essential that employers of professional engineers give greater consideration to this condition. The Association adds that it is in the best interest of industry and the country's economy that the professional engineer subscribe to his one loyalty—his professional body. It points out that there is some tendency on the part of engineers employed in large numbers by individual companies to lean towards unionization in order to secure adequate consideration by employers of salaries and working conditions. It further recommends that government at all levels should be leading the way in ensuring that professional recognition is accorded members of the profession in the Public Service.

R. L. Hearn Receives Highest Honour

Ontario Hydro Chairman Richard L. Hearn has received the highest honour accorded an engineer by the Association of Professional Engineers of Ontario.

The coveted Professional Engineers' Medal, struck in 1946, and awarded to only four persons since that time, was presented to Dr. Hearn on January 28 during the Association's annual luncheon meeting in Toronto. More than 1,000 members of the Association from all parts of Ontario as well as representatives from other provinces and the United States attending the meeting.

The Engineers' Medal was awarded Dr. Hearn, not only for his contribution to Canadian engineering as a hydraulics authority but for his more recent prominence in the realm of atomic energy. He has been instrumental in making available considerable information on atomic energy for peaceful uses to Canadian industry and also in encouraging industrial enterprises to develop their own reactors.

The actual wording of the illuminated citation which accompanied the award read: "The Professional Engineers' Medal presented by the Association of Professional Engineers of Ontario for outstanding achievement by one of its members is awarded to Richard Lankaster Hearn, B.A.Sc., D.Eng., P.Eng., Chairman of the Hydro-Electric Power

The Professional Engineers' Medal is awarded to Dr. Richard L. Hearn, right, chairman of the Ontario Hydro, by Dr. G. R. Lord, left, for his outstanding achievements in the sphere of hydro-electrical engineering and for his contribution to the welfare of mankind in furthering the application of nuclear fission in peacetime uses.

Commission of Ontario for his distinguished accomplishments in the sphere of hydro-electrical engineering and for his contribution to the welfare of mankind in furthering the application of nuclear fission in peacetime uses."

The four previous recipients of the medal are Rt. Hon. C. D. Howe, Dr. C. R. Young, Gen. A. G. L. McNaughton and Dr. J. B. Tyrrell.

Recognized internationally as one of Canada's most eminent professional engineers, Dr. Hearn has been associated with many of Ontario Hydro's major undertakings since joining the Commission more than 40 years ago. As its chief executive he has played a leading role in Hydro's unprecedented power expansion program embracing major hydro-electric projects and Canada's largest steam generating installation. Latterly, he has applied his wide experience to studies of the future possibilities of producing electrical energy from atomic power.

Gold Medal Award

The Association of Professional Engineers of Ontario presented its Gold Medal award to the two engineering students graduating with the highest standing from University of Toronto and Queen's University at its annual luncheon meeting on January 28 in Toronto.

The two recipients were I. M. Duck, Kingston, of Queen's University, who is now associated with the University of British Columbia; and M. T. Grisaru, Toronto, of U. of T., who is now taking post-graduate studies at Princeton, N.J.

The awards, presented annually, also include $50 in cash to be used by the winners in the purchase of text books.

The Association also provides a $450 university entrance scholarship which is awarded alternately at University of Toronto and at Queen's to the student with the highest academic standing entering the Faculty of Applied Science. In addition, the Association grants 18 annual scholarships to University of Toronto and Queen's students in first, second and third year of $100, $75 and $50 respectively.

News of Members

Francis C. Kresz, of Toronto, has been named honorary president of the recently formed Club of Hungarian Engineers. **Michael Vegh,** also of Toronto, is the acting president of the Club.

Andrew S. Zakrzewski is president of Pneuma-Serve Ltd., of 42 Queen Elizabeth Boulevard, Toronto 14.

The Company, which has recently been organized, is licensed by Taymouth Industries of Toronto to manufacture and distribute Pneuma-Service Screw Feeding devices in Canada. Mr. Zakrzewski states that his company intends to specialize in the field of automation as well as the development and manufacture of special machines.

Frank W. Roberts, the assistant supervisor of the Hillcrest Shops of the Toronto Transportation Commission, is the author of a recent paper "The Electrical Equipment of the Toronto Subway Cars" which appeared in the Proceedings of the Institution of Electrical Engineers of October, 1955. The paper won for Mr. Roberts the IEE Oversea Premium.

Mr. Roberts graduated from the University of London in 1939 and was with the traction division of Crompton Parkinson until 1952 when he joined Bepco and six months later came to Canada. He left Bepco Canada in 1954 to join the Toronto Transportation Commission. His paper, referred to above, was first presented at a joint meeting of IEE and EIC members in Toronto in October, 1954.

John R. Baker has been appointed assistant manager of the central district at Toronto of the Linde Air Products Company Division of Union Carbide Canada Ltd.

Mr. Baker graduated in mechanical engineering from the University of Toronto in 1949 and has been with the company since that time.

Dr. Joseph Kates, of KCS Data Controls Ltd., has been appointed vice-president of the recently formed Operations Research Society of Toronto. The president of this organization is **Dr. Peter Sandiford** of Ontario Hydro, and **Eric Sorensen** of the British American Oil Co. Ltd. is secretary-treasurer.

The new society is governed by a committee representative of industry, universities, and research organizations. Industrial operations research is defined as "the objective analysis of factual information in order to develop relationships which so define a situation that alternate courses of action may be visualized and their consequences forecast in a manner capable of verification in practice."

Several members of the Toronto Society have presented technical papers before the recent annual meeting of the Operations Research Society of America, at Ottawa, early in the new year. This was the American Society's first meeting in Canada.

George F. Knight, assistant general manager of the Consumers' Gas Company of Toronto since 1952, has resigned because of other business plans.

Mr. Knight, associated with Consumers' Gas for 13 years, was responsible for all the company's outside operations, including the transmission of natural gas from the Niagara frontier, expansion of facilities and other planning and of Toronto distribution and service. He was on the board of directors from 1951 until 1954.

A graduate of Manchester College of Technology in England, George F. Knight began his career in engineering and in the manufactured gas industry in that country. He later went to the United States where he supervised construction and maintenance of boiler plants, material handling equipment, chemical plant equipment and gas production plants, including the big Station "A" plant of Consumers' Gas—closed down after arrival of natural gas early last year.

He joined Consumers' Gas in 1942 as engineer in charge of construction and maintenance, and became general superintendent of works in 1946, in charge of all the company's manufacturing facilities.

Col. H. C. Craig has recently retired from the Department of Northern Affairs and National Resources, Ottawa, and is now living in Cobourg, Ont. An engineering graduate of Queen's University, Kingston, he has been engaged in engineering and administration work of federal departments for many years. During the First Great War he was an officer in the Royal Air Force overseas and in command of repair parts and depots for aircraft and transport equipment. For a period following that war he was director of equipment for the Dominion Air Board. Latterly Col. Craig has been financial advisor in the Department from which he has just retired.

D. W. Knowles is chief engineer, gas turbines, government and industrial products division of Studebaker-Packard Corporation, Detroit 32, Mich.

Mr. Knowles, who obtained his degree in engineering at the University of Toronto in 1942, was formerly with the Continental Aviation and Engineering Corporation, also of Detroit.

George F. Martin, of Union Carbide Canada Ltd., has been transferred from Welland, Ont., to Toronto where he is assistant to the manager of purchasing. Prior to this change Mr. Martin was assistant to the superintendent of the electro-metallurgical division in Welland.

Donald R. Steele has left Philco Corporation of Canada Ltd., to join the Minneapolis-Honeywell Regulator Co. Ltd., aeronautical division, Toronto, as a field service engineer. Prior to undertaking his duties he is attending a course of instruction in the Minneapolis plant of the company.

Ferdinand De Maio has joined the development and engineering department of the Canadian Liquid Air Company Ltd., Toronto. Mr. De Maio was formerly employed by Steel Company of Canada Ltd., in Hamilton, Ont.

J. Charles Honey, of Canadian Johns-Manville Co. Ltd., calls attention to the fact that the company's new office and warehouse is located at 565 Lakeshore Road East, Port Credit, Ont.

Clarence W. Johnson, of Windsor, Ont., has been named president of Canadian Sirocco Company Ltd. Current with this announcement is that of the appointment of **Richard R. Noyes,** as vice-president of sales.

Mr. Johnson, who is an engineering graduate of the University of Wisconsin, joined Canadian Sirocco in 1932 as a district manager and during the following five years was sales engineer for American Blower Corporation, the parent company. In 1944 he was made vice-president of the Canadian organization.

Mr. Noyes, a University of Toronto graduate, joined the company in 1936 immediately following graduation. He served as a sales engineer and then as district manager in the Montreal area until his appointment as sales manager in 1952.

P. E. Kent, formerly fire prevention engineer with the Ontario Fire Marshall's office, is with the Canadian Standards Association, Weston, Ont., in the capacity of a test engineer.

Manitoba

Annual Dinner Meeting

The annual meeting of the Association of Professional Engineers of Manitoba was held in the Marlborough Hotel on the evening of January 19. The meeting was preceded by a dinner attended by a large body of the membership as well as the following guests: C. N. Blankstein, president of the Manitoba Association of Architects; J. A. Merchant, registrar of the Association of Professional Engineers of British Columbia; E. J. Durnin, president-elect of the Association of Professional Engineers of Saskatchewan, and T. M. Medland, executive director of the Association of Professional Engineers of Ontario. After dinner the gentlemen from the other provinces made some very interesting comments on their own Associations.

Internal Public Relations

Mr. Merchant discussed public relations as practised by the B.C. Association. Some of the highlights of their program included what he called "internal public relations"; the forming of Toastmaster Clubs in Vancouver, Victoria and Nelson, and a system of awarding certificates to the young engineers qualifying for membership in the Association at a public gathering about twice a year. He felt that these events would stimulate interest and pride of the members in their Association and that publicity was only of secondary importance. He stressed building from within as the best means of achieving good public relations.

Trade Unionism

Mr. Durnin of the Association of Professional Engineers of Saskatchewan gave an interesting talk on the effect of trade unionism on engineers in that province, particularly in regard to the provincial government. It was pointed out that engineers as well as members of other professions, were required by law to be members of trade unions. At present the Saskatchewan Association is making every effort to persuade the government to enact legislation which will eliminate this practice.

Salary Schedules

T. M. Medland, executive director of the Ontario Association of Professional Engineers discussed Ontario's pioneering in the field of salary schedules. It was generally felt by those present at the meeting that the obtaining of a reasonable salary schedule was a very difficult and arduous task, and that Mr. Medland and those who assisted him in this project were to be congratulated for their efforts and the satisfactory results.

After the speeches the meeting adjourned and was reconvened later by the president who presented his annual report to the Association. The highlight of the president's report was the formation of a full time office with a permanent secretary to assist C. S. Landon in his multitudinous duties. The membership had indicated previously by secret ballot their willingness to have such an office set up and the president was applauded for his efforts.

Following this message, the reports of the committee chairmen on Public Relations, Consulting Engineering, Social Functions, Examination Requirements, and the Advisory Committee were heard. There was some lively discussion and some disagreement of the work done by the committees, but generally it was felt that they had rendered good service.

J. Hoogstraten Is New President

The scrutineers' report was then given and a list of the elected Council members for 1956 was read. After a short recess, the Council then elected by secret ballot the officers, as follows: president, J. Hoogstraten, professor of engineering at the University of Manitoba; vice-president, N. Bubbis, director of the Greater Winnipeg Water District; secretary, C. S. Landon. Council Members are G. W. Moule, contract engineer, City of Winnipeg Hydro-Electric System; W. L. Wardrop, consulting engineer; D. M. Stephens, chairman and general manager of the Manitoba Hydro-Electric Board; L. A. Bateman, general superintendent of production, City of Winnipeg Hydro-Electric System.

The meeting adjourned at 10.30 p.m.

Former deputy minister of Manitoba's Public Works Department, M. A. Lyons, left, was honoured in Toronto with a life membership in the Manitoba Association of Professional Engineers. He served as its first president when it was established in 1920. Now a resident of Toronto, Mr. Lyons is the first to be so honoured by the Manitoba Association. Presentation was made by Georges Demers, Quebec, president of the Dominion Council, during the annual meeting of the Association of Professional Engineers of Ontario.

British Columbia

Engineers in the News

J. W. Birch has resigned his position with Hopkins Exploration Consultants and is now employed in the engineering department of Algom Uranium at Quirke Lake Mine, Algoma Mills, Ont.

Mark Robinson, previously of the B.C. Engineering Company, is now with Alaska Pine and Cellulose Ltd. He expects to work in the Vancouver office for a few months before going to Port Alice as assistant resident engineer.

N. E. Cooke, who recently received his Sc.D. degree in chemical engineering from the Massachusetts Institute of Technology, has accepted a position with Canadian Industries Ltd., in Montreal.

Robert M. Martin recently retired from his position with the Indian Affairs Branch, Department of Resources and Development.

J. C. Garnett, has been appointed city engineer of Victoria. He had been assistant city engineer and, recently, acting city engineer during the illness of his predecessor, **Cyril Jones.**

D. J. Baker, a graduate of the University of British Columbia, civil class of 1949, was recently in Vancouver for a short visit. He is with Lockwood, Kessler and Bartlett, Inc., and has been working in Colombia for the past few years.

J. C. Bowling, formerly a design engineer with the B.C. Engineering Company, is now with the Dominion Construction Company at Port Alberni.

G. J. Gill, has accepted a position with the Foundation Engineering Company in Vancouver. He was formerly with the Department of Public Works of Canada.

F. Leipert has left the firm of Gardner and Thornton to accept a position with the B.C. Engineering Company.

R. G. Urquhart is now working as a field engineer for H. A. Simons Ltd. at Port Alberni. He was previously with the B.C. Electric construction department at Lillooet.

W. B. Gale of the B.C. Power Commission was recently transferred from Williams Lake to the head office in Victoria, where he will take up the position of assistant to the superintendent of power districts.

J. P. Sullivan has left the employ of H. A. Simons Ltd. and taken a position with **D. W. Thomson.**

A. W. S. Stuckey is now with Foundation Engineering Co. Ltd. in Vancouver. He had previously been with R. N. Hardy and Associates Ltd. in Edmonton.

R. N. McLellan has moved his recently established consulting practice to 1166 W. Pender St. Mr. McLellan specializes in aerial tramways, cableways, light suspension bridges and general wire rope engineering applications.

S. P. Fox is now with the Canadian Institute of Timber Construction at Ottawa. He had previously been working in Toronto.

J. E. Schoevaars has accepted a position with H. A. Simons Ltd. He was previously with the Wieser Lock Company of Canada.

D. J. Baker, formerly with Lockwood, Kessler and Bartlett, Inc., in Colombia, S.A., has accepted a position with B.C. Concrete Co. Ltd. in Vancouver.

W. E. Kenny, of the B.C. Power Commission, was recently promoted from maintenance engineer to operations engineer, and will move from Nanaimo to Victoria to take up his new duties.

Charles Bentall recently assumed the duties of campaign chairman for the B.C. Heart Foundation. Mr. Bentall is a member of the board of directors and has played a leading role in the establishment of the organization.

S. D. Cavers is now research engineer with the B.C. Research Council at the University of British Columbia. He was formerly with the department of chemistry at the University of Saskatchewan.

G. W. C. Lake, until recently municipal engineer of the District of Richmond, has accepted a position with Canadian British Associates in New Westminster.

E. B. Jakeman, a 1955 civil engineering graduate of University of British Columbia, is now working for Mobil Oil of Canada at Drayton, Alta.

W. Hemerling has accepted a position with Foundation of Canada Engineering Corporation Ltd. in Vancouver. He was previously on the design staff of the B.C. Engineering Company.

W. S. Jackson, of the water rights branch, Department of Lands and Forests, has been promoted from assistant hydraulic engineer to assistant district engineer.

F. E. Rutquist has left Wells, B.C., where he was mill superintendent with the Cariboo Gold Quartz Mine, and is now living in Calgary. He is plant manager with the Alberta Ytong Manufacturing Company, makers of light-weight cellular building blocks.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Norman Keith Cameron, M.E.I.C., partner of the firm Cameron and Phin, contractors in Welland, Ont., died on December 24, 1955.

Mr. Cameron was born in Strathroy, Ont., on January 7, 1883, and received his education at the Royal Military College in Kingston, Ont. His early experience was gained with the Transcontinental Railway and with the Hydro-Electric Commission of Ontario, working on transmission lines in Ontario. In 1907 he was with Larkin and Sangster, contractors, engaged on the Trent Canal. He also worked on the Welland Ship Canal from 1913 to 1915. During the First World War Mr. Cameron served overseas with the Canadian Expeditionary Force. At the end of the war he returned to Canada and spent some time working on the Cornwall Canal at Cornwall, Ont., until 1921 when he went to New Brunswick and was in charge of concrete work for the Saint John Dry Dock and Shipbuilding Company. In 1928 Mr. Cameron went into partnership and formed the firm of Cameron and Phin, contractors, in Welland, Ont.

He joined the Engineering Institute in 1922 as an Associate Member and transferred to Member in 1940. Mr. Cameron attained Life membership in 1954.

Edmund J. Bolger, M.E.I.C., who was recently with the Cartier Construction Company on the Bersimis River Project at Forestville, Que., died on October 19, 1955.

Mr. Bolger was born in Belleville, Ont., on March 24, 1886. He attended Queen's University for two years studying civil engineering and then in 1916 enlisted in the Royal Canadian Engineers. He saw service overseas and retired from the Army with the rank of major following the end of the war.

Prior to attending Queen's University, Mr. Bolger was with the Transcontinental Railway as resident engineer and locating engineer at La Tuque, Que.

In 1924 he was with Hollinger Consolidated Gold Mines Ltd. at Timmins, Ont. Mr. Bolger subsequently spent many years in Northern Ontario engaged in the mining industry. He became mine manager in 1943 for Eldorado Mining and Refining Ltd. at Port Radium in the Northwest Territories, and in 1947 came to Ottawa as assistant to the president for the company. In 1953 he became associated with the Cartier Construction Company on the Bersimis project.

Mr. Bolger joined the Engineering Institute in 1904 as a Student. He transferred to Junior in 1911, Associate Member in 1915, and to Member in 1940. He attained Life membership in 1950.

Jean Paul Boucher, JR.E.I.C., director and general manager of St. Denis Construction of Ville Jacques-Cartier, Que., died on August 24, 1955, in Montreal, following an explosion which occurred during an inspection tour of work completed by the company in Longueuil, Que.

Mr. Boucher was born in Sorel, Que., on October 22, 1918, and received his general education there, and in St. Hyacinthe, Que. He graduated from Ecole Polytechnique in 1946 with a B.A.Sc. degree in civil engineering. He spent some time as instrumentman with Marine Industries Limited at Sorel during vacations from his university courses.

Immediately following his graduation he joined J. A. Lalonde and Company Ltd., consulting engineers in Montreal, as field engineer. He remained with this company until 1953 when he became associated with St. Denis Construction as general manager and director.

Mr. Boucher joined the Engineering Institute as a Student in 1942 and transferred to Junior in 1948.

John Alexander Reid, M.E.I.C., mining engineer, died on December 28, 1955, at his home in Toronto.

Born in Halifax, N.S., on October 23, 1877, Mr. Reid graduated from Queen's University in 1902 with a B.Sc. degree in chemistry and mineralogy. He gained general experience in gold mining from 1903 to 1908 in Nova Scotia, British Columbia and Mexico. For the next few years after that he was engaged in field exploration work in the Cobalt, Ont., area.

Then he became associated with the late Dr. P. A. Coleman in preparing the first Sudbury mining map, which later became famous over the world for its detailed geological information. After lecturing for a year at Queen's University, Mr. Reid returned to Cobalt, Ont. in 1916, where he remained for eight years as geologist and mine manager for the O'Brien Mine. From 1924 to 1934 he travelled extensively covering mining fields in Western Canada and South and Central America. In 1934 he went into private practice as a consultant. He wrote a number of technical papers on his work in Northern Ontario during the next few years.

Mr. Reid was a member of the Walker Mineralogical Club, the Society of Economic Geologists, the Geological Association of Canada, and the Association of Professional Engineers of Ontario.

He joined the Engineering Institute as a Member in 1919 and attained Life membership in 1949.

Correction

In the February issue the Journal published the biography of the late Henri A. Gibeau, of Montreal, a former director of public works for the City of Montreal.

In error, the name was given as Henri A. Gibeault. The editors regret this mistake in its treatment of the biography of a senior and respected Member.

Personals

News of the Personal Activities of Members of the Institute

Dr. O. M. Solandt, HON.M.E.I.C., who was chairman of the Defence Research Board, has been appointed assistant vice-president, research and development, of the Canadian National Railway. The appointment is effective March 1.

Born in Winnipeg in 1909, he received his early education there and in Toronto, and obtained a B.A. degree from the University of Toronto in 1931. Following two years of post-graduate work in the department of physiology, he received an M.A. degree. In 1936 he took his doctorate with honours under Dr. C. H. Best. A year of research at Cambridge University, internship at Toronto General Hospital, and further post-graduate work at the London Hospital, England, preceded his appointment to the teaching staff of the department of physiology at Cambridge, where he was subsequently named a Fellow of Trinity Hall.

Following the outbreak of the war he directed the South-West London Blood Supply Depot until 1941. He founded the Medical Research Council's Physiological Laboratory at the Armoured Fighting Vehicle School at Bovington and became engrossed in research on the physiological problems of tank personnel. In 1942 he established the operational research group, which investigated important tank gunnery problems, and in May, 1944 he was named superintendent of the Army Operational Research Group. He had already joined the Canadian Army in February, and in May was appointed acting colonel.

In 1945 he was chosen to direct the operational division of the South East Asia Command as scientific advisor to Admiral Lord Louis Mountbatten, but the war ended before he could assume this post. Instead he went to Hiroshima and Nagasaki with a joint military mission to evaluate the effects of the first atomic bombs.

Dr. Solandt returned to Canada in 1946 to join the Department of National Defence in Ottawa and take on the job of forming a permanent defence research organization for Canada. He became the first chairman of the Defence Research Board in 1947 and a scientific member of the chiefs of staff committee and defence council.

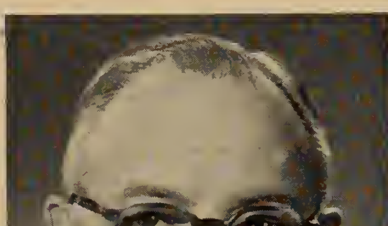
J. T. Dyment, M.E.I.C., director of engineering for Trans-Canada Air Lines, has been elected vice-president in charge of activities concerned with air transportation, for the Society of Automotive Engineers, Inc.

Mr. Dyment will head the thirty-nine member Air Transport Activity Committee. He has also been a member since 1945, and one-time chairman of the technical committee of the International Air Transport Association.

He has been associated with Canadian aviation from the time of his graduation from the University of Toronto, and since 1938 has been with Trans-Canada Air Lines. In 1943 he was chairman of the Winnipeg Branch.

Francis G. Ferrabee, M.E.I.C., president of Canadian Ingersoll-Rand Company Ltd., has been elected a director of the Ingersoll-Rand Company in New York. Mr. Ferrabee has been associated with Ingersoll-Rand since 1924, in Canada and the United States.

Mr. Ferrabee is president of the Machinery and Equipment Manufacturers' Association of Canada, a past-director of the Canadian Industrial Preparedness Association, a past-president of the Montreal Board of Trade, a member of the Canadian Institute of Mining and Metallurgy, and of the Institute of Administration.



F. G. Ferrabee, M.E.I.C.

Rear Admiral (E) John G. Knowlton, R.C.N. (Ret), M.E.I.C., has been elected president of Bogue Electric of Canada Ltd. at Gloucester, Ont. His offices will be at the company's new plant at Gloucester near Ottawa, headquarters for the production of motors and generators, power supplies, communications systems and electronic components.

Rear Admiral Knowlton had completed 37 years of service upon his retirement from the Navy. Since 1947 he has been chief of naval technical services and member of the Naval Board in Ottawa. In this capacity he directed the greatest peacetime ship-building program in the history of the Canadian Navy.

Rear Admiral (E) J. G. Knowlton, M.E.I.C.

In 1945 Rear Admiral Knowlton was awarded the O.B.E. for his World War II activities as engineer superintendent of H.M.C. dockyard at Halifax. He directed the build-up of the dockyard from a small prewar base to its present position of importance as a huge repair and operating base.

S. Logan Kerr, M.E.I.C., president of the consulting engineering firm of S. Logan Kerr & Company Inc. in Philadelphia, was recently cited by the University of Pennsylvania as one of the twenty-three alumni of its engineering school whose professional achievement, contributions to the public welfare and service to their alma mater has been recognized.

Voted by the engineering faculties, these "Centennial Citations" were conferred at the engineering alumni's annual dinner and meeting at the university a short time ago.

• *Personals*

T. A. I. C. Taylor, M.E.I.C., has been named president of the firm of Patterson Electric (Eastern) Limited, Montreal.

A 1936 graduate of the University of Alberta with a degree in electrical engineering, he was for a time with the Saguenay Power Company Ltd. at Arvida, Que., and in 1938 was transferred to the Aluminum Company of Canada Ltd., becoming electrical maintenance engineer. He remained with the company until 1942 and rejoined it in 1946 in the position of project engineer, after four years service with the R.C.E.

Later, in 1950, Mr. Taylor joined Patterson Electric. He was at that time general manager and chief engineer.

F. S. Jones, M.E.I.C., has retired from the Department of Transport after 40 years of government service. He was chief engineer of the St. Lawrence Ship Channel branch of the department, having attained that position in 1942.

He joined the Department of Transport in 1916 following his graduation from the University of New Brunswick. During the First World War he served overseas with the Royal Canadian Engineers and received the Military Cross. In 1946 he was awarded an M.B.E.

Gatineau Power Personnel

Claude Glidden, M.E.I.C., has recently retired from active service with the Gatineau Power Company, Ottawa. He has held the position of chief engineer for twenty years.

Mr. Glidden studied at McGill University, receiving a B.Sc. degree in electrical engineering and in 1922 an M.Sc. degree in mechanical engineering. He was a demonstrator in McGill electrical

R.C. Silver, M.E.I.C.

engineering department for two years, working between terms as resident engineer on a hydro electric plant for Beaubien Busfield and Company Ltd., consulting engineers, at St. Alban's, Que. In 1925 he joined the department of Railways and Canals, St. Lawrence Waterways. He became an electrical engineer with Canadian Hydro Electric Corporation, in 1926, and later, in 1930, joined the Gatineau Power Company in the same capacity. He was appointed chief engineer in 1935, and in 1951 received the additional appointment of vice-president.

Rupert F. Howard, M.E.I.C., has recently retired from his position as purchasing agent for Gatineau Power Company in Ottawa. He will continue to be associated with the company as consultant.

Mr. Howard began his career in the construction department of the Westinghouse Electrical and Manufacturing Company and worked for a time in Pittsburgh, completing the two and a half year student course offered by the company at that time. In 1907 he was transferred to the Canadian Westinghouse Company at Montreal as assistant engineer, having charge of all engineering work for the company from Ottawa to the maritime provinces.

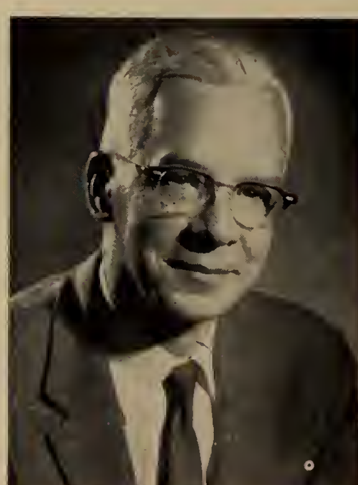
He subsequently assumed charge of the company's work at the city of Winnipeg hydro-electric plant and in 1917 was attached to the Winnipeg office as commercial engineer. Later he resigned to accept the position of chief engineer of the British American Nickel Corporation at Ottawa. He remained there until 1921 when he became connected with Messrs. Kerry and Chace Limited, consulting engineers, Toronto, as assistant in connection with investigating and reporting on the proposed electrification of the Temiskaming and Northern Ontario Railway. In 1922 he entered private practice, but gave this up in 1927 to join Gatineau Power Company and was appointed manager of power sales, then purchasing agent, with headquarters in Ottawa.

Mr. Howard is a graduate of McGill University.

Ralph C. Silver, M.E.I.C., will be assistant chief engineer of the Gatineau Power Company. He was formerly system planning engineer with the company.

Mr. Silver graduated from McGill University with a B.Sc. degree in 1927 and obtained his M.Sc. degree in 1929. From 1927 to 1929 he was demonstrator in the university's electrical laboratory. He first became associated with Gatineau Power in 1929.

He is a member of the Association of Professional Engineers of Ontario, the Canadian Electrical Association, and of the American Institute of Electrical Engineers, having served as a past chairman of the Ottawa section of the latter organization.



A. J. Chabot, M.E.I.C.

Arthur J. Chabot, M.E.I.C., has been appointed chief engineer of the Gatineau Power Company. He joined the company in 1928.

Mr. Chabot graduated with honours from McGill University in 1925 with a B.Sc. degree in electrical engineering, and was awarded the British Association Medal. Then he followed the three year advanced course in engineering with the General Electric Company, in Schenectady, N.Y., at the completion of which he joined Gatineau Power as electrical engineer.

He is a past chairman of the Ottawa section of the American Institute of Electrical Engineers, and a member of the Corporation of Professional Engineers of Quebec, and of the Canadian Electrical Association.

J. A. Michaud, M.E.I.C.

J. A. Michaud, M.E.I.C., has been elected vice-president in charge of woodlands for Consolidated Paper Corporation Limited, Grand'mere, Que. He was formerly general woods manager of the corporation, and has been with Consolidated Paper and its affiliates for 35 years.

Mr. Michaud is president of the St. Maurice River Boom & Driving Company, with which he has been associated since 1920; a director of the Quebec Forest Industries Association, the woodlands section of the Canadian Pulp & Paper Association, and of several forest protective associations.

A. G. Tanner, M.E.I.C., has accepted a position with Angus Robertson Ltd., and is assistant construction engineer on the Warsak Hydro-Electric Development in Pakistan, intending to reside in that country for 2 or 3 years.

A civil engineering graduate of the University of British Columbia, class of 1947, he was previously design engineer with the Shawinigan Engineering Company in Montreal.

F. R. Charles, M.E.I.C., has been named chief of the patents section of the National Research Council of Canada in Ottawa. Mr. Charles has been with N.R.C. since 1946.

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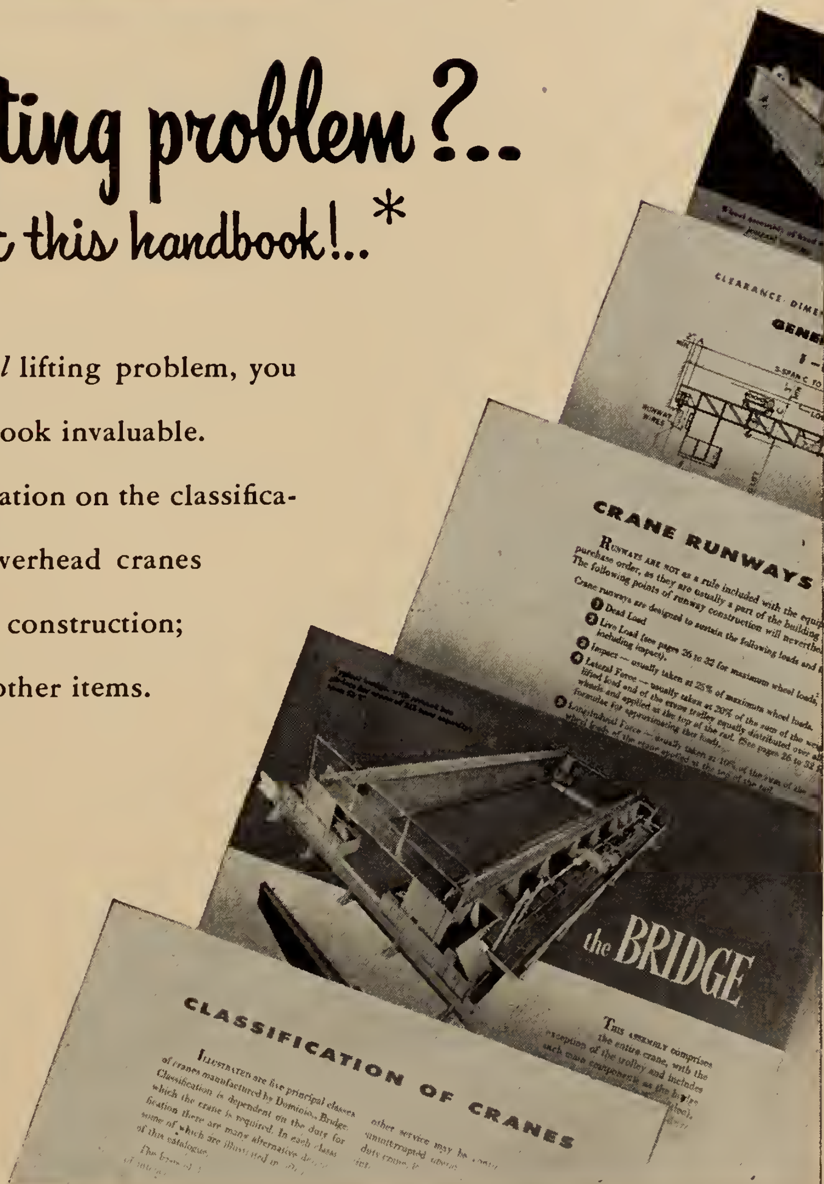

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• Personals

He is a mechanical engineering graduate of the University of Toronto and a law graduate of Osgoode Hall. During the Second World War he served as flight lieutenant with the R.C.A.F.

Mr. Charles is a member of the Patent Institute of Canada and of the Canadian Aeronautical Institute.

G. L. Brown, M.E.I.C., has been elected chairman of the Sault Ste. Marie Branch of the Engineering Institute.

He is assistant manager of L. R. Brown and Company Ltd., general contractors, Sault Ste. Marie. He has been carrying on as acting manager of the company since the death of his father and has been associated with the company since his graduation from the University of Toronto in civil engineering in 1945.

Mr. Brown was first a field engineer on construction work of various types, and was appointed assistant manager of the company in 1950.

E. K. Lewis, M.E.I.C., of Imperial Oil Limited, has been transferred from the Ioco refinery in British Columbia to the Edmonton refinery, and is with the manufacturing department.

With Imperial Oil since 1934, Mr. Lewis has been at Dartmouth, N.S., and in the engineering and development section of the company at Sarnia, Ont. In 1946 he was production manager of the Polymer Corporation and two years later became superintendent of the Imperial Oil Refinery at Montreal. He went to Winnipeg in 1951 as superintendent of the manufacturing department and was then transferred to Ioco the following year.

Mr. Lewis graduated in 1930 from Nova Scotia Technical College.

Ivan M. Wallace, M.E.I.C., has recently joined the consulting engineering firm of C. C. Parker and Associates of Hamilton, Ont., and will have general supervision of their western Ontario operations.

Since 1946 Mr. Wallace has been designing engineer and contract manager with the London Steel Construction Company Ltd. of London, Ont., and was previously with the Canadian Bridge Company Ltd., of Walkerville, Ont.

I. M. Wallace, M.E.I.C.

J. S. Johnston, M.E.I.C.

Linde Air Products Appointments

J. Stuart Johnston, M.E.I.C., has been transferred from Winnipeg to Vancouver as manager of the western district of Linde Air Products Company, division of Union Carbide Canada Ltd. He was previously district manager in Winnipeg.

Mr. Johnston has been connected with Linde Air Products Company since his graduation in 1940 from McGill University. He was in Montreal in 1947 as manager of the process service for the district.

Peter R. Maitland, M.E.I.C., has been appointed assistant manager of Western district with headquarters at Edmonton, Alta., for Linde Air Products Company. He has been sales engineer for the company in Vancouver, B.C.

He graduated in 1950 from the University of British Columbia in mechanical engineering, and has also been chief designer of the engineering department of Barber Machinery Limited in Calgary, Alta.

John F. Short, M.E.I.C., has been transferred by the Linde Air Products Company to Montreal as manager of engineering service for the Eastern district. He was previously service engineer in Toronto for the company.

Mr. Short graduated in 1949 from Queen's University in mechanical engineering and immediately became a sales engineer with the company. He was appointed service representative in Toronto later that same year.

Norman E. Duncan, M.E.I.C., is now in Cleveland, Ohio, with Arthur G. McKee and Co., where he is employed as project engineer on industrial buildings.

He was formerly with Aluminum of Canada in Montreal as a structural design engineer, and is a 1948 graduate of the University of Edinburgh with a B.Sc. degree in civil engineering.

Philip H. Morgan, M.E.I.C., is in Peshawar, West Pakistan, in the capacity of project manager for the H. G. Acres and Co. Ltd.

Mr. Morgan was previously British West Indies project manager with Sprostans Ltd. in Shooters Hill, Jamaica and in 1954 became construction consultant with Aluminum Laboratories in Montreal.

P. R. Maitland, M.E.I.C.

J. F. Short, M.E.I.C.

B. C. Palmer, M.E.I.C., has accepted a position with Mid-Canada Defence Line, in northern Saskatchewan, at LaRonge, Sask.

Mr. Palmer, who graduated from Ohio State Agricultural College in 1948, with an engineering degree has previously been engaged in hydraulic and structural design with Prairie Farm Rehabilitation Administration, Regina, Sask.

K. L. Broe, M.E.I.C., has been appointed manager of the apparatus sales division of the Canadian General Electric Company, in Calgary. He has formerly been with the company in Trail, B.C. He graduated in electrical engineering from the University of British Columbia in 1946.

W. B. Peterkin, M.E.I.C., has been named manager of Canadian Cutler-Hammer Limited in Toronto.

An electrical engineering graduate of the University of Manitoba, Mr. Peterkin was formerly district manager at Winnipeg, Man., for Amalgamated Electric Corporation Ltd. of Toronto.

R. S. Lockeberg, M.E.I.C., has moved to Ottawa and is with R. L. Crain Limited. He was formerly in Montreal on the staff of B. W. Deane & Company.

A 1947 mechanical engineering graduate of Queen's University, he has also been with Canadian Ingersoll-Rand Company Ltd. in Montreal.

• Personals

E. Jack Prince, M.E.I.C., of Dominion Iron & Steel Limited, has been elected chairman of the Cape Breton Branch of the Engineering Institute.

Mr. Prince was born in Leeds, England, and received his education at Brigg Grammar School, Scunthorpe Technical College, and Sheffield University, where he was admitted as associate in ferrous metallurgy in 1933.

Previous to joining the staff of Dominion Steel & Coal Corporation in Sydney, N.S., as research engineer in 1947, he occupied positions in various British steelworks as steelworks chemist, electric furnaceman, melting shop shift manager, assistant melting shop manager, and works metallurgist. Since 1953 he has been assistant superintendent of openhearth and electric furnaces in Sydney.

He is a Fellow of the British Institution of Metallurgists, a member of the British Iron and Steel Institute, and a member of the Association of Professional Engineers of Nova Scotia.

Mr. Prince joined the Engineering Institute in 1948 as a Member. He has been vice-chairman of the Cape Breton Branch in 1950, and secretary-treasurer in 1953, and has served on the Branch Committee since 1949.

E. J. Prince, M.E.I.C.

George F. Knight, M.E.I.C., has resigned as assistant general manager of the Consumer Gas Company of Toronto. Mr. Knight has been with the Consumers' Gas Company for 13 years, and was responsible for all the company's outside operations, including the transmission of natural gas from the Niagara Frontier, expansion of facilities and of Toronto distribution and service. He was on the board of directors of the company from 1951 to 1954.

A graduate of Manchester College of Technology in England, he began his career in engineering and in the manufactured gas industry in that country.

G. F. Knight, M.E.I.C.

Mr. Knight joined the Consumers' Gas Company in 1942 as engineer-in-charge of construction and maintenance, and became general superintendent of works in 1946. He was named assistant general manager in 1952.

He is a member of the Institution of Gas Engineers of Great Britain, the American Gas Association, and is a member of the board of directors of the Canadian Gas Association.

M. Couse, M.E.I.C., is chief engineer of the Scarboro branch office of Proctor, Redfern & Laughlin, consulting engineers of Toronto.

A 1950 civil engineering graduate of the University of New Brunswick, Mr. Crouse joined the company in 1952 as resident engineer.

• Personals

L. P. Bonneau, M.E.I.C., professor in the mechanical engineering department of Laval University, has been elected as the new chairman of the Quebec Branch of the Engineering Institute.

Professor Bonneau was born in St. Francois, Que., and completed his early education there. He graduated from Laval University in 1942 with a B.A.Sc. degree. He spent the next six years on the staff of the Canadian Johns-Manville Company as assistant engineer. In 1944 he was engineer, working on layouts for underground mining, crushing plants, and hoisting plants for the company.

He returned to Laval University in 1947 as lecturer in thermodynamics and applied mechanics. In 1951 he also acted as assistant secretary for the faculty of science and in 1954, was named full professor of thermodynamics and director of the mechanical engineering department.

Professor Bonneau is a member of the board of examiners of the Corporation of Professional Engineers of Quebec, and a member of the young engineers committee of that organization. He is on the committee of revision of the syllabus of examinations of the Dominion Council of Professional Engineers. He is also a member of the Canadian Institute of Mining and Metallurgy, the American Society for Metals, and of the American Society of Mechanical Engineers.

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

He joined the Engineering Institute in 1945 as a Member and has been active on the executive of the Quebec Branch for a number of years.

Andrew S. Zakrzewski, M.E.I.C., recently announced the formation of a new company, Pneuma-Serve Limited, in Toronto, of which he is president. This new company will specialize in the field of automation as well as the development and manufacture of special machines.

Mr. Zakrzewski was formerly with Taymouth Industries Limited in Toronto.

J. C. Pratt, M.E.I.C., is now in the research department of McCulloch Motors Corporation in Los Angeles, California, working as development engineer.

A 1942 electrical engineering graduate of the University of Manitoba, Mr. Pratt has been with the National Research Council in Ottawa, and at Winnipeg as the Manitoba representative of the Technical Information Service for N.R.C.

C. Sidney Dutton, M.E.I.C., has accepted a position as design engineer with Proctor, Redfern and Laughlin, consulting engineers of Toronto. He was formerly field engineer for Infilco (Canada) Ltd. in the Ontario territory.

Mr. Dutton graduated in 1939 from the Victoria University of Manchester with honours in civil engineering. Previous to being associated with Infilco (Canada) Ltd. he served as a design engineer on sanitary engineering projects in Britain and the United States.

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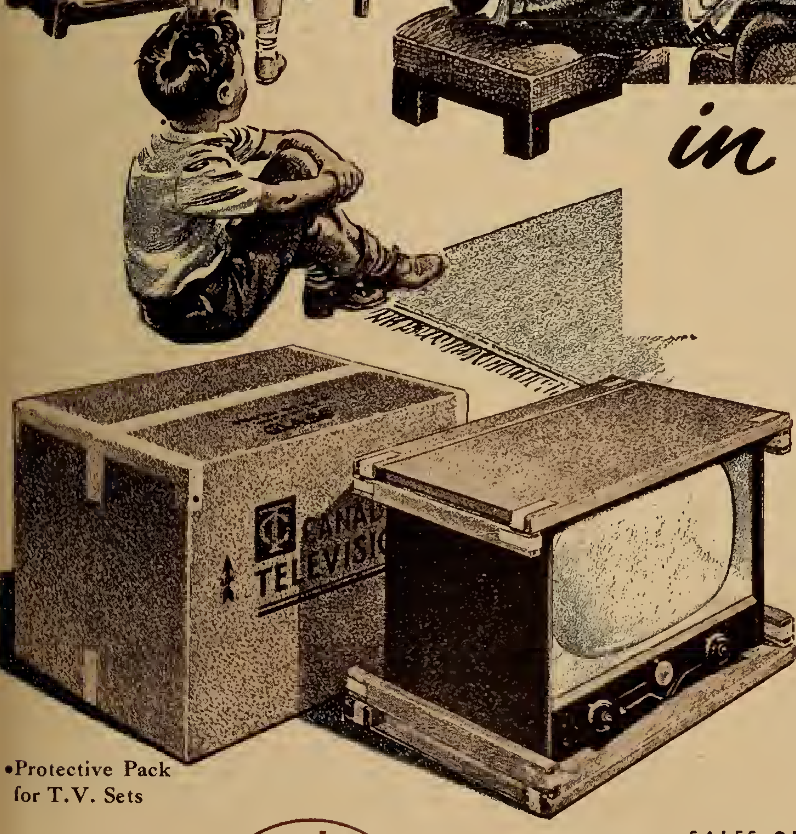

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• Personals

W. G. Mitchell, M.E.I.C., chief draughtsman with Canadian Bridge Company Limited in Walkerville, Ont., is the new chairman of the Border Cities Branch of the Engineering Institute.

W. G. Mitchell, M.E.I.C.

Born and educated in Ireland, Mr. Mitchell received bachelor degrees in engineering and arts from Trinity College, Dublin, Ireland, in 1925. After several years in the London offices of Dorman Long and Company, he came to Canada in 1929 and joined Dominion Bridge as a draughtsman. He has held the position of chief draughtsman for the company in Walkerville, Ont., for a number of years.

He is a member of the Association of Professional Engineers of Ontario, and became a Member of the Engineering Institute in 1941.

T. W. H. Stoddart, M.E.I.C., has joined the staff of Philips Canadian Industrial Development Company Ltd. in Toronto. Prior to this new position he was manager of the commercial research department of Rogers Majestic Electronics Ltd. in Toronto.

Mr. Stoddart graduated from the University of Toronto in 1941 and has also been with the Exide Battery Company and with Northern Electric Company Ltd. in Montreal as development engineer.

T. O. Whillans, M.E.I.C., is presently on retiring leave from his position as assistant commissioner of patents with the Patent and Copyright Office of the Secretary of State Department.

He joined the patent office in 1921 as an assistant patent examiner and has held progressively higher positions since that time.

Mr. Whillans graduated from Queen's University with a B.Sc. degree in mechanical engineering in 1917.

V. F. Murzo, M.E.I.C., has joined the staff of P. G. Gauthier, consulting engineer and Quebec land surveyor in Montreal as a civil engineer.

Mr. Murzo, who is a civil engineering graduate of the University of Belgrade, was formerly with Angus Robertson Limited of Montreal, working as civil engineer on the Bersimis project.

• *Personals*

N. E. Hudak, Jr.E.I.C., has joined Amalgamated Electric Corporation Limited in Toronto. He was formerly design engineer with Canadian Westinghouse Company Ltd. in the metalclad switchgear department in Hamilton.

Mr. Hudak graduated in 1948 from the University of British Columbia with a B.A.Sc. degree in electrical engineering. He was awarded the British Columbia Telephone Company Limited scholarship and returned to the University of British Columbia for post-graduate studies. He received his M.A.Sc. degree in 1951 and that year joined Canadian Westinghouse on a graduate engineer training course.

In 1953 Mr. Hudak was awarded the John Galbraith Prize of the Engineering Institute for his paper "Locations of Faults in Power Cables by Fault Generated Surges".

Lucien Jean, Jr.E.I.C., is now employed as an electrical engineer with Shawinigan Water and Power Company, at St. Therese, Que. He is a 1954 graduate of Ecole Polytechnique in electrical engineering.

R. B . Kerr, Jr.E.I.C., has joined Cooper-Bessemer of Canada Ltd., in Edmonton. He was formerly with Canadian Westinghouse Company Ltd. in Edmonton as sales engineer.

Mr. Kerr graduated in 1948 from the University of Saskatchewan with a B.Sc. degree in electrical engineering, and then joined the engineering apprentice course at Westinghouse in Hamilton, Ont.

He was secretary-treasurer of the Edmonton Branch of the Institute in 1954.

A. J. McInroy, Jr.E.I.C.

Andrew J. McInroy, Jr.E.I.C., has been appointed to the sales engineering staff of Martin Engineering Incorporated in Montreal. The announcement was made by **Lt. Colonel L. Martin,** M.E.I.C., president of the company.

Mr. McInroy received his B.Eng. degree from McGill University in 1954 in electrical engineering. Upon graduation he joined the staff of the Shell Oil Company and was employed as junior geophysicist in the exploration division at Edmonton, Alta.

He has been on the training course program of Martin Engineering up to

• *Personals*

his present appointment, and has just recently returned from a visit to the American manufacturing plants represented by Martin Engineering in Canada.

A. G. MacDonald, JR.E.I.C., has joined the staff of Wirtanen Electric Company Ltd. in Edmonton, Alta., as electrical engineer.

Mr. McDonald graduated from McGill University in 1953 in electrical engineering and has also been associated with Harrington Tool and Die Company Ltd. in Lachine, Que.

R. S. Shephard, JR.E.I.C., is now design engineer in the central engineering office of Fraser Companies Ltd. at Edmunston, N.B.

Mr. Shephard, who has returned after spending two years in England on an Athlone fellowship, graduated from the University of New Brunswick in 1953 with a B.Sc. degree in civil engineering.

F/O D. A. Walker, JR.E.I.C., has been transferred by the R.C.A.F. to Claresholm, Alta., from Lethbridge, Alta.

F/O Walker, who has been with the R.C.A.F. for some time, is a 1951 graduate in mining engineering from McGill University.

L. H. Mensforth, JR.E.I.C., has been transferred to the civilian atomic power department engineering laboratory of the Canadian General Electric Company in Peterborough, Ont. Mr. Mensforth was previously with the fractional motors facilities engineering of the same unit.

He graduated in 1952 with a B.Sc. degree in mechanical engineering from the University of Manitoba.

E. Madsen, JR.E.I.C., has been named assistant supervisor in the testing and communications section of B.C. Electric Company Ltd. in Vancouver, B.C. He was formerly service engineer with Canadian Westinghouse Company Ltd., also in Vancouver.

Mr. Madsen graduated in 1949 from the University of Alberta in electrical engineering and immediately joined Canadian Westinghouse as an apprentice engineer in Hamilton, Ont. He was transferred to Vancouver in 1952 to the service department becoming service engineer in 1953.

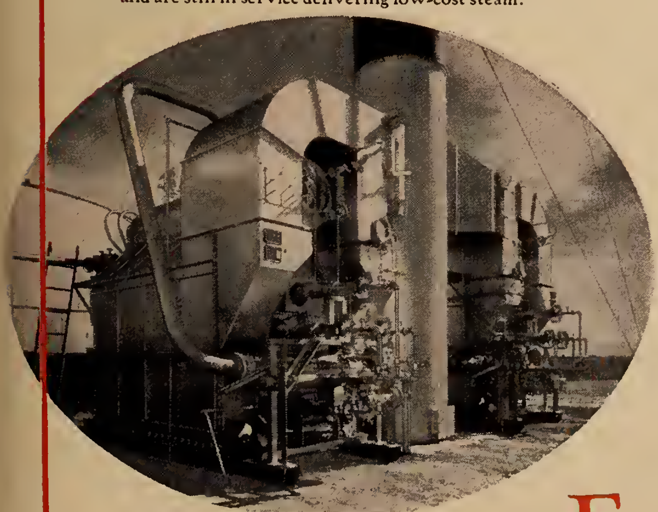
Gilles Brochu, JR.E.I.C., has accepted a position with the firm of Piette, Audy and Lepinay, consulting engineers, in Quebec City.

Mr. Brochu obtained his B.A.Sc. degree in civil engineering at Laval University in 1954. He has recently worked with the drainage service, Department of Agriculture, Quebec City, Que.

Stanley A. Herzog, JR.E.I.C., has accepted a position with the Petroleum and Natural Gas Conservation Board of Alberta, situated at Camrose, Alberta.

Mr. Herzog received his B.Sc. degree in petroleum engineering from the University of Alberta in 1952. Recently he has been associated with the firm of Black, Sivalls and Bryson Limited, Edmonton, Alta.

New Series AG-100 Packaged Steam Generator



• *Personals*

C. A. Marteinson, Jr.E.I.C., has been transferred to Calgary from Winnipeg by E. H. Price Limited. He is employed as a sales engineer and will be in charge of the Calgary office of the firm.

Mr. Marteinson graduated in mechanical engineering from the University of Manitoba in 1950 and has been service engineer with Superheater Company Ltd. in Winnipeg, Man., and with the Combustion Engineering Corporation as sales and service engineer in Montreal.

Jacques Perreault, Jr.E.I.C., is now city engineer for the City of St. Lambert, Que. He was previously construction supervisor at the Beloeil works of Canadian Industries Limited at McMasterville, Que.

He graduated in 1952 from Ecole Polytechnique with an engineering degree.

Charles S. Walker, Jr.E.I.C., has joined Sandwell and Company Ltd., pulp and paper mill consulting engineers at Vancouver, B.C. He was formerly with Canadian General Electric Company Ltd. at Peterborough, Ont.

Mr. Walker graduated in 1951 from the University of British Columbia with a B.A.Sc. degree in electrical engineering, received his master's degree in business administration from Stanford University in 1953.

W. B. Dodd, Jr.E.I.C., has returned to Canada after completing his Athlone Fellowship, and is now with the hydraulic division of Dominion Engineering Works in Lachine, Que. While in England he was employed as a graduate apprentice with British Thomson Houston Company Ltd. in Rugby. He also spent a year in Switzerland working in the turbo-supercharger section of Brown-Boveri's turbine division.

Mr. Dodd graduated in 1951 with a mechanical engineering degree from the University of Toronto, and spent some time with Canadian Industries Limited at Brownsburg, Que., before going overseas.

George Skoryna, Jr.E.I.C., has been named industrial engineer with Ford Motor Co. of Canada at Windsor, Ont.

Mr. Skoryna came to Canada from the Institute of Technology in Vienna where he received a diploma in engineering in 1943, later graduating with an M.Eng. degree from the Nova Scotia Technical College, Halifax, N.S. He has since been associated with the firm of Surveyer, Nenniger and Chenevert, in Montreal.

M. Poupard, Jr.E.I.C., has returned to the staff of Ecole Polytechnique as instructor in the mechanical engineering department, following two years spent in England on an Athlone Fellowship. While in England Mr. Poupard was employed by the Brush Group Organization, spending some time with Petters Company Ltd., Bryce Berger Company Ltd., National Gas & Oil Engines Company Ltd., and with Brush Electrical Company Ltd. He also spent some time at the University of Sheffield studying courses in mechanical vibrations and in plasticity of metals.

Mr. Poupard graduated in 1953 from Ecole Polytechnique with a B.A.Sc. degree and remained on the staff as assistant professor prior to going to England two years ago.

Robert Theriault, Jr.E.I.C., has joined the staff of the Aluminum Company of Canada at Isle Maligne, Que.

Mr. Theriault, who received a bachelor's degree in civil engineering from the Ecole Polytechnique, Montreal in 1951, has been with the rehabilitation and design department of Canadian Arsenals Ltd., Valleyfield, Que.

K. C. Read, Jr.E.I.C., has moved from Montreal to Deep River, Ont., where he is employed with Atomic Energy of Canada Ltd. on a building construction project.

Mr. Read is a graduate of McGill University, class of 1954, where he received a degree in mechanical engineering.

P. A. Preville, Jr.E.I.C., is employed as port engineer with Clarke Steamship Co. Ltd., in Montreal.

Mr. Preville graduated from McGill University in 1954 with a bachelor's degree in mechanical engineering.

George W. Newman, Jr.E.I.C., is currently employed as a plant engineer with the firm of Bulloch's Limited, Winnipeg.

Mr. Newman graduated from the University of Manitoba in 1954 with a degree in mechanical engineering.

W. A. Webber, Jr.E.I.C., has joined the radio engineering department of Canadian National Telegraphs in Toronto, Ont. He was formerly with the sales department of Rogers Majestic Electronics Ltd., also in Toronto.

Mr. Webber graduated in 1954 from the University of Manitoba with a B.Sc. degree in electrical engineering.

E. D. Blix, Jr.E.I.C., has joined the Aluminum Company of Canada Ltd. at Kemano, B.C. He was formerly with the electrical laboratory of Northern Electric Company Ltd. in Lachine, Que.

Mr. Blix graduated in 1954 from the University of Leeds with a B.Sc. degree in electrical engineering.

B. C. Kaulback, Jr.E.I.C., has accepted a position as mechanical engineer, with the Lunenburg Foundry and Engineering Company of Lunenburg, Nova Scotia.

A 1950 engineering graduate from McGill University, Mr. Kaulback has previously served as assistant to the division manager, ammunition department, Canadian Industries Limited, Montreal.

G. I. Fekete, Jr.E.I.C., has been transferred to Montreal from Brownsburg, Que., by Canadian Industries Limited For the past year and a half he held the post of production and process engineering assistant. He now takes on head office duties as assistant project engineer, engineering department.

Mr. Fekete obtained his mechanical engineering degree at McGill University in 1954.

P. M. Evjen, S.E.I.C., a civil engineering graduate of the University of Alberta in 1955, is now employed by the Alberta Department of Highways, at Stony Plain, Alta., as resident highway engineer.

J. C. Clark, Jr.E.I.C., is now employed as manufacturing engineer with the electronics division of Canadian Westinghouse Company Ltd. in Hamilton, Ont.

J. C. Clark, Jr. E.I.C.

Mr. Clark received his engineering degree from the University of Saskatchewan in 1951 and then joined the Robinson Machine & Supply Company in Calgary, Alta. In 1953 he was awarded an Athlone Fellowship spending the following two years in England.

Maurice L. Desjardins, Jr.E.I.C., is employed by the Quemont Construction Inc., Montreal, as the assistant to the chief engineer, buildings division.

Mr. Desjardins graduated in 1954 with a degree in civil engineering, from the Ecole Polytechnique, Montreal.

Richard F. Dee, Jr.E.I.C., is at present employed with the Ontario Hydro as a junior engineer on an engineering program. He is temporarily working in the rehabilitation and relocation schemes of the St. Lawrence Seaway Project.

Mr. Dee, a 1954 graduate in civil engineering, received his degree from the University of New Brunswick.

K. J. Fallis, Jr.E.I.C., has joined the staff of the Manitoba Hydro Electric Board as resident engineer of the Brandon generating station, Brandon.

Mr. Fallis graduated in civil engineering from the University of Manitoba in 1949 and has been associated with the Winnipeg Electric Company, Winnipeg, Man.

James S. MacDonald, Jr.E.I.C., is employed as an engineer with the Bell Telephone Company of Canada Ltd. in Montreal. He was formerly in Sydney N.S. with Dominion Coal Company Ltd

Mr. MacDonald graduated in 1950 from Nova Scotia Technical College with a bachelor's degree in mechanical engineering and has also been with Canadian Vickers Limited in Montreal as industrial engineer.

Armand Couture, Jr.E.I.C., is now employed by the Foundation Engineering Corporation of Canada in Montreal.

Formerly with the National Harbour Board in Ottawa, Ont., Mr. Couture is a civil engineering graduate of Laval University, class of 1953.

Wm. J. Roy, Jr.E.I.C., has rejoined the engineering department of the City of Lethbridge, Alta. He was town engineer at Fort MacLeod, Alta.

Mr. Roy graduated in civil engineering from the University of British Columbia in 1951, and in 1953 was with the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TO THE PEOPLE

• Personals

engineering department of the City of Lethbridge, prior to going to Fort MacLeod.

I. Thomassen, Jr.E.I.C., is now employed as a structural engineer with H. A. Simons Limited in Vancouver, B.C. He was previously with the Hydro-Electric Power Commission of Ontario in Toronto.

Mr. Thomassen graduated in 1954 from the University of Manitoba in civil engineering.

Z. E. Wasarab, Jr.E.I.C., has accepted a position as product development engineer with Clayburn Company Limited in Abbotsford, B.C.

Mr. Wasarab, who graduated in mechanical engineering from the University of Saskatchewan in 1954, was previously with Northern Electric Company Ltd. in Montreal.

Gordon S. Roy, Jr.E.I.C., has moved to the United States and is with the Consumers Power Company in Jackson, Michigan, as assistant distribution engineer.

Mr. Roy graduated from Nova Scotia Technical College in electrical engineering, class of 1954. Recently he was with the engineering staff of the Shawinigan Water & Power Company in Three Rivers, Que.

Pierre Brillon, S.E.I.C., who graduated in 1955 from the Ecole Polytechnique with a B.A.Sc. degree in electrical and mechanical engineering is now with Hydro-Quebec at Labrieville, Que.

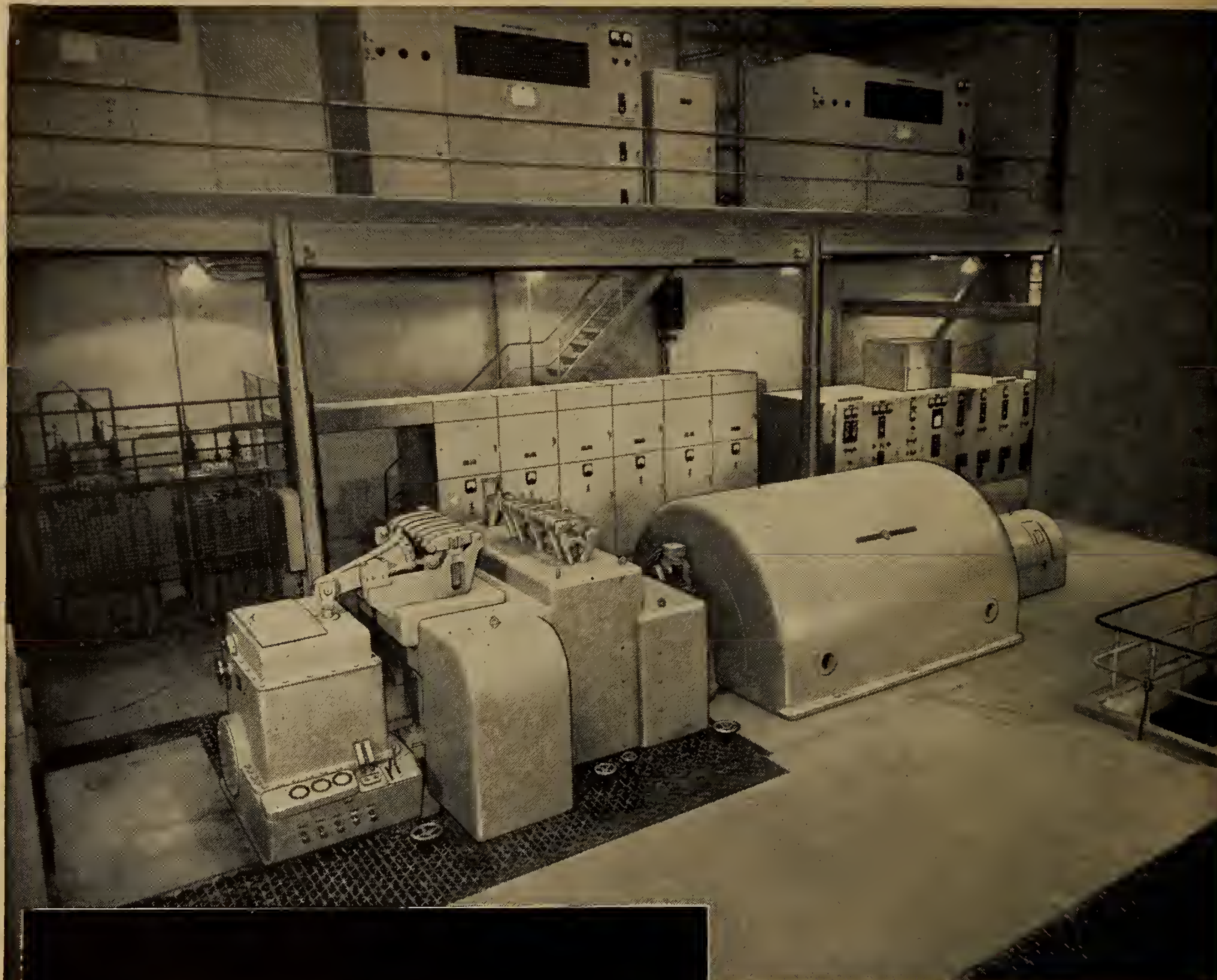
J. T. McManus, S.E.I.C., is presently employed as a petroleum development officer with the Saskatchewan Department of Mineral Resources, Swift Current, Sask.

He is a 1955 graduate from the University of Saskatchewan School of Engineering.

D. W. Tutt, S.E.I.C., who graduated in 1955 from the University of Toronto with a B.A.Sc. degree in civil engineering is employed with Mobil Oil of Canada Limited, Drayton Valley, Alta.

Francis M. Yamada, S.E.I.C., has been transferred to the Sao Paulo Light and Power Company Ltd., from the Rio de Janeiro Tramways, Light and Power Company Ltd. Both of these utilities are among the operating companies of the Brazilian Traction, Light and Power Company Ltd., of Toronto, Ont.

A 1955 graduate of the University of Toronto, with a B.A.Sc. degree in engineering, Mr. Yamada went immediately to Brazil. Prior to graduation he was associated with the Stone and Webster Engineering Corporation for two and a half years as office engineer and acting resident engineer during the construction and preliminary operation of the Richard L. Hearn Generating Station, in Toronto, Ont. He has also been with the Fletcher Manufacturing Co. Ltd., formerly of Toronto, Ont., as a mechanical design draftsman.



General Electric Steam Turbine Generator and Plant Switchgear, Transformers and Control at the Saint John Mill of Irving Pulp & Paper Ltd. Turbine is rated 12,500 KW at 3600 RPM and 6,900 volts. Single Automatic Extraction, non-condensing — installed in 1955

G-E Turbine at Irving Pulp and Paper Limited lowers operating costs

TO KEEP operating costs to a minimum, the Irving Pulp and Paper Limited of Saint John, New Brunswick, has chosen a G-E Steam Turbine Generator for its new plant — thereby lowering operating costs. In addition to the Turbine Generator, Canadian General Electric also supplied Switchgear, Transformers, and Control Equipment for the plant.

The Single Automatic Extraction, Non-condensing Turbine used is rated at 12,500 KW at 3600 RPM and 6,900 volts. It takes steam at

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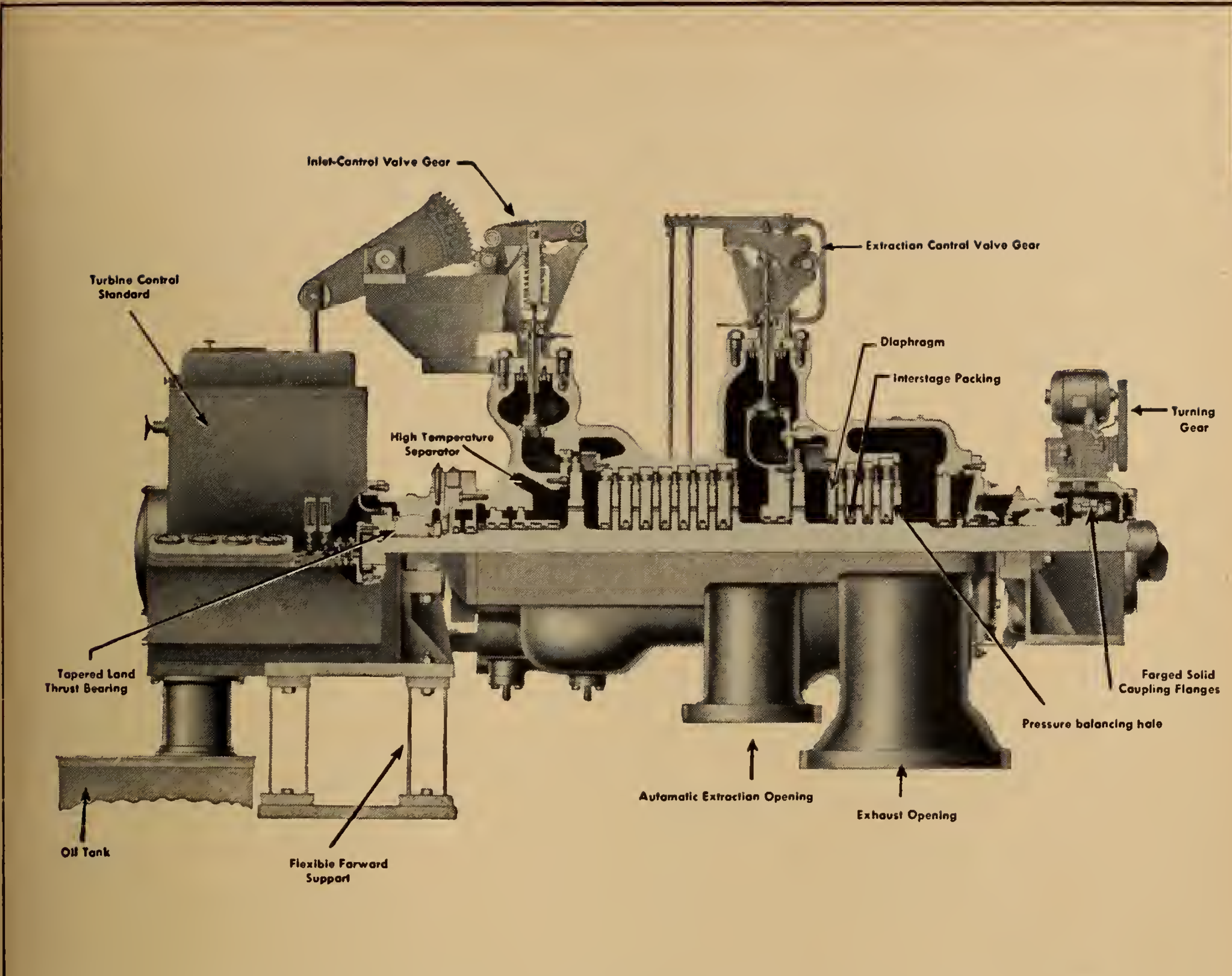

Sectional view of General Electric single automatic-extraction, non-condensing steam turbine. High pressure steam passing through turbine produces economical by-product power — with steam extracted and exhausted at lower pressures for plant processes.

850 psig, 825°F., automatically extracts at 140 psig and exhausts at 40 psig for plant process uses.

G-E single or double automatic extraction units in other plants throughout Canada are continually providing economical by-product power and process steam.

This Turbine Generator installation at the Irving Pulp and Paper plant is another example of the manner in which C-G-E works with pulp and paper companies to increase production and lower operating costs. In fact . . . C-G-E supplies 75% of all Turbines for the Pulp and Paper Industry.

Canadian General Electric leads the field in supplying Turbine Generators for Canadian industry — leads too in engineering techniques . . . continually devising new and better methods to keep plant operating costs at the lowest possible level.

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Belleville

J. A. Grant, M.E.I.C.,
Secretary-Treasurer

W. M. Hogg Discusses Power Project

A general meeting of the Belleville Branch was held on January 16, 1956, the fourth meeting of the 1955-56 season. Approximately 60 members and guests attended.

Mr. W. M. Hogg of the Hydro Electric Power Commission of Ontario spoke on the St. Lawrence Power Project. Mr. Hogg's talk was accompanied by coloured photographic slides of the project in various stages of construction.

The speaker was introduced by E. G. Gurnett and thanked by Mr. J. A. Grant.

Brockville

K. R. Bullock, Jr.E.I.C.,
Secretary-Treasurer
F. Trewartha, M.E.I.C.,
Branch News Editor

Joint Meeting With C.I.C.

The Brockville Branch held a joint dinner meeting with the Brockville-Prescott section of the Chemical Institute of Canada, on January 17, at the Manitonna Hotel in Brockville. Sixty members heard William Hogg, field project engineer of the H.E.P.C. of Ontario speak on the St. Lawrence Power Development.

Wm. Hogg Guest Speaker

The many phases of the project were discussed and the progress and difficulties encountered were reported upon. His talk was illustrated with coloured slides showing scenes of recent construction. Mr. Hogg's subject was of considerable interest to his audience many of whom are involved with the changes being made in the St. Lawrence River.

Mr. Hogg was introduced by D. A. S. Laing and thanked by F. F. Walsh, past chairman.

J. S. Waddington is Speaker

On Tuesday evening, February 14 at the cafeteria of Phillips Electric, J. S. Waddington of that company described the fabrication and installation of the 13.2 kv. power transmission line to Pelee Island from the mainland. Films and slides were used to illustrate the presentation.

Approximately 11 miles of 13.2 kv. single conductor 1/0 submarine cable (ground return) were manufactured in two lengths and shipped by railway on spools to the area. Here the cable was transferred to a barge and while in the process of rewinding on the barge, the two lengths were spliced. Laying of the cable involved the hazards of weather and of crossing a busy ship channel.

Mr. Waddington discussed the methods of manufacturing and testing. In conclusion he commented on the recent failure of the cable due to ice formations and described the efforts being made by the owner, H.E.P.C. of Ontario, to resume services to Pelee Island.

Mr. Waddington was introduced by R. H. Wallace and thanked by George Fowler.

Cornwall

L. H. Snelgrove, M.E.I.C.,
Secretary-Treasurer
W. Rothwell, M.E.I.C.,
Branch News Editor

Annual General Meeting

The annual general meeting of the Branch was held at the Cornwall Golf and Country Club, on Monday, January 30, 1955, dinner being served at 7.00 p.m.

Reports were given by the secretary-treasurer, L. Snelgrove, and the chairmen of the program and entertainment committees. A report on student guidance was given by W. Nesbitt, who suggested that ways and means should be sought to present more information and advice to potential engineering students at an earlier age, stressing the advantage of a general course in the high school rather than a technical course for those wanting to become engineering graduates. The meeting was later thrown open for general discussion of this topic, and members indicated their keen interest in the subject by discussing the problems involved at some length.

Branch Bursary

The Branch is sponsoring a bursary for award annually to a student of engineering from the Cornwall district tenable for one year, and made possible from funds subscribed by local industries. Drummond Giles, chairman of the Bursary Committee gave his report, and was able to tell the meeting that funds had been assured for this purpose and further details would be announced later.

The chairman, Jack Morris, announced to the meeting that the president would be visiting the Cornwall Branch on Wednesday, February 22, and that a dinner and dance had been arranged for the occasion to which the Brockville Branch members and their ladies had been invited.

P. Nasmyth, chairman of the nominating committee, announced the election of two members to the executive, Vic Harrison and Dave Burnham.

Hamilton

A. F. Barnard, Jr.E.I.C.,
Secretary-Treasurer
R. R. Parker, Jr.E.I.C.,
Branch News Editor

Radioactive Isotopes

At the January meeting of the Hamilton Branch Dr. P. J. Stewart, director of radiography for Isotope Products Limited, described the nature and manufacfacture of radioactive isotopes.

Radioactive isotopes, he said, are produced by irradiation in nuclear reactors, of which Canada has one of the most powerful in existence. The irradiated materials look the same as the normal element or compound, but contain active isotopes which emit characteristic radiations of which the most significiant are called beta (electrons) and gama (short-wave electromagnetic radiation, comparable with X-rays). Breakdown of some radioactive elements produces other active isotopes—another source of radioactive material.

Radiation emitted is characteristic of the element and a wide range of gamma wavelengths is available. The life of an active isotope is also characteristic and varies from seconds to years; the half-life (time for half of the active material to decay) of cobalt 60 is five years, that of radio-sodium 13 hours.

Industrial Uses

Industry makes the widest use of the radiation from radioactive isotopes for gauging materials and for radiography. Thickness gauges are based on the variation of absorption of beta-radiation by different materials or thicknesses of material. Applications include measurement and control of paper, rubber, and metal sheet thickness; coating thickness; and profile. Densities of fluid and solid phases in process industries may also be measured.

Gamma radiation is widely used to obtain radiographs of castings, structural materials, welded vessels and pipelines Exposure time is relatively long, but isotope sources are more convenient than X-ray equipment for use in confined spaces, greater penetration is obtainable, complete vessels may be radiographed at one exposure, and constant energy radiation gives sharp pictures.

• Branch News

Halifax

W. D. Pippy, M.E.I.C.,
Secretary-Treasurer

Joint Annual Banquet

One of the highlights of engineering activity in the Halifax area is the joint annual banquet of the Halifax Branch of the Institute and the Association of Professional Engineers of Nova Scotia.

Under the capable direction of Committee Chairman W. T. Windeler, the banquet, held on January 31 this year, was an outstanding success. Included in the list of distinguished guests were Premier Henry Hicks, Lieut. Gov. Alistair Fraser, and representatives of many organizations with interests in the engineering field.

Comdr. F. W. H. Bradley Guest Speaker

The principal speaker of the evening was Commander F. W. H. Bradley, Comdr. Air, Shearwater Naval Base, who described the role of aviation in naval strategy, tracing developments from earliest pioneering to the recent adoption of Banshee Jet aircraft by naval units.

Co-Chairmen G. A. Cunningham, representing the Institute, and C. N. Murray of the Association, remarked on the close and happy relationship which has existed between these bodies at all times. Seating capacity was taxed to the utmost by 300 engineers from all parts of Nova Scotia who joined in the festivities.

Among the guests at the annual banquet of the Halifax Branch and the Association of Professional Engineers of Nova Scotia were the Lieutenant Governor and the Premier of Nova Scotia. Chatting with the co-chairman of the meeting, they are, left to right: Premier Hicks, C. N. Murray of Sydney, Lieutenant Governor Fraser, and G. A. Cunningham of Halifax.

Kitchener

B. D. McCaffrey, Jr.E.I.C.
Secretary-Treasurer
J. L. Fair, M.E.I.C.
Branch News Editor

The President's Visit

January 24 marked the president's visit to the Hamilton and Kitchener Branches, as well as the annual meeting of the Kitchener Branch.

Dr. and Mrs. Heartz, accompanied by the assistant general secretary, E. C. Luke, met at luncheon in the Walper House, Kitchener, with members of the executives of the branches and some of their wives. During the afternoon the president conferred with executive members on Institute affairs, rejoining the ladies at a five o'clock reception.

Dinner Meeting

Dinner was held at the Kress hotel

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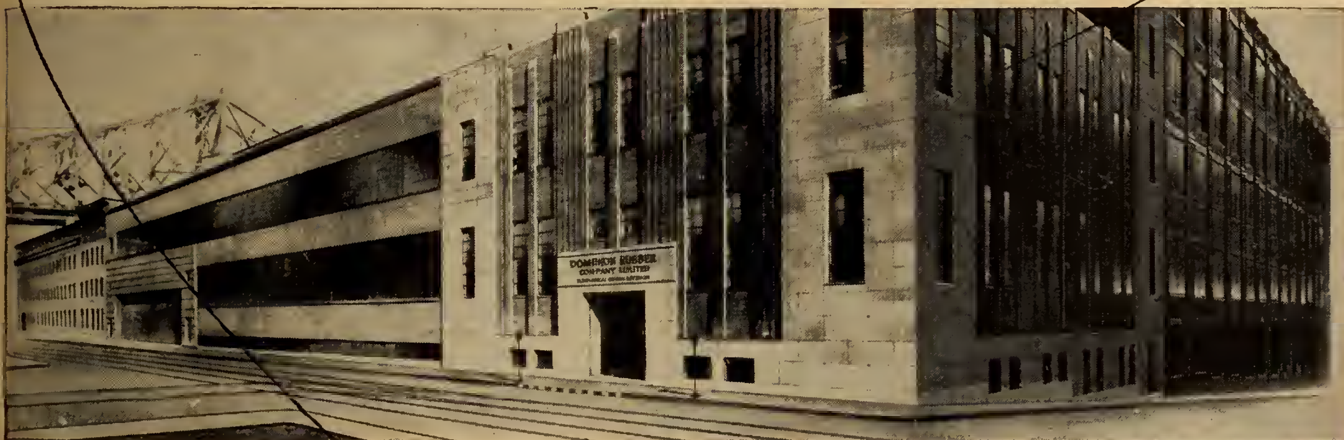

THE choice of Bristol automatic controls by the Dominion Rubber Company Ltd. is a significant one. Not only was Dominion the founder of the rubber industry in Canada but today it is one of Canada's most important producers of rubber and plastic products. In keeping with its more than a century of leadership, Dominion insists on the highest standards of precision control over this vital vulcanizing process. Naturally, we are proud that Bristol instruments are used on this crucial job.

The same qualities of accuracy and rugged dependability that recommend Bristol Instruments to Dominion Rubber, have made them the choice of the leaders in every field of industry.

If you have a problem related to instrument control engineering, involving recording, measuring or controlling, get in touch with us—we will be pleased to make a specific survey, report and estimate.

One of the colourful episodes in Dominion Rubber's long history was the land office business it did manufacturing rubber boots for the Klondyke Gold Rush miners. It's a far cry from the equipment of those days to the immense vulcanizer in the Mechanical Goods Division, Montreal. The largest in Montreal, it is typical of the plant's advanced equipment. In the foreground are some of the Bristol instruments which automatically control its operation.

Product reliability has always been stressed at the Dominion Rubber Company. Bristol instruments do their part by precisely controlling and adjusting temperatures and pressures according to a predetermined time schedule. To the left are Bristol diaphragm-operated control valves.

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MEASUREMENT OF INDUSTRIAL PROGRESS

• Branch News

in nearby Preston with about 85 members representing the two branches. Due to the illness of the retiring chairman, L. J. R. Sanders, a past chairman, W. R. Roberts, presided. A. J. Girdwood, another past chairman, introduced the president.

Dr. Heartz delivered a pointed and challenging address on the requirements for training engineers to meet the growing needs of Canada and the responsibility of the profession in making possible the achievement of the new objectives. He emphasized the need for more graduates, more competent graduates, and the importance of filling the gap between the secondary schools and the universities.

". . . Increasing the engineering student body, reducing the number of failures, and improving the quality of the graduate, all highly desirable, is a complex problem which has some of its roots, I fear, at high school level, or possibly even earlier," he said.

"While the universities have done an excellent job, often under trying conditions, it seems the time has come for them to modify their programs to suit existing and probable future demands. . . . As engineering knowledge spreads further and deeper, and life becomes increasingly complex," he added, "there is an urgent need for more engineers who, in virtue of their basic training, will be qualified to solve not only the problems of today, but be in a position to handle the new ones tomorrow.

"We cannot expect the universities to carry out their monumental task without our moral and financial support. We must think more about the universities and we must increase our contributions substantially, and convince others to do likewise, if we are to carry our full share of responsibility," Dr. Heartz said.

Following the address the assistant general secretary, E. C. Luke, gave an interesting account of Institute affairs for the past year. Mr. Roberts introduced the new executive and the incoming chairman, W. R. Runge, spoke briefly.

December Dinner Meeting

Kitchener Branch members and friends joined with the Kitchener-Waterloo chapter of the Canadian Welding Society and the Grand Valley chapter of the American Society of Tool Engineers for a dinner meeting at the P.U.C. Restaurant in Kitchener.

Harry Thomasson, manager of the mechanical and metallurgical section of the Canadian Westinghouse Research and Development Laboratory, addressed the meeting. The speaker showed his usual intense, almost infectious, interest in this industrial art and science as well as his great "knowledge of familiarity." Special reference was made to metallurgical problems associated with the highly alloyed steels common in the manufacture of tools and certain non-ferrous alloys in use today. Mr. Thomasson also discussed the role of pre-welding and post-welding heat treatments in coping with some of the problems he described. A spirited discussion followed.

Mr. Thomasson rounded out the evening with a presentation of some outstanding 3-D colour slides of flowers.

Lethbridge

R. D. Hall, jr.e.i.c.,
Secretary-Treasurer

R. B. Godwin, jr.e.i.c.,
Branch News Editor

E. A. Olafson is Speaker

E. A. Olafson, engineer in charge of drainage, P.F.R.A., Vauxhall, Alta., was the featured speaker at the regular January meeting of the branch. Mr. Olafson has recently returned from a two-year assignment under the United Nations Food and Agricultural Organization in India, and during the assignment he visited irrigation and drainage projects in Holland and Egypt.

In his address Mr. Olafson presented a brief review of the political history of

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Pakistan. Pakistan was formed in 1947 of two widely separated areas containing peoples of predominantly Moslem faith. East Pakistan, in the extreme East of India is a very wet area, with an exceptionally high annual rainfall. West Pakistan is a dry area, with large desert sections and with some 20 million acres under irrigation. The irrigation projects, started by the British engineers some 30 years ago, dwarf irrigation achievements in Canada. The very flat country, however, makes storage of water, except in the mountain region, almost impossible, and the system has no water storage. Water tables have risen so much that some 800,000 acres of irrigable land have been almost ruined due to salinity of the soil. It was in the phase of land drainage that Mr. Olafson received his assignment.

Irrigation in Pakistan

The only practicable method of land drainage devised to date is by a system of wells and the lack of electricity is a great deterrent to the success of the operation. Almost all work is performed by primitive methods. Mr. Olafson stated that machinery cannot be used by the Pakistanis with any measure of success due to their almost complete lack of experience with machinery and equipment. Wells are dug by hand and electricity provides the power for pumping where possible.

Due partially to political difficulties, the F.A.O. drainage project has now been abandoned. Education and training and stable political leadership are badly needed, as is electric power and industrialization in this predominantly agricultural country.

British Engineering Praised

Mr. Olafson expressed praise for the British engineering and accomplishments in the field of irrigation in Pakistan. He stated that at present wheat is grown in winter, and that two or three crops can be harvested annually. Recent low rainfall has caused non-productivity and famine, however the speaker expressed confidence in the eventual success and ability of Pakistan to provide food for its population and for export.

West Pakistan has some 2,400 miles of main irrigation canals. Water is carefully controlled to minimize silting of the canals since dredging on a system of this size is virtually impossible.

Following his address, Mr. Olafson showed a short film on Pakistan, and colour slides he had taken covering pertinent projects and places of interest in Pakistan, Egypt, Palestine and Holland. Mrs. Olafson and their four small children accompanied Mr. Olafson during this interesting, if only partially rewarding assignment.

Walt Thomson introduced Mr. Olafson, and Charlie Moore expressed the thanks of the membership present for his very interesting and educational address.

Mr. and Mrs. Geo. Brown provided dinner music and accompaniment for community singing led by George Brown.

Novelty vocal numbers were presented by very charming and talented young Miss Dolores O'Connell, who was accompanied at the piano by her father.

R. A. Thrall is Speaker

Alberta has a large percentage of the world's known reserves of coal, tremendous petroleum and timber resources; however, these are only a small part of the important resources of this province, according to R. A. Thrall, guest speaker at the Lethbridge Branch regular dinner meeting held February 11.

In his talk, Mr. Thrall, a prominent Lethbridge business man, manager of the McIntyre Ranching Company, the Summit Lime Works, and Mountain Minerals, listed resources roughly into two main classifications, human and physical. The physical resources may be further broken down into three main classifications. First, those which do not diminish with use such as air and scenery. Second, there are the recurring resources such as rain, grass and other crops, and livestock. Under the third sub-classification come the disappearing resources such as petroleum, mined minerals and timber. Whereas timber does recur the time for this to take place is so long that it may be classified as

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non-recurring for practical considerations.

Alberta's Resources

When we consider the clear pure air of this province we take too much for granted. Industrialization on a large scale can cause smog conditions such as found in Los Angeles and London.

Water is a resource which is often in short supply. Mr. Thrall noted that it costs about 5c per ton to purify salt water, and Lethbridge water is sold for from 5c to 12c per ton. A prominent oceanographer Professor Isaacs has estimated that Antarctic icebergs weighing 1,000 million tons, could be towed and floated with the aid of the Humbolt stream to Los Angeles for approximately one million dollars, or one tenth cent per ton. Such an iceberg containing only pure water would be worth 10 million dollars at 1c per ton.

Referring to Western Canadian and local engineering, the speaker suggested that water conservation projects such as the South Saskatchewan river irrigation scheme should be proceeded with as soon as practicable in order to conserve this practical resource. Water uncontrolled can cause havoc, and Mr. Thrall suggested that the gas turbine-generator for Lethbridge might be installed away from the steam plant and out of the river valley in order to achieve protection from floods.

At the home of J. L. Armstrong and Mrs. Armstrong in Nobel, Ont., engineers were entertained to a buffet supper and an Ontario Hydro-Electric Power Commission film on December 1. Front row, left to right: P. G. White, W. Ayers, J. C. Conrath and R. A. Nutt. Second row: P. A. Ross-Ross, C. Fry, J. L. Armstrong, F. Alport, E. P. Guloien, and M. L. Rooney. Back row: C. A. Margison, H. R. Montgomery, R. Harper, Col. L. F. Grant, A. Rowbotham, and J. A. Chant.

Livestock and Minerals

Wherever good livestock are in evidence, good civilization is in evidence also. Lethbridge used to be in the midst of one of the world's finest grass areas, and grass and consequently livestock are very important resources of this province.

Alberta stood third among the provinces in 1955 in mineral production, largely because of petroleum which pro-

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Roto-King Pumps are manufactured only by Viking Pump Company, Cedar Falls, Iowa, U.S.A.

THROUGH ERROR, our advertisement for Roto-King pumps in a recent issue of this magazine showed illustrations upon which the word "Viking" appeared. "Viking", in Canada, is the registered trade mark of Viking Pump Company, Ltd. of Windsor, Ontario, Canada, and our use of that mark in Canada was unauthorized. We regret this error. In the United States the "Viking" mark has been owned and the pump manufactured since 1911 by the original Viking Pump Company of Cedar Falls, Iowa, U.S.A.

Our November ad announced Roto-King pumps. "Roto-King" in Canada is the registered trade mark of Viking Pump Company, Cedar Falls, Iowa, U.S.A. which has no connection whatever with the Canadian company.

Viking Pump Company, Cedar Falls, Iowa, U.S.A. is the world's largest, exclusive manufacturer of positive displacement rotary pumps. It originated the "gear-within-a-gear" principle in 1911, and has been continuously engaged in the manufacture of a full line of positive displacement rotary pumps embracing that principle ever since.

Its pumps have been sold throughout the U.S.A. since 1911 and in most nations of the world under its trade mark "Viking", but are marketed in Canada under the trade mark "Roto-King".

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including iron and brass castings from its own foundries, a large engineering and research staff constantly seeking improvements,

and modern manufacturing methods utilizing the latest developments in metal working,

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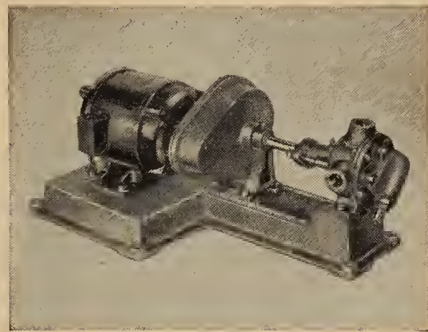
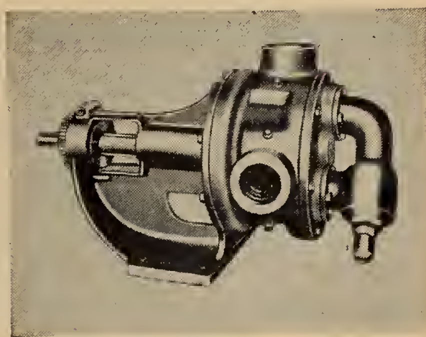
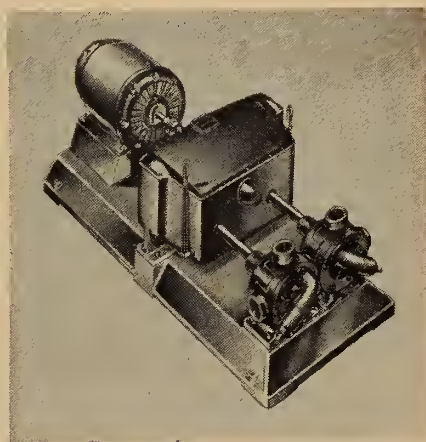


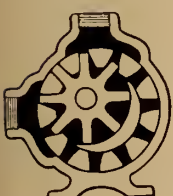
General purpose pump mounted gear drive unit.



LP-Gas truck mounting pump.



Oil pump all-weather twin



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• Branch News

vided the highest dollar value of any of Canada's mineral resources. Other minerals in order of value were copper, nickel, gold, zinc, iron ore, asbestos, coal and lead.

The Mountain Minerals plant in Lethbridge processes barytes, pyophyllites, talc, volcanic ash. Barytes which weighs 300 lbs. per cu. ft. is used for "heavy mud" for oil well drilling.

The human resource must be improved if other resources complemented by nuclear energy are to be used to the benefit of mankind. Mr. Thrall stated he looks to the future with the greatest of confidence.

C. S. Clendening introduced Mr. Thrall, and the thanks of those present was expressed by C. E. Little.

Musical entertainment was provided by Brown's Orchestra who supplied dinner music and accompaniment for community singing ably led by Bob Lawrence, George Brown, and Ron Jones. The "Serenaders" favoured the meeting with several barber shop quartet numbers, and encores.

Montreal Junior Section

John Mikulec,
Secretary-Treasurer
Yvan Montcalm, Jr.E.I.C.,
Publicity Chairman

Annual Meeting

The annual meeting of the Junior Section, Montreal Branch, took place on January 16 at headquarters. It was the scene of an election which resulted in the appointment of four new directors, namely, Messrs. Jim Coke, Simon Marcotte, Robert Walker and G. Vermette.

G. L. McLean Elected Chairman

New Chairman G. L. McLean told the members in attendance that every effort would be made to arrange a program that would differ from that of other years and urged all young engineers to participate in the activities of the Institute.

Executive Members

Other members of the executive are: Jacques Soucy, vice-chairman; John Mikulec, secretary-treasurer. Heading committees and working groups are: André Bérard, Steve Bloomer, Jean Blouin, William Broughton, William Cameron, Jean Dubuc, Gaetan Ducharme (ex-officio), Maurice Joubert, Yvan Montcalm, Yves Rousseau and Ron Somers.

Nipissing and Upper Ottawa

J. KARTZMARK, Jr.E.I.C.,
Secretary-Treasurer
F. R. MARSHALL, Jr.E.I.C.,
Branch News Editor

Four Speakers at Dinner Meeting

A dinner meeting of the Nipissing and Upper Ottawa Branch was held on Wednesday, January 11, at the Windsor Hotel in Sturgeon Falls. Members were present from Temiskaming, North Bay, and Sturgeon Falls, with several guests from the Sudbury Branch. The meeting was conducted by Chairman R. Prescott of Temiskaming.

J. S. Cooper

After dinner four brief papers were presented. Mr. Prescott first introduced J. S. Cooper of North Bay, assistant chief engineer of the Ontario Northland Railway who served during World War II as engineering officer with the Royal Navy and the Royal Canadian Navy. With the aid of drawings Mr. Cooper described the engine room and auxiliary equipment of large battleships and destroyers. *H.M.S. Queen Elizabeth* was constructed, he said, with four boiler rooms and four engine rooms, each separated from the other by heavy bulkheads with a valve system by means of which any engine room could be connected to any boiler room in case of damage. The ship carried 3,300 tons of oil not only for her own use but also for refuelling of smaller vessels at sea. He gave a brief description of auxiliary equipment for lubrication, water and fuel pumps, the closed system for feed water, air compressors for torpedo discharging and all important provisions for fire and damage control.

L. Wilson

The second speaker, L. Wilson, township engineer for Neelon and Garson, was introduced by Ted Powell, consulting engineer from Sudbury. His topic was "Problems in a Typical Mining Community." He outlined the problems of a residential community adjacent to a community with one large central industry. The residential area is not self-supporting from local taxes. Education development and maintenance costs are high. Debts tend to pile up and it becomes difficult to sell debentures. To minimize the above, he said, development must be carried out in a sane manner. Subdivisions have come to realize that they must provide many initial services. Without presenting a final solution Mr. Wilson discussed the alternatives of amalgamation, annexation, and the more favoured creation of a metropolitan area which would provide assistance from assessment of the neighbouring industries.

M. Felix

M. Felix, mechanical engineer with Canadian International Paper Company, Temiskaming, was then introduced by the chairman. His subject was "Problems of Industrial Documentation." He emphasized the need in industry for a logical and simple system for locating desired information in libraries, periodicals and other sources. Libraries are usually remote, he said. Circulation of many periodicals through a plant is an expensive and inefficient method of distributing information. The long time required results in a loss of novelty. It was felt that someone conversant with company operations should be assigned the job of circulating bulletins on available material. This information should be indexed and classified. A big problem, of course, is the classification suggested. Use of the decimal system was suggested.

E. Heslop

The final speaker of the evening was Elliot Heslop, assistant manager of the Sturgeon Falls division of the Abitibi Pulp and Paper Company, who was introduced by Frank Clark. His topic was "Dimensions of Materials Used in Paper-Making." Mr. Heslop first emphasized the difficulty in forming a clear mental comparison of dimensions of very small particles when stated in microns, and also the tendency to assume erroneously that very small particles are perfect spheres or perfect cylinders.

Illustrations depicted on a highly magnified view of a section of paper-making screen gave a clear picture of the sizes and shapes of various hard and soft wood fibres, clay filler particles and micro organisms, etc., and of how they interlock and adhere to each other to form paper. The effect of the irregularities of these particles and of the screen itself in producing a rough surface on the paper was discussed and also the means adopted to smooth the paper by means of clay filler paste and rolling to provide a surface suitable for the printing of coloured pictures.

The meeting was then briefly addressed by W. S. Black, chairman of the Sudbury Branch. P. Rebin of Sturgeon Falls expressed the appreciation of the group to all of the speakers and the meeting was adjourned on the motion of J. W. Millar.

Saint John

D. I. Higgins, jr.e.i.c.,
Secretary-Treasurer
G. E. Graham, m.e.i.c.,
Branch News Editor

The annual meeting of the Saint John Branch was held on Tuesday, December 13, 1955, in the Admiral Beatty Hotel.

Officers for the coming year were elected with F. G. Doty, chairman; J. J. Donahue, vice-chairman; D. R. Higgins, secretary-treasurer; H. N. Day, councillor, and J. B. Eldric Jr., councillor.

Minutes of the last annual meeting, reports of the Executive, and a report of the councillor, A. G. Watt, were presented at this meeting.

A total of 108 members were listed for the year 1955.

At the close of the business meeting two films were shown, a documentary of the life of Leonardo da Vinci, and another entitled, "See How They Fly".

Sudbury

H. M. Whittles, jr.e.i.c.,
Secretary-Treasurer
H. F. Coffin, jr.e.i.c.,
Branch News Editor

"The Microwave Story" by D. G. Black

The regular monthly meeting of the Sudbury Branch was held at the Granite Club on Thursday, January 12, 1956.

"The Microwave Story" and its connection with long distance transmission of television programs and long distance calls, was the subject of an interesting lecture given to 34 members and guests by D. G. Black, Bell Telephone Company representative.

4,300-Mile Network

The Canadian Broadcasting Corporation, early in 1955, awarded a contract to the Trans-Canada Telephone System to carry network television programs across the country. In order to meet the C.B.C. contract and at the same time provide increased long distance facilities, the system is now building a 4,300-mile microwave radio-relay network stretching from the Atlantic to the Pacific.

At the present time, microwave links Toronto, Ottawa, Montreal and Quebec City, with a Toronto-Buffalo link to carry television programs to and from the United States. According to present schedules, the Toronto-Winnipeg section will be in operation by the fall of 1956. Regina and Calgary will be added by early 1957. The Quebec-Saint John-Sydney section is expected to be in service by the middle of 1957 and the Calgary-Vancouver chain by early 1958. In addition there will be spur lines built to a number of cities including Sault Ste. Marie, Sudbury, Timmins, Saskatoon and Edmonton.

Television Principles Illustrated

Mr. Black in his presentation used miniature microwave equipment to illustrate some of the characteristics of radio relay and with the aid of a "Nipkow Disc" explained the evolution of basic television principles. A short film also very effectively illustrated the long distance aspect of microwave.

"The completion of the microwave project will mark one of the most significant advances in Canadian Communication," Mr. Black said.

A discussion period followed in which several of the members and guests from the Bell Telephone Company participated.

Toronto

L. F. Bresolin, jr.e.i.c.,
Secretary-Treasurer
A. C. Davidson, m.e.i.c.,
Branch News Editor

Students' Night

On February 9 the annual Students' Night was held in Hart House. The successful event was under the direction

Institute members from Hawkesbury, Ont., and Brownsburg, Que., met together on January 19 at the Bridge Inn in Hawkesbury. Front row, left to right: D. R. Crawford, L. T. Gaunt, S. V. Donvito, P. E. Wall, C. Brain, D. U. Findlay, J. K. Watson; middle row: E.E. Lang, W. G. Ivany, G. D. McKay, J. Defeyter, C. Dodd, Col. L. F. Grant, R. J. Child. G. Legault; back row: L. F. Camus, D. Young, J. S. Pringle, R. D. Christie, K. B. Bourne, H. J. Whiting, R. A. W. Bond, B. A. Watson.

of Ivan Widdiefield and Ross Norgrove of the Branch executive. About 150 were present to witness the able efforts of the student panel of experts who had volunteered to appear from the student body of the University of Toronto Faculty of Applied Science.

Quizmaster John Hall drew quick responses from the students on the panel and from the floor. Witty answers brought appreciative laughter and applause from the members present.

Panel of Practising Engineers

While the winners were being selected by the judge, Ross Norgrove, questions of the student panel were answered by another panel of experts, all practising engineers: Clare Carruthers, Bob Teagle and Dunc Whitson. Questions from the students centred principally on the profession of engineering and what it meant to the practising engineer. The expert panel of practising engineers received an attentive hearing. Students remarked afterwards on the statements of this panel, stating the simple lessons learned from them were much appreciated.

Prize Winners

Prize winners in the student panel were: first prize, Al Walden, fourth year chemical; second prize, A. J. Burgess, fourth year civil; third prize, N. Laughlen, fourth year aeronautical.

The Civil Club won the prize for having the greatest percentage of its members present. Various prizes of slide rules and data books were given to those who answered questions correctly from the floor.

Following the quiz program coffee and doughnuts were served in the Great Hall of Hart House. Members and students mingled and discussed student problems to their mutual benefit. Questions such as "Which job should I take?" and "Is it best to work for a large or a small engineering firm?" loom large in the students' minds. The older engineer in practice will realize that the students are asking such questions all the time, and an experienced engineer can help the student to feel at home and be part of the profession with his answers. Many students feel lost and can be orientated and helped to feel the fellowship of older engineers when their questions are answered, even if the answer is only a partial one.

Credit is due to Tony Webster, S.E.I.C., the Professional Relations representative of the Students' Engineering Society who helped to arrange publicity for the event.

Both students at the University and members present enjoyed themselves. All look forward to next year's Student Night with anticipation.

Winnipeg Electrical Section

G. L. MacDonald, M.E.I.C.,
News Editor

R. J. A. Behan is Guest Speaker

At the December meeting of the Electrical Section of the Winnipeg Branch, members heard a talk on testing of low voltage high rupturing capacity fuses by R. J. A. Behan, manager of the fusegear division of the English Electric Company of Canada, Limited.

• Branch News

Low Voltage H.R.C. Fuses

The high rupturing capacity fuse, Mr. Behan said, was developed to cope with higher fault levels and to maintain constant characteristics throughout the working life of the fuse. The latter characteristic was considered a most important feature of the device and tests were primarily to investigate the property of non-deterioration claimed for these fuses. The tests were detailed and also somewhat unique in that they were not of the so called accelerated aging type.

R. J. A. Behan of English Electric Company of Canada Ltd. and G. C. Cartwright of Railway and Power Engineering Corporation, Winnipeg.

Development of the hermetically sealed H.R.C. fuse began in England about 25 years ago, and fuses were available which had been in continuous service from 18 to 25 years, and some record was also available of loading and service conditions of these fuses.

Protective Devices

Protective devices are subject to a variety of conditions that may produce deterioration. They carry varying degrees of load currents, including overloads, and may be called on to withstand through fault currents of considerable magnitude. They may be exposed to extremes of ambient temperature and to innumerable cycles of expansion and contraction of the metal parts. They may also be subject to mechanical vibration of associated equipment, and to atmospheric contamination.

The principal components of the fuse are a ceramic body, pure silver elements, clean silica quartz, asbestos washers, and copper end caps and tags, the last two being electro-tinned. The fuse is hermetically sealed and the silver elements are solidly soldered to the end caps, and the end caps, in turn, soldered to the tags. Solid solder joints are used throughout, the object being to effect a perfect electrical contact without affecting the structure of the materials being joined together.

To provide a basis of comparison, a number of fuses were made up to exactly the same specification as the earlier types of fuses being tested, and old and new fuses were tested simultaneously when possible. Tests included visual examination of all inner and outer components, X-ray tests, X-ray difraction tests, photo-micrograph examination of fuse elements, measurement of resistance, temperature rise at full rated current, determination of minimum fusing current, and short circuit tests at various values of fault current.

Hermetic Sealing Effective

It was found that the hermetic sealing emained completely effective. The silver elements were as bright as when first placed in the fuse, and the quartz filler was completely unchanged. The elements were in their proper position and free from sagging or thinning as might be caused by mechanical or thermal stress. All solder joints were completely effective and cement joints as effective as when the fuse was new. Resistance tests showed that, in all cases, the fuse links were within the permitted tolerance of plus or minus 5 per cent. Temperature rise, measured at the top contact, top terminal and on the cable 12 in. from the top contact, was also within permitted tolerance. Short circuit tests were considered the most critical as the test imposes the maximum stress on the fuse link, both electrically and mechanically, and the criterion of success is that the fuse will interrupt the short circuit without bursting, or in any way damaging associated equipment. A study of the current limiting characteristic of the fuse was included in the short circuit test. Test results and oscillograms were shown by slides. The old fuses successfully interrupted short circuit test currents, and the oscillograms showed a remarkable degree of agreement between the old and new fuses, both as regards operating time and the shape of the prearcing and arcing curves. A point of interest on the oscillograms was the fact the arc voltage, in no case, exceeded the system voltage by more than a small margin.

President R. E. Heartz, right, presents the certificate of Life Membership in the Engineering Institute to Dr. E. P. Fetherstonhaugh, while Mrs. A. E. Macdonald looks on.

Test on Associated Equipment

A separate series of tests was carried out on associated equipment, including motor starters and fusible disconnect switches. Specification C22, No. 106, calls for a low voltage H.R.C. fuse to have an interrupting capacity of 100,000 R.M.S. asymmetrical amperes at 600 volts. It was desirable to know what would happen to associated equipment when the fuses were interrupting fault currents of this magnitude. Short circuit tests were carried out on standard combination magnetic starters, Sizes 1, 2, 3 and 4, fitted with high rupturing capacity fuses. Tests were made at 46,000, 66,000, and 80,000 symmetrical amperes. Three tests were made at each fault level on each starter with the fault applied to the closed starter, and a further three tests on each by closing the starter on the fault. Tests were satisfactory and all starters were suitable for use after the tests were made. A switch, of the service entrance type, rated 200 amps, 575 volt, 3 PST, was fitted with high rupturing capacity fuses and subjected to the same test. Again, three short circuit tests were made at each fault level, with the switch closed, and a further three tests at each fault level by closing the switch on the fault. A slight burning of the contacts was experienced and the switch was suitable for further use without replacement of any parts.

Vancouver

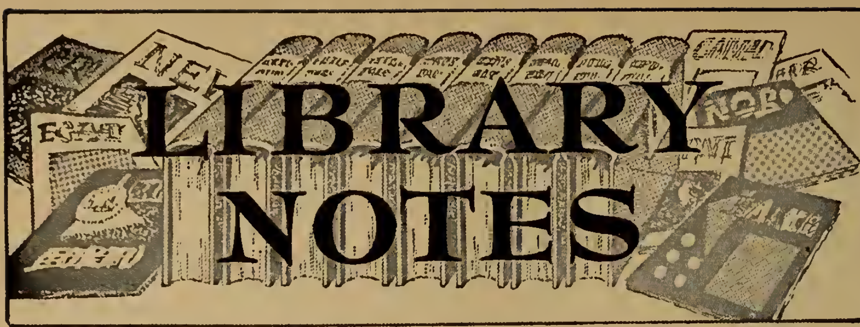
A. D. Cronk, jr.e.i.c.,
Secretary-Treasurer
C. H. Maartman, jr.e.i.c.,
Branch News Editor

Helicopter Company Tour

Members of the Vancouver Branch spent an interesting morning as guests of Okanagan Helicopters Limited at Vancouver International Airport on Saturday, January 28, 1956.

The party was welcomed by A. Stringer, vice-president in charge of engineering, who gave a discussion on the history of the company and its future plans. This was followed by the showing of two films depicting the rise of helicopter transportation to its present position of importance in industrial development. In his talk, Mr. Stringer outlined the many problems and trials that faced the growing company and then went on to tell of current plans to extend operations into other areas and of plans for regular helicopter passenger service as soon as equipment becomes available.

Under the guidance of the pilots, individual groups then inspected some of the helicopters in the hangar and were shown the points of interest of the machines and the method of operation.



Additions to the Institute Library

Reviews — Book Notes — Abstracts

BOOK REVIEW

Industrial lubrication practice. P. D. Hobson. New York, Industrial Press, 1955. Various paging, illus., $8.00 (U.S.).

Directed primarily to plant lubrication overseers, this book will be of interest also to plant engineers, maintenance engineers and repair superintendents. The author concentrates on practice, machine design, operation, the lubrication systems and the conditions under which the lubricant must function. Text is accompanied by good diagrams, illustrations and views. The Appendix has useful charts covering blending; gravity, temperature and viscosity conversion, Viscosity Index chart, and a Glossary of Terms.

Generally speaking this text covers a wide range of applications in a thorough and very complete way. It should prove a good reference for those concerned with the lubrication and maintenance of machinery. The chapters covering Types of Lubricants and their Use is apt to create some misconceptions for those who are learning about lubricants. The term asphaltic is no longer considered synonomous with napthenic, and lubricating oils produced from napthenic stocks do not contain asphalt. In the section on lubricating greases the statement "Barium grease has no dropping point in the normal sense" is misleading and we rather suspect that the author was confusing Barium with Bentone. Also the statement that Calcium base greases are insoluble in water and may be used submerged in it, must be taken with reservations, since continuous exposure to water will result in fairly rapid break-up of the common types of Calcium base greases.

The contents of the chapter on Physical and Chemical Characteristics of Lubricants could have been more interesting by the use of illustrations of the test apparatus. The text is rather skimpy on the subject of viscosity and fails to bring out that the majority of oil companies use the Kinematic Viscosimeter and convert back to Saybolt Universal. In other chapters we feel that the book would benefit from some updating of material, particularly with regard to the comment on compression ratios of Four Stroke Gasoline Engines, and on the A.P.I. MM classification. Chapter 23 on Cutting Fluids is a very good chapter but needs some updating on new cutting oil types. In Chapter 25 no mention is made of solvent carrier type wire rope lubricants.

The major part of this work is very well done, with comprehensive coverage of the subject, good illustrations and good maintenance information.

John H. Whyte,
British-American Oil Co. Ltd.

BOOK NOTES

Prepared by the Library
The Engineering Institute of Canada

*Review provided through the courtesy of the Engineering Societies Library in New York.

Air industries and transport association of Canada reports, 1954-55. Quebec City, 1955. 132pp.

Following the general manager's report and the summary of the work done by different committees of the association, there is a section of statistics on labour trends in aviation, licensing, aircraft accidents, etc. This is followed by an outline of the activities of the members of the association and a directory of products and services. The last section lists the important personnel, and their positions, of the member companies.

Alloy series in physical metallurgy. M. C. Smith. New York, Harper, 1956. 338pp., $6.00 (U.S.).

This is the companion volume to the author's **Principles of physical metallurgy,** which is reviewed below, and presents the background for this book.

We find here a systematic discussion of the effects of composition and of heat treatment upon the structures and properties of metals and their alloys.

In detail, the chapters cover such subjects as the phase rule and its applications, constitutional diagrams, binary alloys, changes in solid alloys, alloys of iron and carbon, the cast irons, and ternary and higher alloys.

Basic television. Indianapolis, Sams, 1955. 304pp., illus., $5.00 (Practical training manual; television series, v.1).

This practical manual is divided into 24 lessons which include both theoretical and practical discussions of each subject, with emphasis upon modern commercial circuits. Topics covered are commercial cathode-ray oscilloscopes; AM and FM carrier waves; detectors; antenna; picture tubes; tuners, sweep circuits, I F amplifiers; sound and video systems; and others.

A separate section gives suggested shop jobs on a number of different projects so that students can practice the lessons in the manual.

Bibliography on machinery foundations; design, construction, vibration elimination. Engineering Societies Library. New York, The Library, 1955. 25pp., $2.00 (U.S.).

This revised list of annotated references to books and periodical articles, published from 1924 to 1955, covers the theory, design and construction of machinery foundations; certain specific problems such as heavy foundations on unstable soils; and vibration as related to foundations of hammers, oil engines, electrical machinery, turbines, steam engines, compressors, machine tools, pumps, presses, etc.

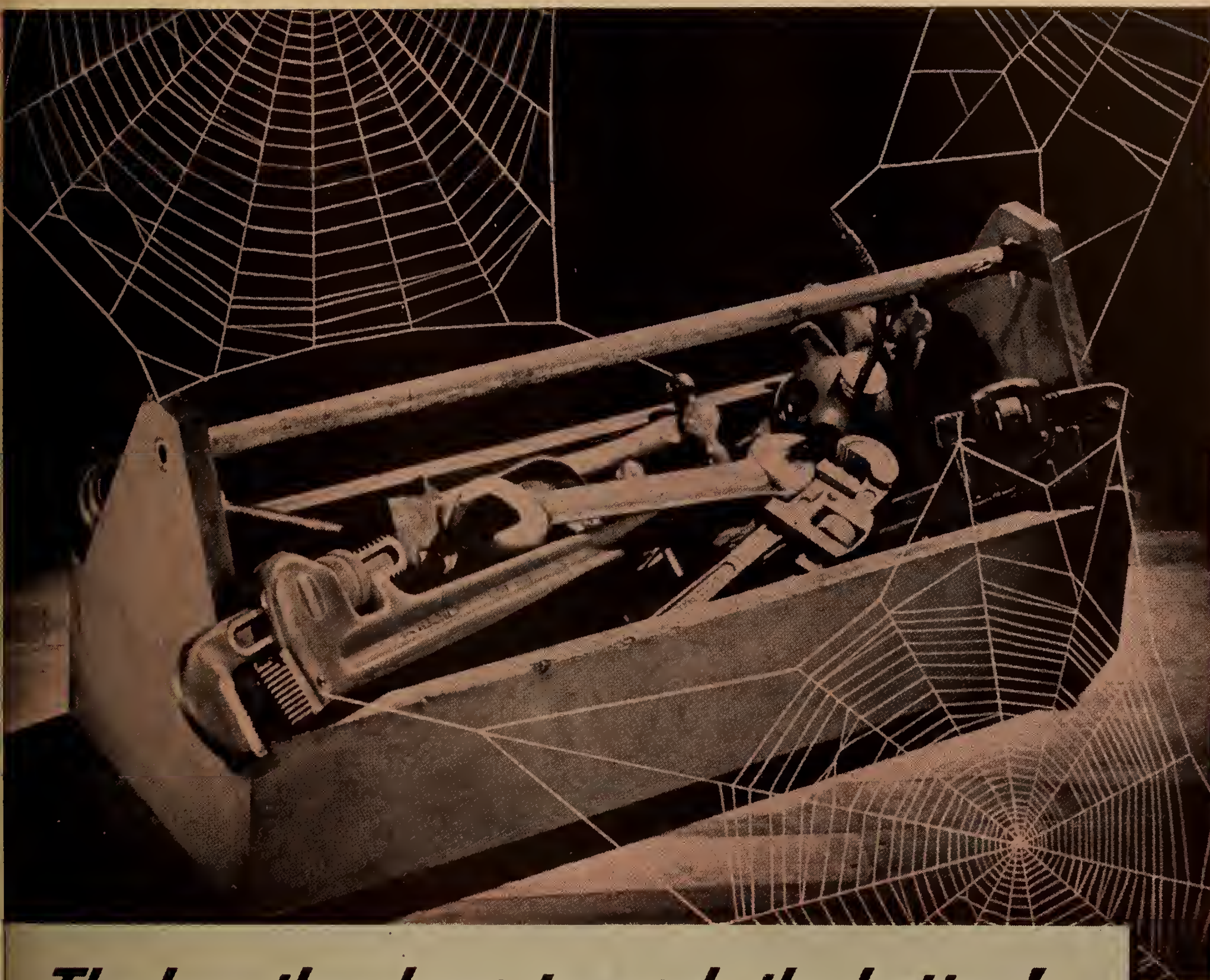
Compact heat exchangers: a summary of basic transfer and flow friction design data. W. M. Kays and A. L. London. Palo Alto, Calif., National press, 1955. 156pp., diagrs., $5.00 (U.S.).

The purpose of this volume, which first appeared as a technical report to the Office of Naval Research, is to make available the results of experimental and analytical work on compact heat-transfer surfaces. All the types in use today are dealt with, including tube banks, plate-fin surfaces, finned tube surfaces, screen and sphere matrix surfaces. Basic heat transfer and flow friction test data are presented for a total of 88 surface configurations.

Other chapters consider analytical solutions for abrupt contraction and expansion pressure-loss co-efficients, laminar-flow heat transfer in circular and rectangular tubes, and the effects of temperature-dependent field properties on heat transfer and flow friction. There is also a discussion of heat-exchanger performance theory, developed around the effectiveness versus number of heat-transfer units concept.

***Design of heating and ventilating systems.** F. W. Hutchinson. New York, Industrial Press, 1955. 308pp., diagrs., $7.00 (U.S.)

Intended to supplement rather than to replace standard texts in the field, this book emphasizes the elements of the system which require the rational application of engineering knowledge. Considerable space is allotted to the factors involved in determining loads — transmission losses, intermittent heating, ventilation, humidification, and losses from ducts, — and design procedures are given



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for panel and solar heating as well as for conventional systems. Full-page graphical solutions of important equations are included, along with basic data for solving many practical problems.

Dimensional motion times; development and application. H. C. Geppinger. New York, Wiley. 1955. 100pp., illus., $4.00.

This is the first broad survey of a new motion time system and it will interest many plant supervisors and managers. It describes concisely how to specify and record work details by motions and how to predetermine the necessary manual time of operations, and shows how to ensure uniformity of analysis context and measurement.

Familiarity with decimal equivalents and the ability to read blueprints are necessary for a better understanding of this technique. Complete examples of the application of the theory are included.

Electric melting and smelting practice. A. G. E. Robiette. London, Griffin. 1955. 347pp., illus., $7.20.

The author's **Electric melting practice,** published in 1935, was the basis for this new book, the scope of which is extended by the inclusion of a survey of smelting practice.

The book deals with the construction and operation of all the principle types of electric furnaces in use: arc furnaces for steel-making, for melting iron and for non-ferrous metals; normal frequency or channel-type induction furnaces; high-frequency or coreless induction furnaces; and resistor melting furnaces. The basic principles of operation, and the electro-chemistry of the different processes are explained with particular attention given to changes in design of plant due to increasing size and mechanization.

The electrical engineer's reference book. 7th ed. Toronto, British Book Service, 1954. Various paging, $14.00.

Arranged in thirty-two sections, this is a broad survey of modern standard practice and the most recent information on new developments in all branches of electrical engineering.

The 7th edition includes such new subsections as generators for steam and gas turbine drive; generators for hydroelectric plant; power station batteries; Diesel engine power plant; controlled expansion alloys: argon shielded welding.

Following the first section on basic electrophysical principles, there are twenty-seven sections describing standard practice in applied electricity. Another section, entitled "Progress", covers development, research, construction and design in all branches.

In addition to the technical sections, there are others dealing with education, electricity rules, regulations and supply data, periodicals and bibliographical references.

***Electronic and radio engineering,** 4th ed. F. E. Terman. Toronto, McGraw-Hill, 1955. 1078pp., diagrs., $15.00.

The change of title in this edition from the title, ***Radio Engineering,*** of the previous editions reflects the greater

emphasis on general techniques of electronics without regard to their use in radio systems. In manner of presentation and coverage the book remains the same: a summary in readily understandable terms of basic principles and techniques treated in three parts devoted to circuit elements and circuit theory, radio engineering and radio systems, and electronic fundamentals. Some material has been added to most of the chapters, and the chapters on microwave tubes and transistors are new.

L'électronique française. Paris, Syndicat des industries de matériel professionnel électronique et radioélectrique. 1955. 68 pp., illus.

This is a catalogue of electronic equipment produced by French manufacturers, with a description of each item in French and English.

FBI register of British manufacturers, 1956, 28th ed. London, Iliffe, 1955. 1110 pp., 42/-.

Listing the products and services of 7,000 British industrial firms, the Register also features French, German and Spanish glossaries, and an alphabetical directory of member firms of the Federation of British Industries.

The Financial Post survey of mines, 1956. Toronto, Financial Post, 1955. 376 pp., illus., $3.00.

1955 saw important developments in Canadian mining, especially in the production of uranium, copper and nickel. This new edition of the Financial Post survey of mines again includes statistical data on mineral production, price range of stocks and metals, and a large section, alphabetically arranged by provinces, on the principal milling plants in Canada. At the conclusion of the survey are a professional directory and maps of Canada's mineral areas.

The foreseeable future. George Thomson. Toronto, Macmillan, 1955. 166pp., $2.00.

A well-known scientist and winner of the Nobel Prize, who is concerned with nuclear physics, fuel research and scientific administration, writes of the changes which science could bring about in our world in a hundred years. He forecasts the exciting changes which might occur in the fields of energy and power, materials, transport and communications, meteorology, food and biology. The social consequences of such scientific advances are discussed and the last chapter is devoted to the new possibilities of artificial and natural thought, with the many problems which may arise.

Guidance. A. S. Locke. Toronto, Van Nostrand, 1955. 729 pp., diagrs., $13.50. (Principles of guided missile design, ed. by Grayson Merrill, v. 1).

This is one of several volumes which present the underlying principles of guided missile technology. In particular, it deals with those devices and techniques that are used to guide missiles.

The first two chapters describe the fundamental problems of missile guidance and earlier developments in the field. These are followed by chapters (each written by a specialist in that aspect of the subject) on terrestrial and celestial references, transmission of radio waves, emission, transmission and detection of the infra-red, basic mathematics, servo systems, measurements of missile motion, detection and information gathering, and target considerations.

There are also sections on launching missiles, economic considerations, missile guidance systems and bandwidth studies.

Illuminating engineering course. H. Zijl. Eindhoven, Philips, 1955. 241 pp., $4.50 (U.S.).

Many aspects of illumination are treated in the twenty-three chapters of this book which is more practical and utilitarian than artistic. The theoretical technical principles of lighting are covered, with a minimum of mathematics, and are related to the basic rules which govern visual perception and mental reaction.

Architects, works or production managers, as well as illuminating engineers, will find this book helpful. A large number of questions and examples are included.

Kinetic theory of liquids. J. Frenkel. New York, Dover, 1955, c. 1946. 488pp., $1.95 (U.S.)

This volume includes discussion of all types of arrangements of solids, thermal displacements of atoms, motion, interstitial atoms and ions, and transition between states of matter.

The mathematical analysis of electrical and optical wave-motion on the basis of Maxwell's equations. H. Bateman. New York, Dover, 1955, c. 1914. 159pp., $1.60 (U.S.).

This is a practical introduction to those developments in Maxwell's electromagnetic theory which are directly connected with the solution of the partial differential equation of wave-motion.

Modern physics. R. L. Sproull. New York, Wiley, 1956. 491 pp., diagrs., $7.75.

Those aspects of modern physics most productive of engineering applications form the subject of this analytical book. Crucial experiments are analyzed and the elementary theory underlying the properties of atoms, molecules, solids, and nuclei is based on this analysis.

The first two chapters discuss fundamental particles and their assembly, followed by a chapter on atomic physics which is divided into a study of the extranuclear structure of the atom and the study of nuclear physics.

The next three chapters are devoted to quantum mechanics and its applications. The author then turns to the development of molecular and solid-state physics before returning to the subject of nuclear physics. Included in this last chapter is a section on nuclear reactors and on applications for radioactive isotopes.

Mks units are used throughout the book but instructions are given for converting to cgs units. Other useful data and tables are found in the appendices.

The nature of cities. L. Hilberseimer. Chicago, Theobald, 1955. 286pp., illus., $8.75 (U.S.)

The origin, growth, and decline of cities is an important topic today and the value of this book is heightened by the high calibre of the illustrations. It discusses early settlements as well as modern cities and is divided into three sections.

The first part is a history of various types of cities and clearly illustrates how they reflect the social and cultural trends of the age. The second part deals with the geometric and organic planning of cities and includes notes on the architecture and landscaping of certain representative cities. The final section is concerned with the present day problems of cities e.g. the rapid growth of industry and mechanized transportation, traffic hazards, noise, air pollution, blight and slums. The possibilities of decentralization, replanning of old cities, and ruralizing cities are discussed.

The author has written extensively on art and architecture, housing and planning and is well known in both Europe and the United States.

Partial differential equations of mathematical physics, 2nd ed. A. G. Webster, ed. by S. J. Plimpton. New York, Dover, 1955, c. 1938. 440pp., $1.98 (U.S.).

This treatise covers the basic method, theory and application of partial differential equations, dealing with integral and elliptic equations, Cauchy's method and other topics.

Principles of physical metallurgy. M. C. Smith. New York, Harper, 1956. 417pp., $6.00 (U.S.).

This is the first of two volumes which present the theory of metal behaviour in an integrated and consistent manner.

The principles of physics and chemistry, as relating to the field of metallurgy, are outlined in the introductory chapters. These include descriptions of the atom, crystal structures, polymorphism, and crystal imperfections. The next chapters discuss the electrical and magnetic properties of metals, deformation, the effects of elevated temperature, and fracture.

The second volume in the series, **Alloy series in physical metallurgy,** begins where the present book ends.

Proceedings of the joint conference on combustion, sections 1-5, advance copies. Institution of mechanical engineers and the American society of mechanical engineers. Westminster, The institution, 1955. £2.5s (for the bound volume to be published later).

The first of the five sections deals with general questions of combustion—its chemistry and physics, scientific principles, and an appraisal of combustion research. The second section on boilers includes papers on the detection of flame failure, effect of fuel properties on firing methods and liquid-fuel firing. Among the papers on industrial furnaces are those on gas as a source of protective atmosphere, instrumentation of process tubular heaters, and oil burners for open-hearth furnaces. The fourth part of the proceedings deals with internal-combustion engines and discusses combustion in large diesel engines, in diesel engines with divided combustion chambers, in petrol engines, and in dual-fuel engines. The last section on gas turbines contains papers on coal-firing for the open-cycle gas turbine, combustion of residual fuel in gas turbines, and application of research to gas-turbine combustion problems.

Rotorcraft. R. N. Liptrot and J. D. Woods. Toronto, Butterworth, 1955. 161pp., illus., $6.50.

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ment of rotary wing aircraft, presented in a simple and practical manner. After a historical resume there is a chapter on definitions, nomenclature, and basic principles of rotor flight. A general description of the operation of the helicopter precedes more technical and detailed chapters on rotor aerodynamics, the articulated rotor, vibration and noise, and control and stability. The last two chapters discuss design study procedure and economics of the helicopter.

The appendices include specifications of numerous makes of rotorcraft, a bibliography, and names and addresses of manufacturers.

Strengthening management for the new technology. New York, American management association, 1955. 64pp., $1.75 (U.S.).

Three phases of the new development in management are here discussed: developing patterns in company organization, management development under changing conditions, and the impact of automation on these aspects of management.

A study of the September 1952 dust explosion at Port Arthur grain elevator no. 4A. A. R. Morse, Ottawa, National research council, Radio and electrical division, 1955. 158pp.

This study includes a review of other dust explosions as well as the one at Port Arthur, and also investigates the possibility of ignition of grain dust clouds by electrostatic or mechanical sparks. The report contains a bibliography, arranged chronologically and giving abstracts of articles.

The supervision of civil engineering construction. A. C. Twort, Toronto, Macmillan, 1955. 234pp., illus., $4.25.

The duties and responsibilities of the civil engineer who supervises construction of works on the site are here discussed. Young "resident engineers," as they are described in this book, will be helped by the practical information and advice offered by the author.

Part I of the book outlines the chief supervisory duties and powers, and responsibilities for organization and management, of the resident engineer. It also deals with the administrative and clerical work connected with the position.

Part II is more technical and describes the types of civil engineering work which are common to almost all contracts.

The last section includes specifications, bills of quantities and contract drawings.

Traffic engineering and control in the United States. Organisation for European economic co-operation. Toronto, Ryerson, 1955. 186pp., illus., $1.25.

This report was prepared by a group of road engineers, chiefs of police, town planners and representatives of road users, who visited the United States in 1954. A general review of American traffic conditions is followed by the conclusions, observations and recommendations of the group.

The main part of the report deals with such specific problems as highway administration and finance, road and street design, parking, traffic laws and control, and traffic safety education. The appendices include statistical tables on U.S. highways and a short note on the New Jersey turnpike.

Trigonometrical series. Antoni Zygmund. New York, Dover. 1955, c. 1935 329pp., $1.85 (U.S.).

The theory of trigonometrical series is covered in twelve chapters, half of which treat the Fourier series. The theorems of Hausdorff-Young and Riesz. Fejer, Cantor-Lebesgue, etc. are discussed. With a few exceptions, the book does not presuppose any special knowledge.

Vacuum valves in pulse techniques. P. A. Neeteson. Eindhoven, Philips. 1955. 170pp., 27/-.

In this book a method is developed to analyze networks containing vacuum tubes which are treated as non-linear elements. These new calculation methods could apply to the whole field of electronic pulse equipment such as computers, scalers, radar, television, telephony, etc.

The introductory chapters discuss the opening and closing of switches in networks and some principles of operational calculus, followed by a thorough study of the vacuum valve as a switch. This section is sub-divided into a treatment of the grid circuit and of the anode circuit, both for the triode and pentode.

In the last chapters, three important and widely used circuits, known as multivibrators, are described—these are the bistable, monostable and astable multivibrators. Throughout the book, the author presents experimental verification of the theories included.

Year book of the heating and ventilating industry, 1955. London Technitrade Journals. 1955. 379pp. 8/4.

While some of the sections in this year book, in particular those concerning the working agreements in Great Britain between employers and contractors, will be of little use to Canadian users, there are "feature" articles which will interest anyone in the heating and ventilating industry. These discuss fuel consumption, heating and ventilating on the farm, the selection and application of unit heaters, and panel heating. As in former editions, there is a buyers' guide, and lists of trade names, manufacturers' addresses, and trade associations.

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

Building construction

Permafrost and buildings. (Canada, NRC. Div. of building research. Better building bulletin no. 5).

Concrete

Insulation facilitates winter concreting. G. B. Wallace. (U.S. Bureau of reclamation. Engineering monograph no. 22).

Electrical engineering

Applications of electricity to crop drying

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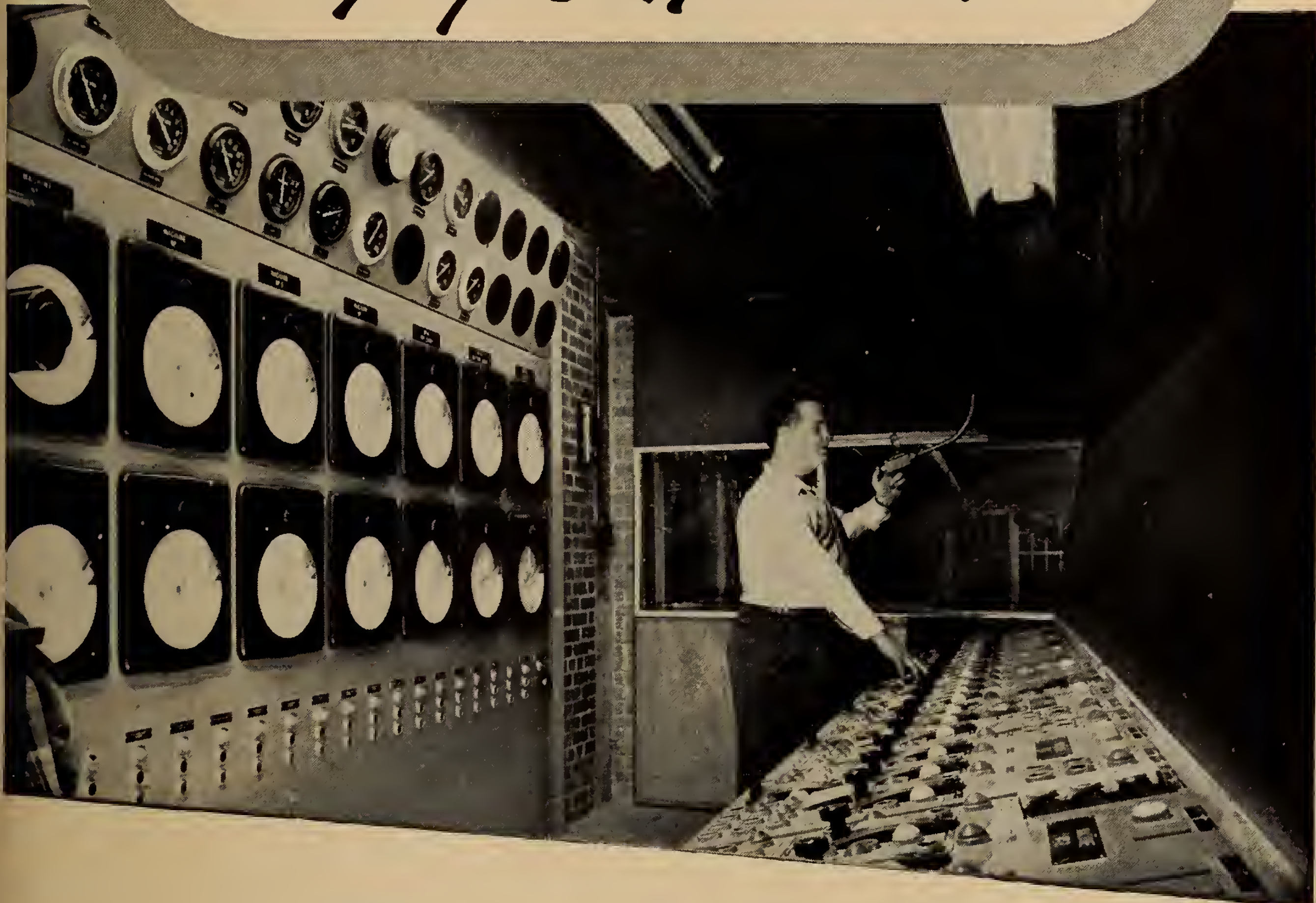

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on farms. P. Finn-Kelcey. (E.R.A. report W/T25).
The effect of enclosure on the temperature rise of fuses. H. W. Baxter. (E.R.A. report G/T297).
Gas temperature ni argon spark channels. R. D. Craig. (E.R.A. report L/T318).
On the thermal excitations of trapped electrons in ionic solids. J. H. Simpson. (E.R.A. report L/T317).
Stray losses in transformer cores. (E.R.A. report Q/T124).
Stresses in high-voltage condenser-bushings, S. Silbermann. (E.R.A. report Q/T 125).

Electronics

The touch-sensitive electronic organ. H. LeCaine. (Canada. NRC. Radio and electrical engineering div. Bulletin v. 5, no. 4, Nov. 1955).

Engineering

The Engineer. Centenary number, 1856-1956.

Highway traffic

Abatement of highway noise and fumes. (U.S. Highway research board. Bulletin 110).
Poisson and traffic. (Eno foundation for highway traffic control).

Inflammable materials

Storage, handling and use of flammable liquids. (Dominion board of insurance underwriters. Standard no. 30).

Libraries

Libraries for research and industry: planning and equipment. (Special libraries association. Monograph no. 1).

Miscellaneous

Award of the 1955 James Watt international medal to Dr. I. I. Sikorsky. Institution of mechanical engineers.
The communication of ideas. Royal Bank of Canada.
Information for U.K. manufacturers exporting electrically-operated equipment to Canada. (B.S. no. PD 1533).
List of inspected appliances, equipment, and materials, September 1955. Underwriters' laboratories of Canada.
Nuclear energy; the next ten years in Canada. L. G. Cook.
Presidential address. P. L. Jones. Institution of mechanical engineers.
Review of Canada's economy in 1955. C. D. Howe.
Top management and its development: selected references. (Princeton univ. Industrial relations section. No. 67).

Polymers

Determination of the shear stability of non-Newtonian liquids. N. D. Lawson. (ASTM special tech. pub. no. 182).

Roads and streets

Factors related to frost action in soils. (U.S. Highway research board. Bull. 111).
Ungraded aggregates in bituminous mixes (U.S. Highway research board. Bull. 109).
U.S. Highway research board. Proceedings of the thirty-fourth annual meeting, 1955.

Welding

The principles of argon-arc welding aluminum (British welding research association) 2/6.
The welding of austenitic chromium-nickel steel piping and tubing; a committee report (tentative) (American welding society D10.4-55T) $1.00 (U.S.).
Recommended practices for interruption of heat treatment cycles for low chromium-molybdenum steel piping materials. (American welding society. D10.3-55T).

The following publications have also been received by the library:

Annual reports.

Alberta. Dept. of lands and forests. Annual report for the fiscal year ended Mar. 31, 1955.
Canadian broadcasting corporation. Annual report, 1954-55.
Carnegie corporation of New York. Annual report, 1955.
Ohio river valley water sanitation commission. 7th annual report, 1955.
United Kingdom atomic energy authority. 1st annual report, 1954-55.

STANDARD REVIEWED

A.S.T.M. standards, American society for testing materials, 1916 Race Street, Philadelphia 3, Pa.

A.S.T.M. standards on paper and paper products and shipping containers (with related information) September, 1955. $3.75 (U.S.).

A total of 101 designations are included in this publication. There are five new standards and ten others have been revised since the previous edition, published in 1953. There are seven appendices, four of which are new.

New standards cover Tentative specifications for electrical insulating paper—interlayer type; Tentative methods of test for tensile strength of paraffin wax; Tentative method of test for needle penetration of petroleum wax; Tentative method of test for package cushioning materials; Method of test for 45-deg., 0-deg. directional reflectance of opaque specimens by filter photometry.

A.S.T.M. standards on soaps and other detergents (with related information) September, 1955. $2.50 (U.S.).

This compilation containing specifications, methods of test, and definitions of terms for soap and other detergents has been substantially revised since the previous edition was published in March, 1952. Of the total of 42 specifications and tests, six are new and 12 have been revised. There are 17 specifications for soap and soap products, 9 for various alkaline detergents, and 15 methods of analysis covering soaps and detergents. Definitions applying to these materials are also included.

British standards, British standards institution, 2 Park Street, London, W.1. British standards are available from the Canadian standards association, National research building, Ottawa, Canada.

B.S. 2635: 1955—Drafting specifications based on limiting the number of defectives permitted in small samples, by B. P. Dudding. 2/6.

This standard is a contribution to the solution of problems of sampling for industrial specifications. It is intended to aid those concerned in the drafting and use of clauses in specifications based on a statistical analysis of the results of sampling, particularly with small samples. The chances of finding defectives in tests of small samples of consignments of different quality are discussed, and are illustrated by graphs for different sizes of samples and a wide range of percentage of defectives in the articles produced.

The information given in this standard can be applied to individual consignments of goods, for which no information other than that given by the particular sampling test is available; or better still, to the examination of successive consignments to provide information as to the general level of quality maintained by the producer.

B.S. 2640: 1955—Class II oxy-acetylene welding of steel pipelines and pipe assemblies for carrying fluids. 7/6.

This standard is one of the process standards in the comprehensive series for the welding of steel pipeline and tube assemblies. It covers the shop and site oxy-acetylene welding of the steel pipe and tube assemblies suitable for Class II conditions, in sizes up to 20 inches in diameter, and of a thickness not exceeding 7/16 inch. It refers to all types of butt joints, branches and sleeve welds, in addition to qualifying tests for welders.

The appendices give recommendations for the welding techniques, and the method of preparation for macro-etching.

B.S. 2S 99: 1955—80 ton, 2½ per cent nickel-chromium-molybdenum steel (high carbon) for aircraft. 2/-.

This revision of the standard has been prepared to make provision for heat treated parts.

Canadian standards, Canadian standards association, National research building, Ottawa, Canada.

C.S.A. C22.2 No. 24: 1955—Construction and test of temperature-indicating and -regulating equipment, 2nd ed. $1.75.

This specification applies to temperature-indicating and temperature-regulating equipment for potentials up to and including 600 volts between conductors. It applies to electrical control equipment for air-conditioning, heating, cooking, and refrigeration.

C.S.A. C22.2 No. 64: 1955—Construction and test of cooking and liquid-heating appliances (domestic and commercial types) 2nd ed. $1.00.

This specification applies to both portable and stationary cooking and liquid-heat appliances for potentials of 250 volts and less.

It covers toasters, waffle irons, hot-plates (table stoves), sandwich toasters, grills, coffee makers, kettles, chafing dishes, water-heaters, doughnut cookers, portable electric ranges (rangettes) and similar devices, but does not apply to stationary electric ranges, humidifiers, stills, sterilizers or industrial heating appliances.

It applies to cooking and liquid-heating appliances intended for general and commercial purposes, e.g. in homes, restaurants, and similar establishments

ENGINEERING CAREERS

The Royal Canadian Navy

The technical officer, with a solid background of education, training, and experience, is playing an ever increasing part in the moulding of the Royal Canadian Navy to meet the modern trends in sea warfare.

The recent advances in warship design and propulsion machinery and the mounting number of electronic devices and complicated weapons systems carried in fighting ships, have combined to broaden the role of the technical officer in all phases of naval operations.

Officers with engineering backgrounds today are serving in the navy's engineering, electrical, ordnance, constructor, and civil engineering branches.

With the exception of engineering, all of these branches are comparative newcomers to the naval scene, the electrical, ordnance, and civil engineering branches having been set up since the second world war. Each of these activities, however, has been part and parcel of naval operations for some time.

A brief description of the function of each of the technical branches follows.

Engineering Branch: The design, supervision of manufacture, evaluation, operation and maintenance of main and auxiliary prime movers in ships and aircraft and the associated ancillaries and auxiliaries, and the equipment which supplies the services for the ship, such as fresh water production and distribution, air conditioning and ventilation.

Electrical Branch: The design, supervision of manufacture, evaluation, operation and maintenance of electrical equipment, such as power generation and distribution, communications, radar and other detection and warning devices.

Ordnance Branch: The design, supervision of manufacture, evaluation and maintenance of armament in ships and aircraft.

Constructor Branch: The design of the ship as a whole, including its arrangement, structure, floatability, stability, strength, habitability and speed. The design, supervision of manufacture, evaluation and maintenance of the structure, and all fittings in the ship associated with seaworthiness and habitability.

Civil Engineering Branch: The design, construction and maintenance of the Navy's works and buildings.

ENTRY

It is possible for young men who qualify, to enter the Navy's technical branches through the Canadian Services Colleges at Royal Roads, Victoria, B.C., Collège Militaire Royal de St. Jean, P.Q., and Royal Military College, Kingston, Ont., through the Regular Officer's Training Plan (ROTP) at various Canadian universities. In addition, it is possible for an engineer with the required academic and professional background to enter any one of these branches of the service directly from civilian life.

Each technical branch requires the successful candidate to undergo further technical training in the application of mathematics and the physical sciences to the specific problems of design, construction and operation peculiar to each branch.

After completing his formal training, the officer is then employed at sea or ashore until he reaches the higher administrative levels, when his employment is entirely ashore.

The general pattern in the career of a young man with senior matriculation and entering each technical branch is noted below under respective branch headings.

Engineering Branch

(1) Canadian Services College as a cadet; two years.

(2) Sea service with Royal Navy as midshipman (E); eight months.

(3) Royal Naval Engineering College as midshipman (E) to undergo basic engineering training; two years.

(4) Sea training as sub-lieutenant (E); one year.

(5) Specialization course, Royal Naval Engineering College, to specialize as general engineer, ordnance engineer, or air engineer; one year.

Alternative: Direct entry from a background in the physical sciences with training as in (4) and (5) above.

On completion of this training, promotion to lieutenant (E) and employment in the engineering branch.

The general pattern of this employment will include two years at sea in an aircraft carrier as a watchkeeping and departmental officer, during which time the officer will be responsible for operating a main propulsion plant of up to 80,000 h.p., and maintenance of a section of the machinery, such as boilers, turbines, and auxiliary machinery. A firm understanding of the details and relationships in employing and training personnel of the branch is gained at this stage.

Following his initial service at sea, the officer will be employed ashore in a maintenance activity in the dockyard, in an overseeing activity in the naval ship construction program or in a design activity at headquarters — duration four years.

He then returns to sea as engineer officer of a ship, such as a destroyer, where he is in charge of all aspects of operation and maintenance of the ship's propulsion plant and associated ancillaries, involving a plant of 40,000 h.p., extensive refrigeration and air-conditioning equipment, diesel engines, evaporating plant capable of producing extensive pumping arrangements. During this period he directs a staff of some fifty technicians and semi-skilled men. The duration of this appointment is approximately two years, following which he returns ashore for two years, in a design, maintenance, manufacturing or training activity; or he may remain at sea as senior engineer of a large ship for two years.

If he has been appointed ashore, his next appointment normally will be to sea as engineer officer of a large ship, such as a carrier or cruiser for two years, or he may remain ashore in a senior administrative post in a maintenance, manufacturing or design activity; or in a liaison post, such as naval technical representative to the U.K., U.S.A., or other country where the navy has technical interests. He may be employed in intelligence, logistics, planning or training duties, where experience and judgment involving technical matters are required. This variety of duties with increasing administrative responsibility continues for the remainder of his career.

He may rise, by selection, to the navy's highest technical administrative position — that of Chief of Naval Technical Services, who is a member of the Naval Board with the rank of Rear-Admiral, is the head of all technical branches in the RCN, and is the senior RCN authority charged with the overall responsibility for the naval shipbuilding program.

Electrical Branch

(1) Canadian Services College as a cadet for four years, or ROTP for five years.

(2) From Canadian Services College, one further year in either electrical engineering, engineering physics, radio physics or mathematics and physics.

On completion of ROTP or college training:

Rear-Admiral (E) W. W. Porteous, O.B.E., C.D., Chief of Naval Technical Services.

(3) Training at sea for four months.

(4) Divisional training as an officer for two months.

(5) Electrical School for long naval electrical course, for one year.

On successful completion of this training he is promoted to the rank of lieutenant (L) in the electrical branch.

The general pattern of his employment will include appointments in which a wide knowledge of the responsibilities of the electrical branch can be obtained, including ship's electrical department for four months; dockyard for four months, and naval radio station for four months.

On completion of these appointments he will go to sea for two years and receive extensive experience in maintenance and supervision of fire control engineering, communication engineering and detection, including radar, Asdic and radio aids to navigation. On the other hand, he may remain ashore for practical experience in air electrics, including air radar and radio, or in electrical systems and electrical installations, including power generation and distribution. After such experience, the officer may be selected for further training in one of the preceding special categories.

Subsequent employment may be in a maintenance activity in the dockyard, in an overseeing activity in a naval ship construction program, or in a design activity at headquarters, usually for a period of four years. On the other hand, he may go to sea as electrical officer of a ship, such as a

During the construction and fitting of the aircraft carrier Bonaventure at Belfast, Northern Ireland, supervisory RCN personnel discuss machinery space arrangements with a representative of the shipbuilder. (National Defence Photo)

On the bridge of HMCS St. Laurent are Rear-Admiral J. G. Knowlton (left), who retired as Chief of Naval Technical Services in January 1956, Commander R. W. Timbrell, commanding officer, and Constructor-Captain F. Freeborn, Principal Naval Overseer, Montreal Area.

destroyer, where he is in charge of all aspects of supervision and maintenance of the ship's electrical system. During this period, normally two years, he directs a staff of 20 technicians and semi-skilled men.

Subsequent appointments, within his branch, parallel those of officers in the engineering branch, up to and including the appointment of Chief of Naval Technical Services.

Ordnance Branch

(1) Canadian Services College as a cadet for 4 years, followed by degree year at University or ROTP.

(2) Sea training for four months as a sub-lieutenant.

(3) Officers' divisional Course for 6 weeks.

(4) Long ordnance course in the Ordnance School for one year, or gunnery specialist course, Royal Naval Engineering College, for one year.

On completion of this training, promotion to ordnance lieutenant in the Ordnance branch.

The general pattern of the ordnance officer's appointment within his branch, parallels that in the above-mentioned technical branches, beginning with employment at sea in an aircraft carrier or cruiser as a department officer, or employment in ships such as destroyers as head of the Ordnance Department, during which period he is in charge of all aspects of supervision and maintenance of a ship's ordnance equipment. He directs a staff of 7 technicians and semi-skilled men. He usually spends less time at sea than fellow officers in the engineering branch. He too, may rise to the position of Chief of Naval Technical Services.

Constructor Branch

(1) Canadian Services College as a cadet for two years.

(2) Training as for Engineering branch which includes sea service as midshipman (E) Royal Naval Engineering College to undergo basic engineering training.

(3) Selection for training in Constructor branch.

(4) Practical and theoretical training in a Royal Navy dockyard for one year.

(4) Royal Naval College, Greenwich, for special training as naval constructor for two years.

Alternative method of entry:

(1) University under Regular Officers' Training Plan (ROTP) for four years.

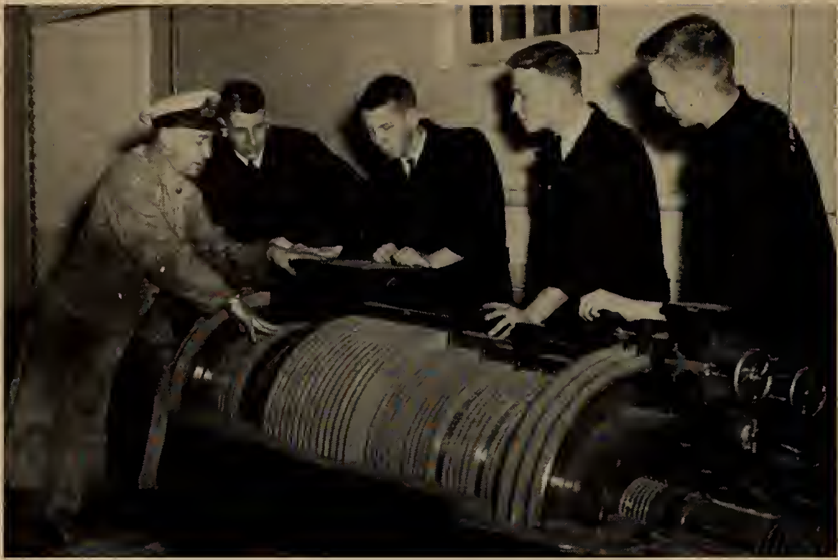
(2) By selection, further training in naval architecture in the Massachusetts Institute of Technology for two years. On completion of formal academic training, promotion to constructor lieutenant in the Constructor branch.

The general pattern of his employment will include a period of one year at sea in a large ship, during which time he will carry out duties involving the supervision of hull maintenance and repair.

Subsequent employment during the career of officers in this branch is most likely to be ashore where they will be involved in maintenance activities in the dockyard, in an overseeing activity in the naval ship construction program, in a design activity in headquarters.

As experience is gained, employment in senior administrative positions in a maintenance, manufacturing or design activity, employment in various liaison positions such as naval technical representative in the U.K., U.S.A., and other countries in which the navy has technical interests.

Naval cadets on board the cruiser Ontario undergo practical training in the ship's engine room during her training cruise to Australia and New Zealand.



Cadets at Royal Roads, one of the three Canadian Services Colleges, receive instruction on turbines.

This variety of duties, with increasing administrative responsibility, continues for the remainder of the career.

Officers of the constructor branch may rise by selection to the highest technical administrative position of Chief of the Naval Technical Staff.

Civil Engineering Branch

Entry from university with a degree in civil engineering or architecture, or equivalent professional qualifications recognized by E.I.C. or R.A.I.C.

Additional professional training is not given prior to employment in duties pertaining to design, construction, maintenance, repair and alteration of buildings and works and outside services.

HMCS St. Laurent, the Royal Canadian Navy's new anti-submarine destroyer escort, carries an engineer officer, two electrical officers, an ordnance officer, and a constructor officer.

The pattern of employment generally is in shore-based activities, during which experience is gained leading to increased responsibility.

GENERAL

The general pattern of requirement and employment of naval personnel with a background in the physical sciences is:

(1) Intelligence and personal qualities required for leadership.

(2) Provision of formal training in the physical sciences at government expense, or, alternatively, formal training attained by the individual through his own resources.

(3) Further formal training in the class-room and on the job in the application of the physical sciences to concrete problems of design, construction and operation.

(4) Employment at sea or ashore in general administrative and design duties related to the special requirements of a specific technical branch.

(5) Employment at sea or ashore in the higher levels of administration and maintenance duties related to the special requirements of a specific technical branch.

(6) (a) Employment ashore in the higher levels of administrative duties related to the co-ordination and administration of many or all technical activities in a dockyard, design, or ship construction activity; or

(b) In duties related to the co-ordination and administration of many functional related activities such as personnel, planning, intelligence, foreign liaison.

(7) Employment ashore in the highest levels of administrative duties related to the co-ordination and control of all technical functions within the navy.

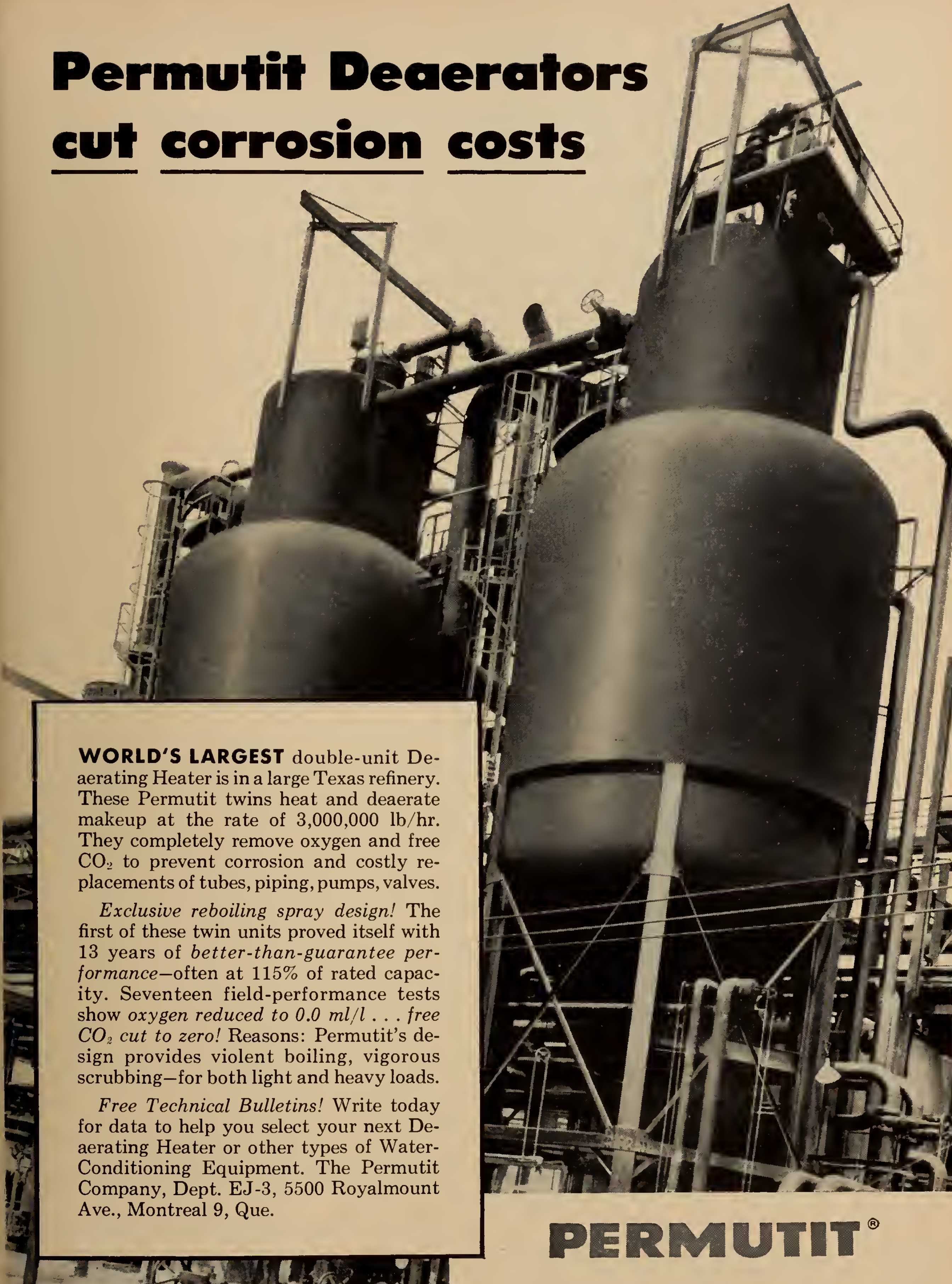
PAY SCALE

Some samples of the pay scale for naval officers are as follows:

A naval cadet receives each month a basic pay of $55 together with rations and quarters. A married lieutenant receives $290.00 basic pay, $110.00 subsistence allowance and $40.00 marriage allowance, for a total of $440.00 per month. A married commander receives approximately $7,500 annually, and rear-admiral about $14,000.

In addition, beginning in the rank of sub-lieutenant up to and including captain, progressive increases to the basic rate of pay for the rank held are given after three and six years in that rank.

Additional benefits for all naval personnel include free medical and dental care and pension benefits. ✓



Salt-Stabilized Roads

It was in 1928 that one of the first, if not the very first, modern efforts to stabilize roads with salt were made in Nova Scotia, near Canada's first rock salt mine at Malagash. Improvements were made in Canada during the '30's, but with the coming of the war in 1939, practically all efforts in this method of road construction were abandoned.

Although far from perfect, even these earliest Canadian results pointed the way to the development of today's efficient salt-stabilized roads.

Meanwhile, in the United States interest was maintained and the Canadian idea was studied and perfected. But efforts were somewhat sporadic until about 1950. Then engineers started turning to salt as a major means of meeting the rising construction and maintenance costs of farm-to-market roads and unimproved urban streets.

Use of salt to stabilize gravel, clay or other untreated earthen roads is on the increase in many sections of the country, according to the Salt Institute, as more and more engineers turn to this type of construction to build durable, low-maintenance, hard-surface secondary roads. In other instances it is a basic part of the construction of stronger subgrades and all-weather shoulders for already hard-surfaced roads.

ECONOMY

Economy is the principal advantage. Others are increased safety of vehicular traffic by eliminating dangerous loose gravel, or sand, and reduction of maintenance costs.

On the subject of economy, an untreated gravel or dirt road will lose one-half inch of the surface material each year due to the wheel throw-out, and deterioration effects of the elements, such as blow-away, erosion and frost heave. At an average cost of $2.00 per yard for gravel, loss of surface materials from a one-mile, 20-foot wide stretch amounts to $300 annually, with an equal amount needed for replacement, or a total cost of $600 to put the road back in its original condition. Salt compaction bonds loose material to prevent this loss.

On the average, based on costs in divergent sections, a road can be salt stabilized for $400 per mile per 20-foot width, which includes a base mat 4 inches in depth. Records kept on such roads over the period of the last three to five years showed the need of minimum maintenance on the original stabilized surfaces. A few roads date back to the early 1930's and are still in service.

The latter is considered an "experimental" road by the salt industry that first began work on stabilization 18 years ago, when they used from 16 to 18 tons of salt per mile. Today, with the added experience and know-how at their disposal, salt companies recommend on the average 1½ tons per mile per inch of compacted depth on a 20-foot width of road.

With Canada's increasing salt supply, the improvements of modern road-building equipment and methods, salt-stabilized roads seem the obvious answer to many roadbuilding headaches. This method should be of particular interest to the prairie Provinces and other less densely populated areas where paved roads are not feasible.

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17,400 copies of this issue printed

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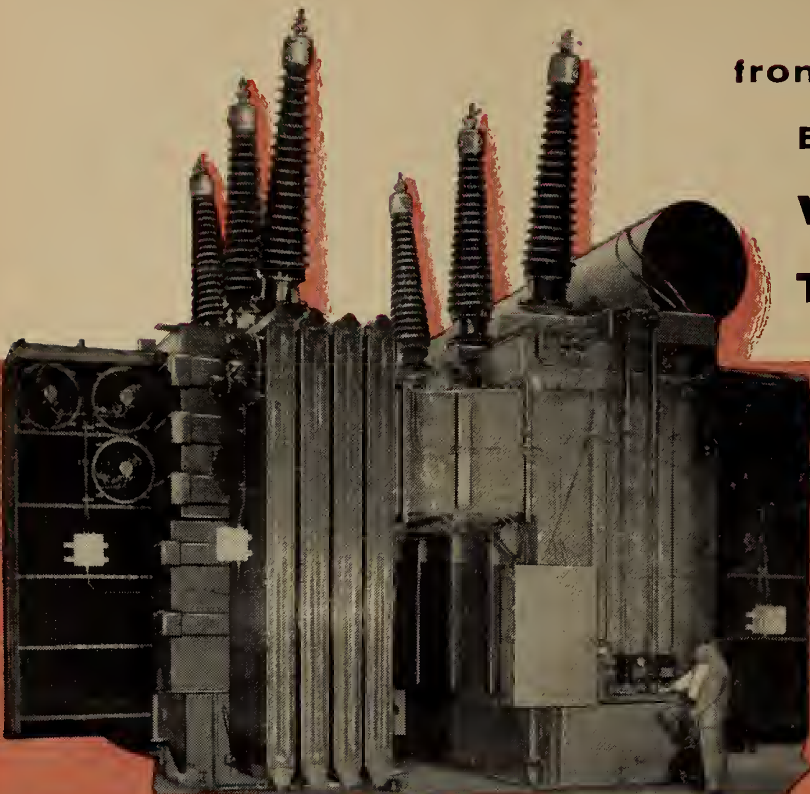
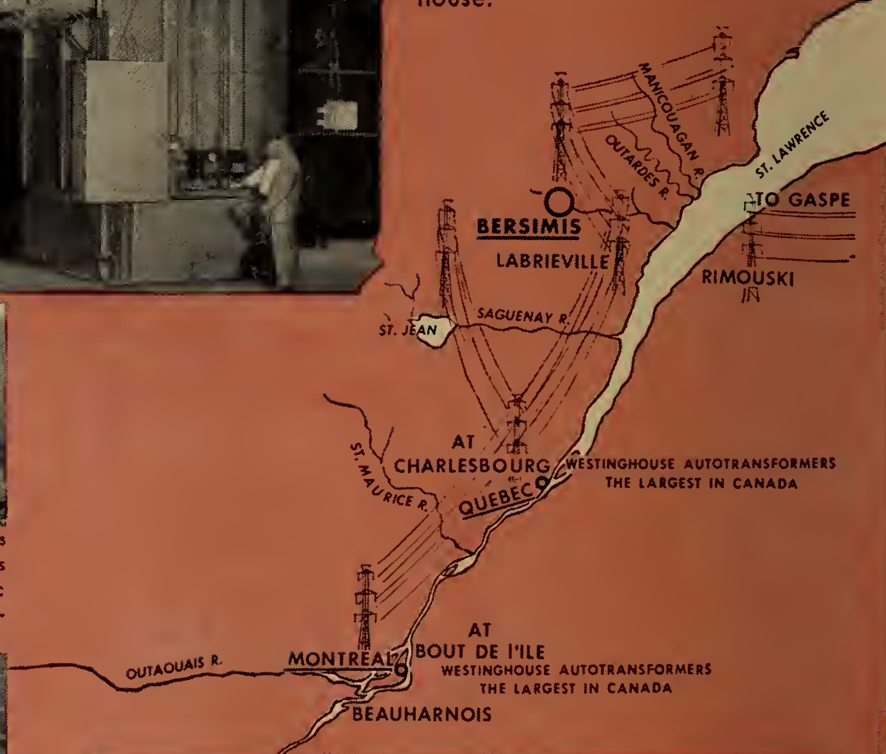
ALL THE POWER

from the giant Bersimis system is WESTINGHOUSE TRANSFORMED



Largest autotransformers with TCUL ever built in Canada, this is one of five supplied for the Bersimis system by Westinghouse.



Beneath the hills at right is the huge Bersimis generating station. Westinghouse transformers boost the voltage of the generated electric power for transmission over miles of countryside such as this.

The townsite of Labrieville.

One of the huge dams on the Bersimis system. These dams make possible a lake containing 350 billion cu. ft. of water.

From the underground generating station in Labrieville, townsite of Hydro-Québec's Bersimis River project and from the Lower Bersimis Generators will come 1,800,000 hp of electric energy. This power will travel over 400 miles of transmission lines to Quebec and Montreal.

Transformation of power on this system is accomplished by thirty-six Westinghouse power transformers, among them Canada's largest phase-shifting and autotransformers with TCUL* located at Charlesbourg and Bout de l'Ile to step down and shift voltage for the Shawinigan and Montreal systems.

Hydro-Québec has done a magnificent job. Westinghouse, a major supplier, congratulates the farsighted men who made Bersimis a reality.

Today, as in the past, it may be said of this, Canada's oldest land "Québec sont là!"

* TCUL Tap Changing Under Load.

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BERSIMIS-LAC CASSÉ

Hydro-Electric Power Development

F. Rousseau, M.E.I.C.
Chief Engineer,
Power Development Division,
Quebec Hydro-Electric Commission

Despite the author's reserve in regarding the Bersimis Power Development as ". . . just another power plant", there can be no doubt that it is, in fact, a major engineering achievement. The reasons for choosing the site, and a detailed account of the constructional work are given in this paper, which is to be presented at the forthcoming Annual Meeting of the Institute, May 1956.

The picture that forms a background to the title of this paper shows a view of the temporary power project and the rapids above which the main reservoir dam was constructed on the Bersimis River.
(Quebec Provincial Publicity Bureau—Photo Driscoll)

ALTHOUGH COMPETENT authority has qualified the Bersimis Power Development an outstanding engineering achievement, to engineers of the Quebec Hydro-Electric Commission it is just another power plant being added to a system to meet an ever-increasing demand for power.

A few details of background might be useful to provide a more complete perspective.

Hydro-Quebec took over the Montreal Light, Heat & Power Cons. and its subsidiary companies in 1944. The production capacity of the system at that time was 916,000 h.p. This capacity had been increased to 1,675,000 h.p. by 1954, mainly by adding the No. 2 plant to the existing Beauharnois installation. Quebec's rapid and steady industrial expansion, however, has developed a hunger for power which seems to grow in geometrical proportions. So much so, that the 1,200,000 h.p. expected by 1958 from the Bersimis plant will barely satisfy the demand.

Why did Hydro-Quebec decide in 1952 to give preference to Bersimis over such other power sites as the closer-at-hand sites of Lachine and Carillon or the No. 3 plant at Beauharnois?

The Lachine development could not have been started before the St. Lawrence Seaway project had been approved by the Canadian Government in 1952. Even had construction been started immediately, the additional production of 500,000 h.p. required for the Hydro-Quebec system by 1956 could not have been obtained from this particular development within the time allotted.

The Carillon development, with a firm capacity of 300,000 h.p., would have been inadequate. Moreover, Carillon will have its maximum usefulness in the future as a peak plant to firm up the Beauharnois and Lachine run-of-the-river plants.

Construction of the No. 3 plant at Beauharnois must coincide with completion of the Beauharnois Canal and, even at the present fast rate of dredging operations, the Canal could not be completed before 1960.

With its installed capacity of

1,200,000 h.p., at an estimated outlay of $190 per horsepower delivered in Montreal, Bersimis seemed to Hydro-Quebec authorities to be the proper answer to the immediate problem.

THE BERSIMIS RIVER

The Bersimis River discharges into the St. Lawrence on the North Shore at a distance approximately 190 miles below Quebec City. It flows in a southerly direction for 250 miles and its watershed is bounded on the west by the Saguenay River drainage basin and on the east by the Outardes River watershed. The total fall in the river is some 1,500 feet, with a drop of 1,225 feet in the 100 miles between Lake Pipmuacan, into which the Upper Bersimis flows, and the mouth of the river.

The most important potential head on the river—amounting to approximately 720 feet—is formed by a series of falls and rapids over a stretch of about 20 miles below Lac Cassé. Another drop of 370 feet is experienced in an adjoining 20-mile stretch of the river, ending downstream of the first falls and 45 miles from the river mouth. The river is narrow, has steep, rocky banks and provides favorable sites for power plants. With a surface area of 100 square miles, a drainage area of 4,500 square miles and high banks, Lake Pipmuacan provides the most favourable storage conditions.

The entire Bersimis watershed is rather mountainous and covered with spruce. It is unpopulated except for a very narrow strip along the shore of the St. Lawrence. Prior to construction of the power plant, activities in the area were limited to hunting, fish-

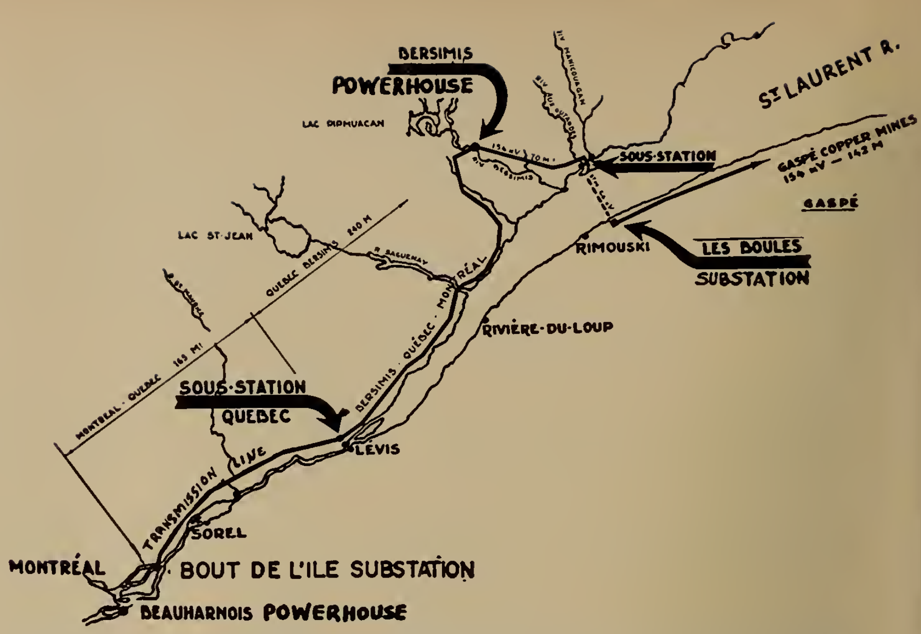


Fig. 1. Map showing the relative geographic positions of Labrieville, Quebec, and Montreal, with the inter-connecting transmission system between Bersimis, Montreal, and Gaspé Peninsula.

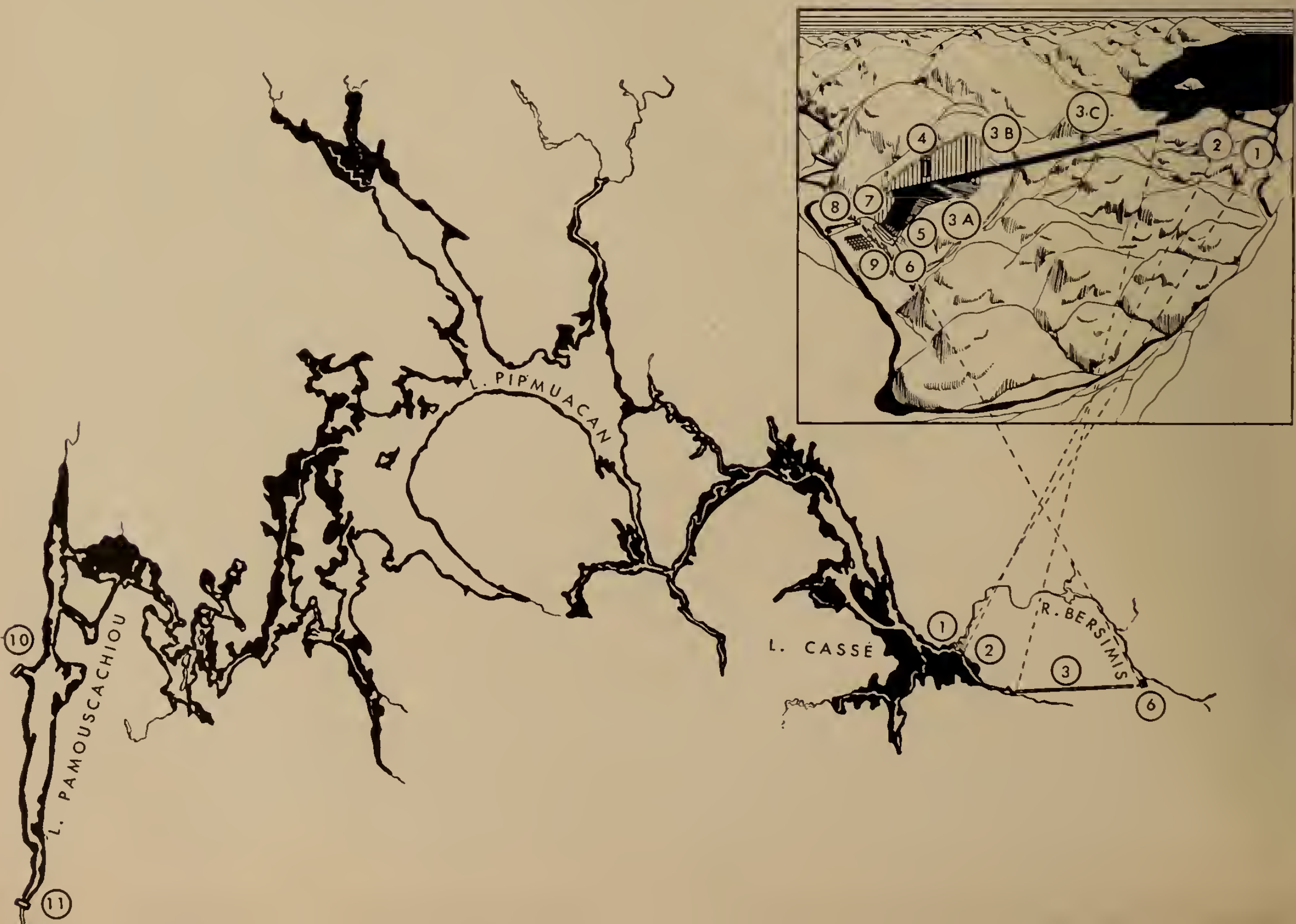


Fig. 2. Plan showing scope of project.
(1) Bersimis dam
(2) Desroches dam
(3) A, B, C. Tunnel sections
(4) Surge tank
(5) Penstocks
(6) Underground power house
(7) Underground tailrace
(8) Open-air tailrace
(9) Switching station
(10) Cut-off dam No. 2 on Lake Pamouscachiou
(11) Cut-off dam No. 1 on Lake Pamouscachiou

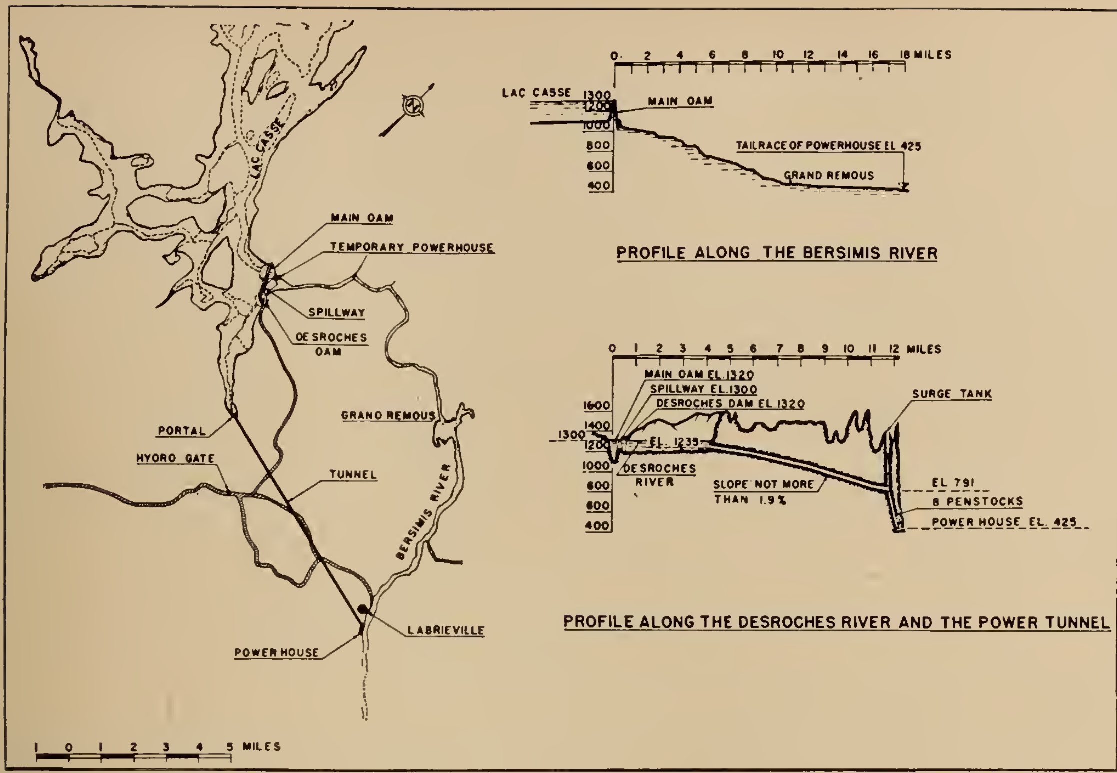


Fig. 2a. Lac Cassé area of project, with profile along the Bersimis and the Desroches Rivers and along the tunnel.

ing and the logging operations of pulp and paper companies.

HYDROLOGY, STORAGE AND POWER

Under the direction of H. M. Finlayson, the Shawinigan Water and Power Co. made a preliminary report in April, 1952, on 'The Hydrology and Power of the Bersimis River'. This report contained most of the information available at the time and showed the possibilities of power development at several sites.

Hydro-Quebec requested H. G. Acres & Co. Ltd. early in 1952 to design a power plant for completion by the Fall of 1956, utilizing all or the greater part of the natural drop of 720 feet below Lac Cassé.

No record of Bersimis water flow over a sufficient period of years was available to compute the regulation of this river with reasonable accuracy. Fortunately, a continuous record of daily discharges of the Outardes River had been kept since 1931 by the Quebec North Shore Paper Co. at its Outardes Falls development. Since the watershed of this river is adjacent and comparable to that of the Bersimis, it was considered that the unit run-off of the Outardes could be applied with sufficient accuracy to the Bersimis to determine its flow for regulation purposes.

The drainage areas of the two rivers were measured from maps charted by means of vertical photography done by the Federal Government. The mean monthly run-offs of the Outardes, derived from the period of record, were applied then to the drainage area of the Bersimis watershed under consideration. This procedure resulted in a hydrograph of the natural flow in the Bersimis River which would have occurred during the same period.

The drainage area at the outlet of Lac Cassé amounts to 5,010 square miles and a study of the hydrograph indicated that the mean monthly regulated flow of 9,250 c.f.s. can be maintained with 168 billion cubic feet of usable storage capacity.

Cost studies established that the most economical utilization of the river could be realized: (1) by building two rock-fill dams at the outlets of Lac Cassé to impound water at elevation 1,300; and (2) by tapping the storage by means of a 7.5-mile tunnel of section sufficient to carry the flow for maximum utilization of the river at 70 per cent load factor. This tunnel, driven across the bend formed by the river, would terminate at an underground powerhouse where tailwater could be maintained at approximately elevation 425.

Table I gives the pertinent statistics.

Table I. — Pertinent Statistics

Drainage area at Lac Cassé outlet	5,010	sq. mi.
Reservoir area	290	sq. mi.
Water surface elevation when full	1,300	
Maximum draw down	25	ft.
Gross storage	410	B.c.f.
Net storage (for regulation)	168	B.c.f.
Maximum gross head	875	ft.
Tailwater elevation	425 - 440'	
Tunnel intake: invert elevation	1,235	
Mean monthly regulated flow	9,250	c.f.s.
Design maximum total turbine discharge	15,000	c.f.s.
Installed capacity: 8 units at 150,000 h.p., 277 r.p.m.	1,200,000	h.p.
Peak primary output at 70% load factor	1,070,000	h.p.
Annual primary energy output	4,890,000,000	kwh.

DAMS AND DIVERSION

To impound storage water in Lac Cassé and Lake Pipmuacan at a water surface elevation of 1,300 feet, dams were found to be required not only on the Bersimis River — at the natural outlet of Lac Cassé — but also on the Desroches River, about 2,500 feet south of the Bersimis River dam and at the northwesterly end of Lake Pipmuacan.

The best location for a dam on the Bersimis was found to be at a distance of some 1,200 feet upstream from the Lac Cassé Falls. The Desroches flows north, in a direction almost at a right angle to the Bersimis, until it turns sharply eastward and is parallel to the Bersimis — with a distance of about 2,500 feet separating the two

graded from three to 10 inches, the intermediate one from one-half to three inches, and the last layer, on which the sloping core rests, is composed of sand.

The purpose of this filter is to prevent the clay core from infiltrating into the rock. The thickness of the clay core is 27 feet at the base of the dam and 15 feet at the top. The material is glacial till and was compacted in six-inch layers to the optimum density of 140 pounds per cubic foot. A reverse filter — one layer of sand and one of gravel graded from one-half to three inches — was placed up-

Soil investigations proved the material to be water-tight and of strength sufficient to carry the weight of the dam.

All unsuitable overburden and organic material were removed and, prior to placing the sluiced rock, a five-foot layer of sand was placed on the foundation, followed by another five-foot layer of gravel graded from one-half to three inches. The impervious core was keyed in a cut-off trench.

The dams were given a slight camber upstream to introduce axial compression in a core shaped in the form of an arch, thus de-

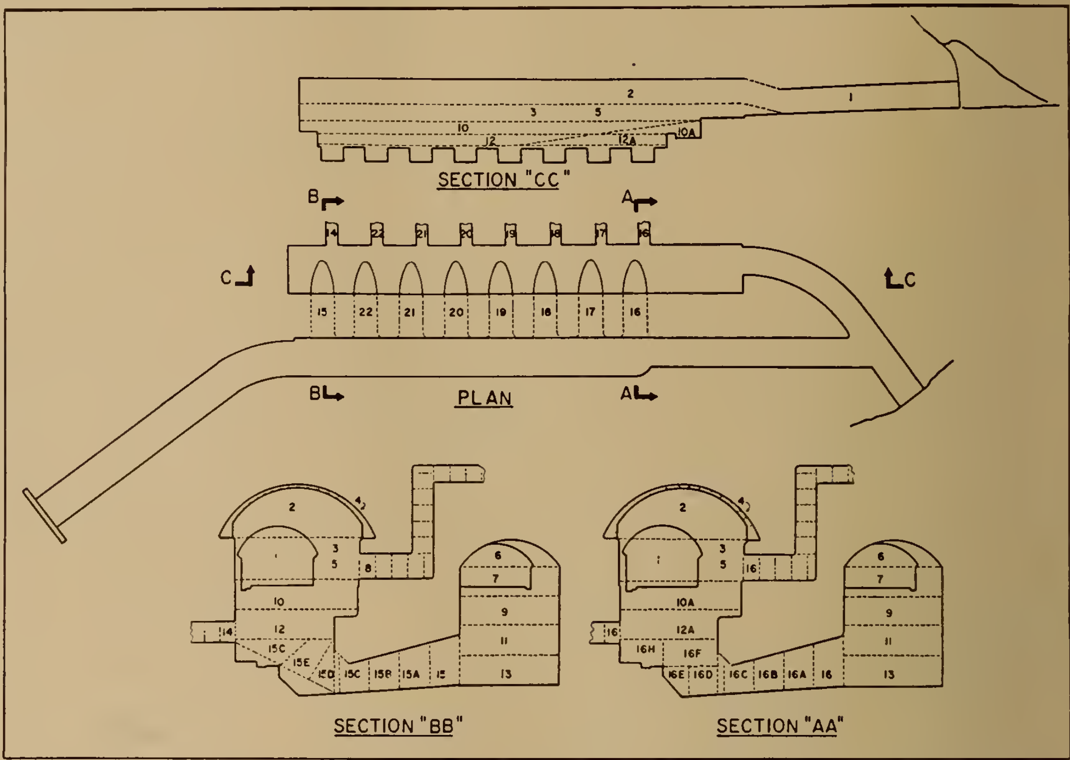


Fig. 3. Power house and tailrace excavation. Numbers indicate the sequence in which the excavation work was performed.

waterways. A suitable location for a dam was found almost in line with the Bersimis River dam.

The two dams at Lac Cassé, completed in November, 1955, are the rock-fill type with sloping clay core at top elevation 1,322. They are similar in every respect to the Kenney dam of the Kemano development. The main body of the dams was formed by dumping quarry-run rock into natural slopes. To reduce the amount of settling in the completed structure, the rock was sluiced thoroughly while being dumped. The quantity of water used for this operation equalled four times the volume of rock being sluiced.

On the upstream face, a filter of three seven-foot layers of graded material was placed. The layer in contact with the stone fill is gravel,

stream from the core. Finally, a rock-weighting zone, with an upstream slope of 1.0 vertical to 2.0 horizontal for the top 50 feet and 1.0 to 2.5 for the remaining height, was placed on the reverse filter.

The foundation below the core was cleaned carefully down to bedrock and grouted to a depth of 40 feet in stage grouting, this to develop an effective cut-off against leakage through the rock and to provide a good seal between core and rock.

Special consideration of dam design and construction was required for the north end of the Bersimis dam. Although bedrock outcrops at river level on the north bank, its surface dips steeply to the north beneath a deposit of glacial till more than 100 feet deep under the north abutment of the dam.

creasing the possibility of tension stresses.

The Bersimis dam is 2,200 feet long at the crest and 900 feet wide at its maximum height of 200 feet, while the Desroches dam is 1,305 feet long and 200 feet high. A fixed crest spillway 1,000 feet long was provided between the structures by the simple process of quarrying surplus rock from the mountain separating them. This rock was used for the dams.

Quantities involved in this phase of the work follow:

	cu. yd.
Sluiced rock	2,500,000
Rock in weighting zone	1,150,000
Filter material	950,000
Rolled clay	500,000
Total	5,100,000

Diversion of the river at the

Bersimis dam was achieved by means of a tunnel 39 feet wide, 36 feet high and 1,050 feet long. Driven 100 feet below the river bed, it terminates in an intake structure upstream from a rock-and-clay cofferdam across the river to a top elevation of 1,175 feet. The intake is provided with two closure gates 19 feet wide by 34 feet high and the tunnel will be closed eventually by a concrete plug below the clay core.

The diversion tunnel is supplemented by a diversion channel 80 feet wide and located on the south bank of the Bersimis. They were designed to prevent spring floods from overtopping the cofferdam, thus permitting preparation of the foundations of the dams during the 1953-54 winter and following spring. As soon as the receding waters permitted, the diversion channel was cofferdammed to allow materials to be placed in the dam the full width of the river.

The construction schedule calls for commissioning three units of 150,000 h.p. apiece by December 1, 1956. The minimum level of the storage at which the Bersimis plant can operate is elevation 1,270, this operating level requiring 242 billion cubic feet of dead storage at that elevation. To impound that much water it was necessary to close the gates of the intake structure of the diversion tunnel in the fall of 1955.

The diversion tunnel performs another very important function—feeding a temporary power plant erected for construction purposes at the Lac Cassé Falls, 1200 feet below the axis of the Bersimis dam. Since the intake gates have been closed, only the minimum flow required for operation of the temporary plant is being admitted into the tunnel—through a regulating valve in the intake structure.

Diversion of the Desroches River was very simple. With a watershed of 200 square miles, this river was diverted easily through a 40-foot square concrete culvert of 1,000-foot length built on the rock foundation across the dam.

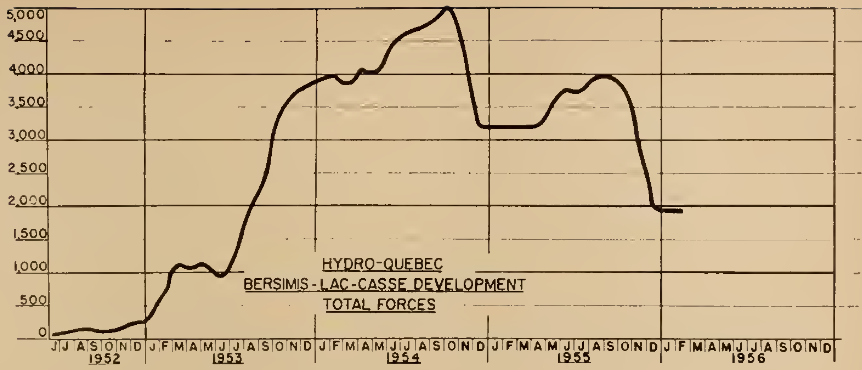
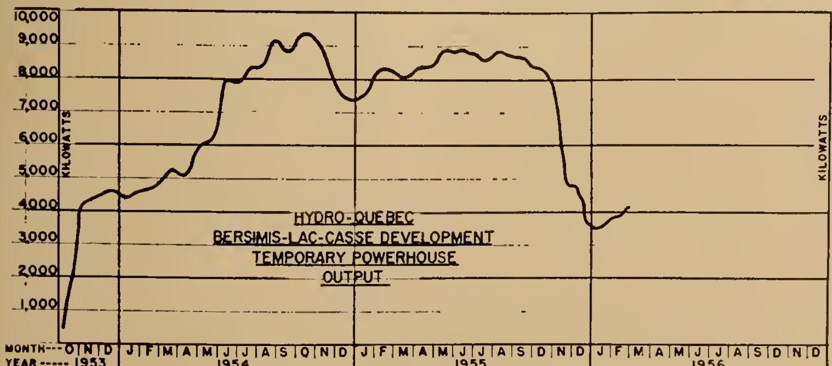


Fig. 4. Chart showing the fluctuation of labour employed on the project.

LAKE PAMOUSCACHIOU DAMS

To prevent water in the Lac Cassé reservoir spilling into the nearby Shipshaw and Peribonka watersheds, it was necessary to build cut-off dams at the western extremity of the reservoir. Suitable foundations for these dams not being available within the limits of the Bersimis watershed, agreement was reached with Price Brothers and Co. whereby two existing dams on their Lake Pamouscachiou reservoir were replaced by dams designed to raise the level of Lake Pamouscachiou by 20 feet.

Founded on rock, both dams are earth fill, with impervious roll fill core flanked by transition zones of pit-run gravel. Dam No. 1—at elevation 1,320—is at the outlet of the lake and has a concrete sluiceway 15 feet wide for river regulation and logging. Dam No. 2, on the western shore of the lake near its junction with Lake Shipshaw, is provided with two 12.5 by 12.5-foot submerged concrete sluices which can be used for diverting water into the Manouane River and thence to the Peribonka if, as and when available. Stop-logs at Dam No. 1 are operated by a 125-kva. diesel generator and gates at Dam No. 2 by a 75-kva diesel generator.

Fig. 5. Fluctuation of temporary power house output, kilowatts.


INTAKE AND POWER TUNNEL

The location of the intake was not a matter of choice. It was dictated by topography. The two dams back up water into the Desroches River for a considerable distance in the direction of the powerhouse. At a distance of 4.5 miles from the Bersimis dam, the river bed of the Desroches is at elevation 1,251 and its east bank, high and steep, provides an ideal site for the intake.

This concrete structure was designed for equal distribution of flow into eight openings of 16 by 30-foot dimensions at the trash racks. There are also intermediate piers especially shaped to provide a change in the direction of the flow of about 75° before it enters a chamber adjoining the tunnel. The velocity at peak flow will increase from four feet per second at the trash racks to 19 in the tunnel, with a corresponding head loss of less than two feet. A gate, 33 feet wide and 32 feet high, with sill at elevation 1,235, will be provided between the chamber and the tunnel. Elaborate model studies paid dividends in providing information which resulted in the design of a structure most economical in head losses.

Some 90,000 cubic yards of rock are being excavated from the bed of the Desroches River, approximately one mile from the intake, to provide a channel of sufficient cross-section at draw down.

The power tunnel is 7.5 miles long from its portal to the manifold of the powerhouse. An elaborate program of core drilling and boring was undertaken to determine the best layout in terms of quality of rock and rock cover. The rock in the general area comprises pre-Cambrian sedimentary gneisses, intruded by a graduated series of igneous rock. The sediments contain mainly quartzite, pegmatite and granite. Special attention was paid to the shear zones or ancient faults in the area and it was established that no trouble of any proportions could be anticipated from poor rock or water. In all respects, indications were that a tunnel could be driven through solid rock without much supporting being required and with sufficient rock cover.

The course of the tunnel varies very slightly from a straight line between the intake and the powerhouse. This deviation was necessary to provide enough rock cover or to shorten the length of the adits. The tunnel drains towards the powerhouse on a grade not exceeding 2 per cent, this grade limit being set to facilitate construction of the tunnel. The total drop in the tunnel is 445 feet. The minimum depth in feet of rock cover at any point of the tunnel was specified at not less than 50 per cent of the maximum pressure at that point.

The most economical section of the tunnel was set at the limit beyond which any gain in value of power, resulting from elimination of friction losses due to increase in the size of the tunnel, would no longer provide a fair return for the additional capital expended. Since the rock proved very solid and tough, it was thought that an unlined tunnel was the answer. Cost studies proved, however, that a lined tunnel would be less expensive than an unlined one for the same friction losses.

The lined tunnel was designed to carry a flow of 13,250 c.f.s. for a load factor of 70 per cent, using the Manning coefficient of friction n=0.0109. It has a horseshoe-shaped cross-section almost equivalent to a circle 31 feet in diameter. This horseshoe-shaped cross-section was chosen—in preference to the circular section—for construction reasons only: it permitted the swinging of the 1.5-cubic yard electric shovels working at the headings.

The thickness of the concrete lining was specified at 10 inches minimum. With the expected overbreak, however, this thickness averages more than 18 inches. Any void left between the lining and the rock at the crown was grouted at 10-foot intervals in two stages at 50 and 100 p.s.i. A different pattern of grouting with higher pressures was specified at the location of faults—to suit particular conditions. Approximately 2.5 bags of cement per lineal foot of tunnel were used for grouting.

SURGE TANK

Entirely hewn out of rock, the surge tank is located above the axis of the tunnel 60 feet upstream from the first penstock. In view of the importance of this structure, extensive design and model studies were carried out on different types of tank. Analysis showed that the restricted orifice-type of tank would be more economical than the differential type.

A 27-foot concrete-lined shaft rises 313 feet from the tunnel at elevation 822 to the bottom of the tank at elevation 1,135. The unlined tank is 85 feet in diameter and 365 feet high. It emerges into the open at the hill top at elevation 1,500 and is offset 45 feet from the axis of the surge shaft to make room for a rock trap at the bottom of the tank. A concrete rim at the top of the tank supports the roof.

It will be noted that the top of the rim is 200 feet above normal water elevation in the reservoir.

PENSTOCKS

The tunnel terminates at invert elevation 792 in a manifold 31 feet in diameter. The 12-foot concrete-lined penstocks of the eight turbines join the manifold at an angle of 50° from the horizontal and 60° in plan, dropping to scroll case level at elevation 422.

Model studies of the manifold were carried out with the view to maintaining equal distribution in all branches and eliminating head losses as much as possible.

The penstocks are field welded to 7 ft. 9 in. straight-flow valves weighing 160 tons apiece and inserted upstream from the scroll cases. Penstocks, valves and scroll cases will be subjected to a maximum pressure of 540 p.s.i. or the equivalent head of 1,240 feet.

The two-foot lining of the concrete penstocks and the two-foot concrete backing between the steel lining and bare rock were poured by means of pumpcrete machines. Pressure grouting — in stages up to a maximum of 300 p.s.i. and to a depth of 15 feet in the rock — was specified to fill any possible void and provide a water-tight curtain around the penstock. The penstocks are steel lined over a distance of 328 feet from the straight-flow valves. The diameter of the steel lining drops by stages from 10 to 9 feet and is finally reduced to 7 ft. 9 in. at the straight-flow valve. Thickness of the lining varies from 1 1/16 to 2 1/16 inches. The steel liners were delivered in 50-foot sections weighing approximately 50 tons. Field joints were welded electrically, stress relieved, and thoroughly X-rayed.

THE POWERHOUSE

Cost was the major factor on which was based the decision to

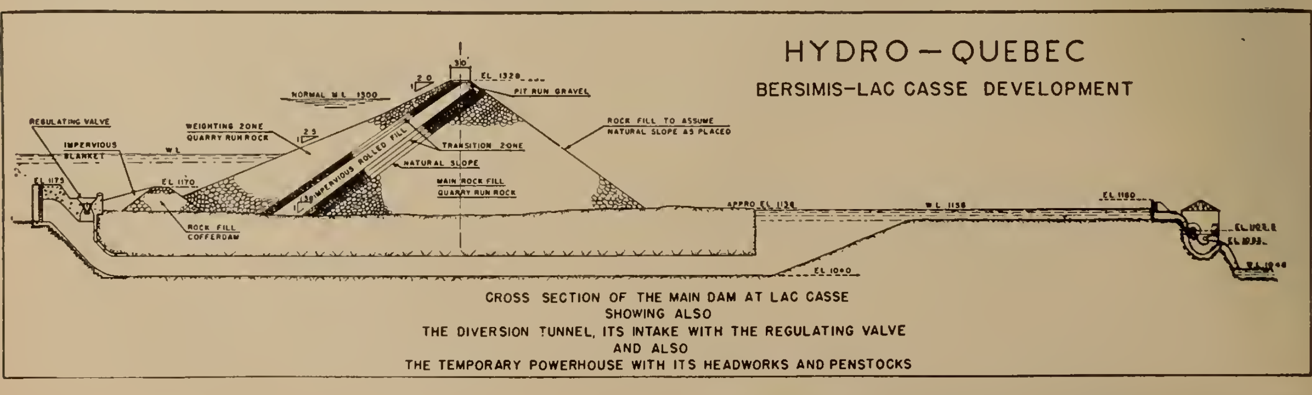
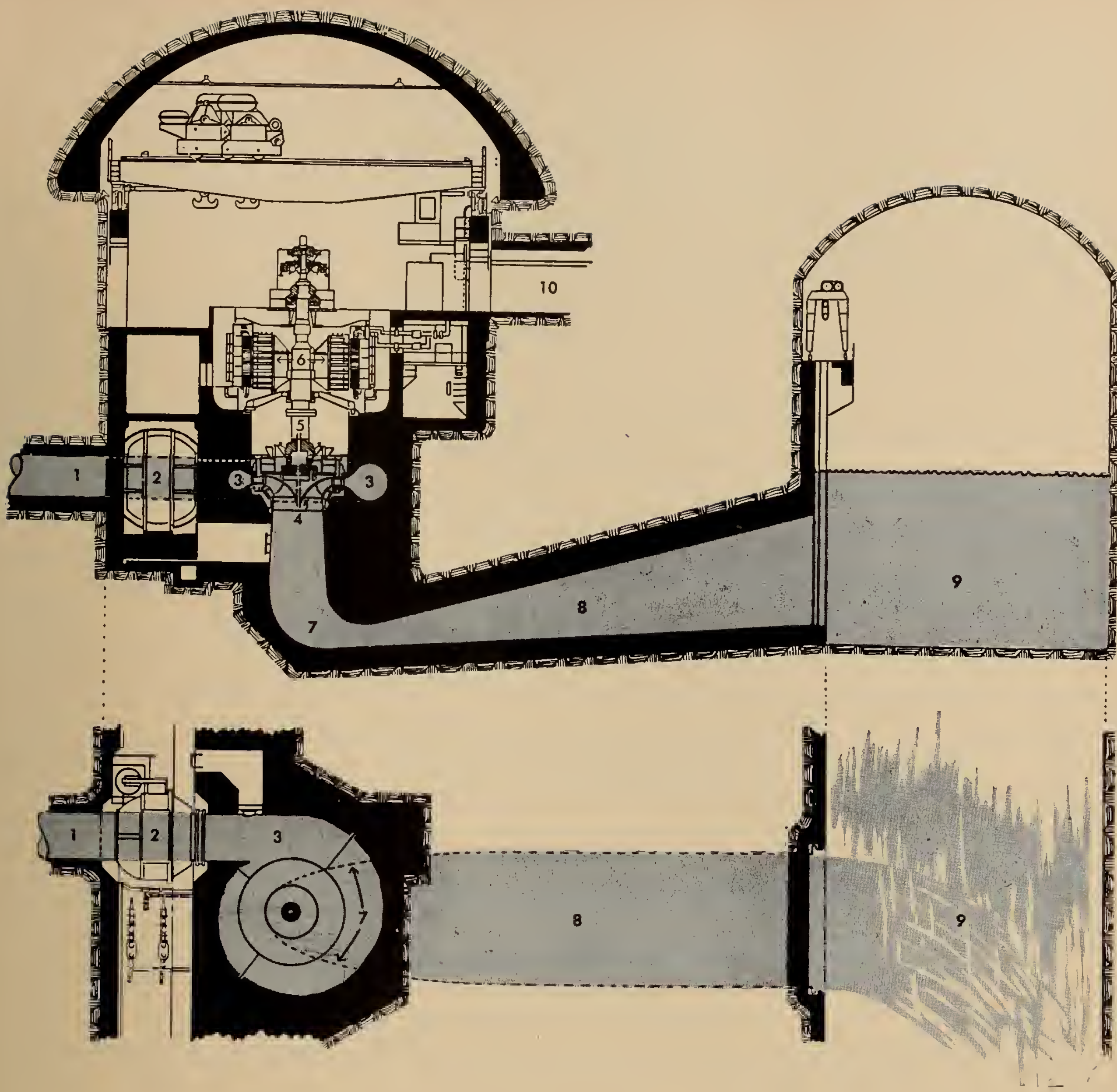


Fig. 6. Cross-section of the main dam at Lac Cassé, showing also the diversion tunnel, its intake with the regulating valve, and the temporary power house with its headworks and penstocks.



build an underground powerhouse. A towering mountain of rock, a few hundred feet from the river, provided the mass to resist the heavy surge pressures to which the penstocks will be subjected and eliminated the necessity of building expensive, wide-diameter penstocks in the open.

A cavern 565 feet long, 65 feet wide, and 80 feet high will house eight Francis turbines 55 feet apart. They are rated at 150,000 h.p. under a 785-foot head at 277 r.p.m. Each unit will drive a direct-connected, three-phase, 60-cycle, 13,800-volt generator rated at 138,000 kva. with 95 per cent power factor.

Each draught tube is connected to a tailrace chamber at atmospheric pressure. Parallel to the powerhouse, this chamber is 410 feet long, 47 feet wide and 75 feet high. A tailrace tunnel, 380 feet long, 47 feet wide and 65 feet high, will carry the discharge to the open tailrace.

Providing normal access to the powerhouse is an entrance tunnel 270 feet long, 36 feet wide and 30 feet high, sloping down from ground elevation 468 to the erection bay north of unit No. 1 at generator floor elevation 447. An eight-by-eight-foot emergency tunnel is located at the other end of the powerhouse, while another tunnel 20 feet wide and 11 feet high — between units No. 4 and No. 5—connects the powerhouse to the control building in the switchyard.

The powerhouse roof arch is concrete-lined and a suspended ceiling will hang from it.

A 400-ton bridge crane, supported by concrete girders and columns poured against the rock walls of the cavern, will handle the heavy equipment parts.

Each generator will be connected by leads through a bus tunnel — 8 by 9.5 feet — to three-phase transformers rated at 40,000 kva.

Fig. 7. Plan and cross-section of power house.

(1) Penstock steel liners
(2) Straight flow valve
(3) Scroll case
(4) Turbine
(5) Generator shaft
(6) Generator
(7) Steel draught tube elbow
(8) Draught tube
(9) Tailrace chamber
(10) Cable tunnels

13.8/301.4 kv. and located outside in the switchyard.

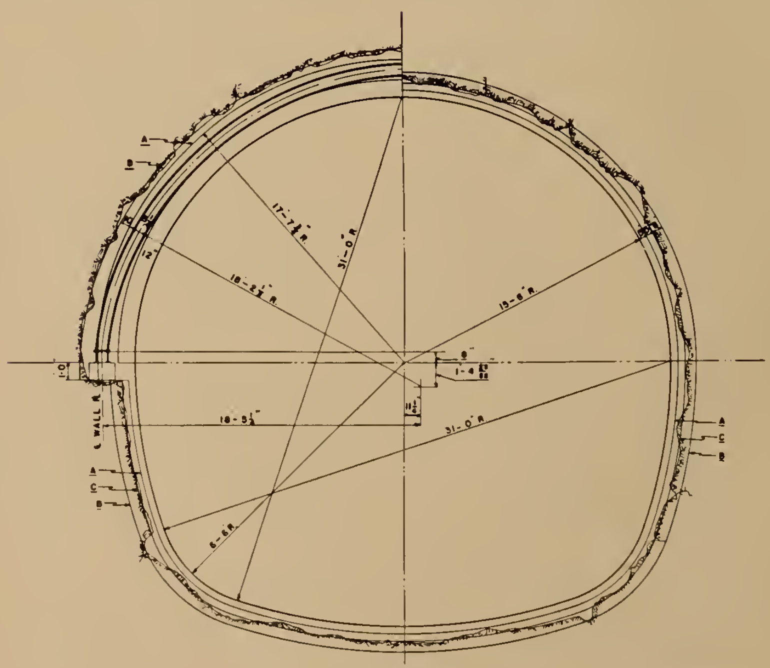
A ventilating tunnel using four blowers is located at the north end of the tailrace chamber. It will circulate from 72,000 to 282,000 c.f.m. of air into the cable passageway below the generator floor for distribution to the generation room at each unit. The air will be admitted directly to the generator room for ventilation alone or will be deflected through the generator when heat is required. A false ceiling, suspended from the roof arch, will house the return duct to the tailrace chamber where part of the air will be discharged or re-circulated. Blowers at the bus tunnels will also discharge a minimum 9,000 c.f.m. and, at the same time, carry away the heat generated by the busses.

The control building in the switchyard will house complete control equipment, instrumentation and necessary office space.

Power will be transmitted from the switchyard to Quebec City and Montreal by means of 300-kv. transmission lines.

Operating and maintenance personnel will be housed within walking distance of the switchyard in a small modern town — Labrieville — with church, school, stores, recreation and other facilities. The town, incidentally, was named after Bishop A. N. Labrie, Bishop of the Gulf of the St. Lawrence.

Fig. 9. Cross-section of tunnel.



ASPECTS OF CONSTRUCTION

The Commission decided early in 1952 to complete the Bersimis development for November 1, 1956. The only information available at that time was a preliminary report showing the possibility of power development and a few vague outlines of several schemes. A practically unknown region in the wilderness had to be explored, surveyed, mapped and from this information structures had to be located, designed and constructed —all in the space of four years.

The project, now nearing completion, offers some interesting constructional aspects.

The surveys were well under way by June, 1952, at the possible sites of the structures. In the same month — even before the location of these structures could be established definitely — work was started on the access road linking Forestville, the nearest St. Lawrence River port, and Labrieville. Surveys had provided sufficient information by August to establish the general scope and layout of the works, permitting Hydro-Québec engineers to draft a preliminary construction schedule.

CONSTRUCTION POWER

It was estimated that the power required for construction would be 12,000 h.p., of which 8,000 had to be available during the summer of 1953. An analysis indicated that approximately two million dollars could be saved if, instead of using

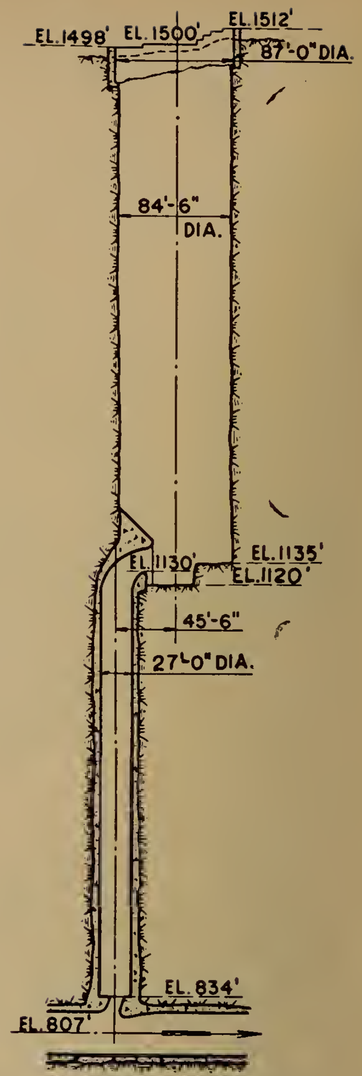


Fig. 8. Vertical section of surge shaft and tank.

diesel power, Hydro-Quebec were to install — at the Lac Cassé Falls — two units from the abandoned St. Timothée hydro-electric plant on the shore of Lake St. Louis near Montreal.

The two 40-year-old horizontal units were dug out of the concrete in September, 1952, transported by boat to Forestville and hauled by road to Lac Cassé during the winter following. The last 15 miles were over a hastily built snow road to assure delivery on time of the turbine and generators.

Erection of the powerhouse by the Hydro-Quebec Power Development Division began in November and continued through the 1952-53 winter. The plant was ready in July, 1953, and a 44-kv. transmission line more than 20 miles long was supplying power to the construction sites by the beginning of October. It is interesting to note that only 50 of the 90 feet of falls were used to conform to the designed head of the turbines. At time of peak, the plant was able to cope with a demand of almost 15,000 h.p.

BUILDING THE TWO DAMS

Construction of the rock-fill dams, diversion works and by-pass tunnel was the object of a separate contract. Most of the 1953 summer was used to build a complete camp set-up and construction plant. The cofferdams, diversion tunnel and intake were completed by the spring of 1954 and preparation of the foundation was well under way. Actual placement of loose rock, clay core and filter materials was started only in August, a month behind the original construction schedule.

To make up time, it was decided to extend the placement of clay into the freezing weather of late November, dissolving calcium chloride in the water used for sprinkling to obtain optimum moisture. Good weather before the spring flood of 1955 permitted the placement of clay to elevation 1,198, the Bersimis was prevented from overtopping the impervious core and the race against Nature was won. Work on the dams continued until completion in the fall of 1955.

The two steel gates of the intake were closed at the beginning of November, 1955, to permit impounding water to the operating level for 1956. The regulating valve, which allows sufficient water to pass to operate the temporary power plant, will discharge via the by-pass tunnel until November, 1956. With the Bersimis power plant in operation then, temporary power will be needed no longer. At that time a plug will be poured in the diversion tunnel under the clay core.

Fig. 10. South end of Lac Cassé dam under construction, showing monitor jets at work.

Due to the short time allowed to drive the diversion tunnel during the 1953-54 winter, mining had to proceed on two headings from a shaft sunk at mid course, offset 30 feet from the tunnel and connected to it by a cross-cut. The cross-cut was sealed by a concrete plug prior to the spring flood.

The rock for the two dams was blasted from a granite hill nearby. Drilling equipment comprised two quarry masters drilling six-inch holes and five nine-inch churn drills. It turned out, however, that this drilling equipment was not sufficient to keep pace with the placement of rock and it was necessary to have recourse to three 50,000-cubic yard coyote blasts. Seven shovels (one of five, two of 3.5, and four of 2.5 cubic yards) were used to load the quarry-run rock into 26 diesel trucks (14 of 35-ton and 12 of 22-ton) which took their loads to the dam sites for back-dumping. Monitors, with 150 p.s.i. jets discharging four times as much water as the volume of rock being placed, assisted compaction.

Fig. 11. Tunnel intake under construction.

Clay or, rather, glacial till was obtained from a pit located four miles from the dams. Loading and transportation were by means of shovels of ¾-cubic yard capacity and three- to five-ton trucks. Pneumatic and sheep foot rollers could not keep pace with the placement of clay in the narow strip. Accordingly, compaction to the optimum density of 140 pounds per cubic foot was realized by rolling loaded trucks back and forth. These vehicles were especially assigned to this process.

A screening plant was set up some three miles from the dams to produce 950,000 cubic yards of screened gravel in three sizes for the filter layers of the dams. Since the only suitable gravel deposits were located in areas to be flooded when the cofferdam was completed, the screening plant was designed to stock-pile at the one time all the material required for the two dams.

The rate per week of placing materials in the dams was 80,000 cubic yards for the rock, 15,000 to 20,000 for the clay, and 30,000 for the filter materials.

DRIVING THE TUNNEL

Due to the short time the construction schedule allowed to complete the tunnel, it was necessary to undertake its driving on six different headings. An analysis of cost proved that it would be cheaper—in this particular case—to drive the tunnel from adits instead of shafts. The cross-section of the adits was reckoned at a width of 32 feet and a height of 25 feet, sufficient to permit truck traffic in both directions, as well as installation of ventilation ducts, air, water and pump discharge lines. Maximum grade allowed for the adits was 8 per cent.

Three different contracts were let for construction of the 40,000-foot tunnel and excavation of the powerhouse. The first contract was for 16,000 feet of tunnel, the intake and an adit of 2,500-foot length, the second for 16,000 feet of tunnel plus an adit of 2,500 feet, and the third for 8,000 feet of tunnel, a 1,400-foot adit and excavation for the powerhouse, tailrace, penstocks and cable tunnels.

Included in each of the two first-mentioned contracts was the erection of camps and temporary buildings to house the work force, of repair shops and stores, compressor buildings, boiler rooms and all the necessary auxiliary structures required for the work. The third tunnel contractor made his headquarters at Labrieville, where most of these auxiliary functions were handled from a central set-up.

Work on the three adits began in July, 1953, and the entire tunnel, including 18-inch concrete lining, was completed in the fall of 1955—with the exception of 50,000 cubic yards of concrete in the invert which is scheduled to be placed early this spring. Worthy of note is the fact that the final break-through was made less than 18 months after the start of adit and tunnel excavation.

Two full headings were developed in opposite directions once the adits had been driven to the tunnel line. For the drilling of each face, 18 to 20 power-feed drifters of 3.5-inch were set on hydraulic booms for positioning. They were mounted at four different levels on a jumbo. Depending on the pattern and round chosen by the contractor, from 150 to 190 two-inch holes—varying in depth from 12 to 20 feet—were drilled on a face and loaded with approximately four pounds of dynamite per cubic yard of rock.

Fig. 12. General view of underground power house showing arch-roof, crane rails, beams, and columns. At centre, the supports for unit No. 2 scroll case.

Long-delay electric blasting caps were used in some 15 intervals varying from 100 milliseconds to one second each. Several types of blasting caps were tried, but it was found that only with the use of long-delay caps could a neat, compact pile of muck be left at the face after a blast for easy loading. Tungsten carbide bits were used for drilling, their average drilling life being 240 feet.

Electric shovels of 1.5-cubic yard design but equipped with 2-cubic yard buckets were used to load the blasted muck into 15-ton diesel trucks. Scrubbers were installed on the exhaust pipes of the trucks to reduce the fumes in the tunnel.

Compressed air plants, each comprising two 2,800 c.f.m. vertical electric compressors, were used to supply air to the drills at the first two adits. The air plant near the third adit contained three compressor units and was used to supply air to the powerhouse as well as the tunnel.

Ventilation of the tunnel was effected by means of 38 reversible axivane fans driven by 60-h.p. electric motors. The fans were set in series on 48-inch metallic ducts. The ventilating system was designed to move the air in the tunnel at a velocity of 50 feet per minute.

A total of 320 feet of non-telescopic metallic form work, set on a jumbo moving on a track, was used to line the arch of the entire tunnel with concrete. The arch was poured in sections varying from 80 to 160 feet and it was not long before six full cycles were attained in one week. From six to nine hours in a 24-hour cycle were allowed for placing concrete, 10 to 11 hours for the concrete setting, and the balance for lowering, moving and setting up the form work in its new location. Guns were used in the first two sections for placing concrete and pumpcrete placers were used in the third section. The sequence for concreting the lining made provision for the invert to be poured last — after the arch had been grouted — to

Fig. 13. General view of power house showing scroll cases No. 2 and 3 in position.

effect savings on the cleaning of the tunnel invert.

The tunnel rock was very good and driving became a matter of routine except for a total length of 2,000 feet of faults where steel supports were required. Serious water trouble was experienced at only one place — under a lake in the first section. Approximately 2,000 cubic yards of grout had to be forced into the rock from inside and outside the tunnel to keep the lake water from leaking into this particular heading.

A power load of 7,000 h.p. was required 24 hours a day, six days a week for the almost 2½ years it required to complete the tunnel.

Data pertaining to the construction of the tunnel are summarized in Table II.

Fig. 14. Drilling jumbo for tunnel excavation.

THE SURGE TANK

Excavation of a surge tank, 365 feet deep and 85 feet in diameter, and excavation of a shaft of 31-foot diameter, dropping another 313 feet from the bottom of the tank, presented a hazardous problem worth mentioning. A 10 by 12-foot pilot shaft was raised from the tunnel to ground level, a height of 678 feet. It followed a previously drilled hole of nine-inch diameter bored from the top. Timbering was removed and a muck-loading chute was set at the bottom of the shaft at tunnel-roof level. Tank and shaft were then slashed to full size by means of down hand drilling in steps from the top of the tank. All muck was passed down through the pilot raise to a loading pocket in the manifold, thence into 15-ton trucks for hauling to the spoil pile.

EXCAVATING THE POWERHOUSE AND TAILRACE

Excavation of the powerhouse cavern and the tailrace chamber with its tunnel was carried out in the simplest manner ever devised. The permanent access tunnel (36 feet wide and 30 feet high) to the powerhouse was driven full face to grade, using standard tunnel practice, from ground elevation 468 to about 50 feet from the entrance to the powerhouse. From this station, the grade was reversed and ended at the entrance to the powerhouse at elevation 470, flush with the shoulder intended to receive the thrust of the powerhouse concrete arch. From there on, the entire face between the roof and the haunches was driven the full length of the power-house. A large quantity of rock bolts was used to make the roof safe before the concrete arch could be poured.

The following method was used to preserve as neat faces as possible at the haunches.

First, a line of 20-foot holes, spaced at 12 inches, was drilled at the face of the two haunches. Then, the drilling of the rock mass between the two lines of holes was carried out the full width of the powerhouse to a depth of 18 feet by means of drifters. The rock was blasted in a herringbone pattern, using long-delay caps to minimize overbreak. The rock from these blasts was left in place over the whole area to support a 30-foot section of wooden arch form set on rails and blocked on the muck for pouring of the concrete arch. After the entire arch had been poured, mucking was resumed and the remaining solid rock was mined in 15-foot lifts down to grade. The rock below the powerhouse entrance, which could not be hauled out through the access tunnel, was taken out through the previously excavated south draught tube and discharge tunnel.

Another cavern (410 feet long, 47 feet wide and 75 feet high) still had to be excavated for the tailrace chamber. For this purpose, an access tunnel was driven, branching from the main entrance tunnel down to a few feet below the springing line of the chamber roof at the north end. The area of the arch was driven the full length of the chamber. Since the muck could be hauled out only through

Fig. 15. Tunnel form used for concrete lining.

Table II. — Tunnel Construction Data	
Total length of tunnel and adits	46,600 ft.
Total excavation, tunnel and adits	1,678,000 cu. yd.
Concrete lining, 18-inch thickness	5.9 cu. yd./ft.
Excavation per linear foot of tunnel	36 cu. yd.
Average weekly advance on two headings	244 ft.
Best weekly advance on two headings	404 ft.
Average overall weekly advance	732 ft.
Average overall round	13 to 14 ft.
Average Tunnel Excavation Cycle	
Loading dynamite, moving jumbo, blasting	1 hr. 25 min.
Ventilating smoke out	25 min.
Scaling, bulldozing, moving shovel in, mucking, moving jumbo in	7 hr. 20 min.
Drilling	3 hr. 40 min.
Total average cycle	12 hr. 50 min.

the north end at this stage, a ramp was developed down to close to the tailrace tunnel grade along the length of the chamber in the process of excavation. The triangular mass of rock left between the north end of the chamber and the tailrace tunnel was excavated then and the muck hauled out through the discharge tunnel.

The tailrace to the river is being dug in gravel by means of tractors, scrapers and shovels. A natural cofferdam of gravel is left at the junction with the river and will be removed later by means of draglines.

Penstocks

The upstream side of the powerhouse mucking was stopped at the level of the penstock invert while the driving of the eight 16-foot diameter penstocks themselves was carried out.

The horizontal section of these penstocks was driven full face from a jumbo mounting four drifters and mucked with rocker shovels loading into 15-ton trucks. The inclined section, at 50° angle, was mined by means of six-by-nine-foot pilot raises which were subsequently slashed to size by downhand breast drilling. A loading pocket was established at the elbow and muck chuted directly to the 15-ton trucks.

Cable Tunnels

Mucking on the downstream side of the tunnel was stopped at the level of the invert of the cable tunnels while their driving was completed. Drilling was carried out by two drifters mounted on booms, the whole placed on sleds moved by bulldozers. Muck was removed by rocker shovels which dumped their loads into the powerhouse muck pile.

CONCRETE AND AGGREGATE PLANT

Over 500,000 cubic yards of concrete will have been required before the Bersimis development is completed. Of this amount, 460,000 cubic yards have been placed already in various structures by six different contractors. For the sake of economy, it was decided to erect a central mixing plant in a gravel pit strategically located less than one mile from adit No. 2—to serve all the tunnel, powerhouse and town site contractors.

The standard automatic concrete plant with a 500-ton overhead bin is fed by a conveyor loading from a reclaiming tunnel under three different stockpiles of aggregate. Four tilting mixers, each of two-cubic yard capacity, discharge into a collecting hopper from which eight cubic yards of concrete are dumped into 15-ton diesel trucks. Except for the Lac Cassé job, all the concrete was mixed in this plant and transported in trucks with open bodies, some of it as far as six miles.

Due to the addition of a dispersing agent, there was practically no segregation at the points of delivery. Before being used in the concrete guns or the pumpcrete placers, the concrete was agitated in a standard re-mixer. The concrete was kept warm during winter transportation by passing the exhaust gases of the trucks through a jacket on their steel bodies. An average 5.5 bags of cement per cubic yard were used in the mixes to produce a concrete with compressive strength of well over 3,000 p.s.i.

Bulk cement was used in the central mixing plant. The cement was transported in a 2,700-ton boat to Forestville, unloaded by pumps into a wood-staved cement silo with a capacity of 25,000 barrels and then piped to a reloading silo. The cement was transported from this transfer silo in tank trucks whose 10-ton loads were dumped into a 50,000-barrel, wood-staved silo at the mixing plant. The silos, 60 and 80 feet in diameter, are equipped with air slides set in the concrete foundation slab to make cement flow to the discharge point.

The aggregate plant consisted of a 48-inch gyratory primary crusher, a 36-inch secondary cone crusher, vibrating screens, scrubbers, conveyors and stacking conveyors over the reclaiming tunnel. The aggregate plant feed was mostly gravel from a nearby esker. Since the esker was deficient in coarse material, it was found expedient to add tunnel muck to supplement the stone supply.

TRANSPORTATION

Over 250,000 tons of equipment, materials, supplies and foodstuffs have been transported already by boat to Forestville and it is estimated that shipments will amount to 50,000 tons during 1956. A 500-foot wharf was built at Forestville to handle cargoes, while a 50-ton derrick on the wharf handles the heavy equipment.

Fig. 16. Interior view of temporary power house.

Fig. 17 (above). Interior of the underground power house.
(Quebec Provincial Publicity Bureau—Photo Driscoll)

ORGANIZATION

Hydro-Quebec was quite surprised when contractors working on the project stated that the Commission was the general contractor for the Bersimis development. Upon retrospection, however, it was realized the contractors were not far from the truth.

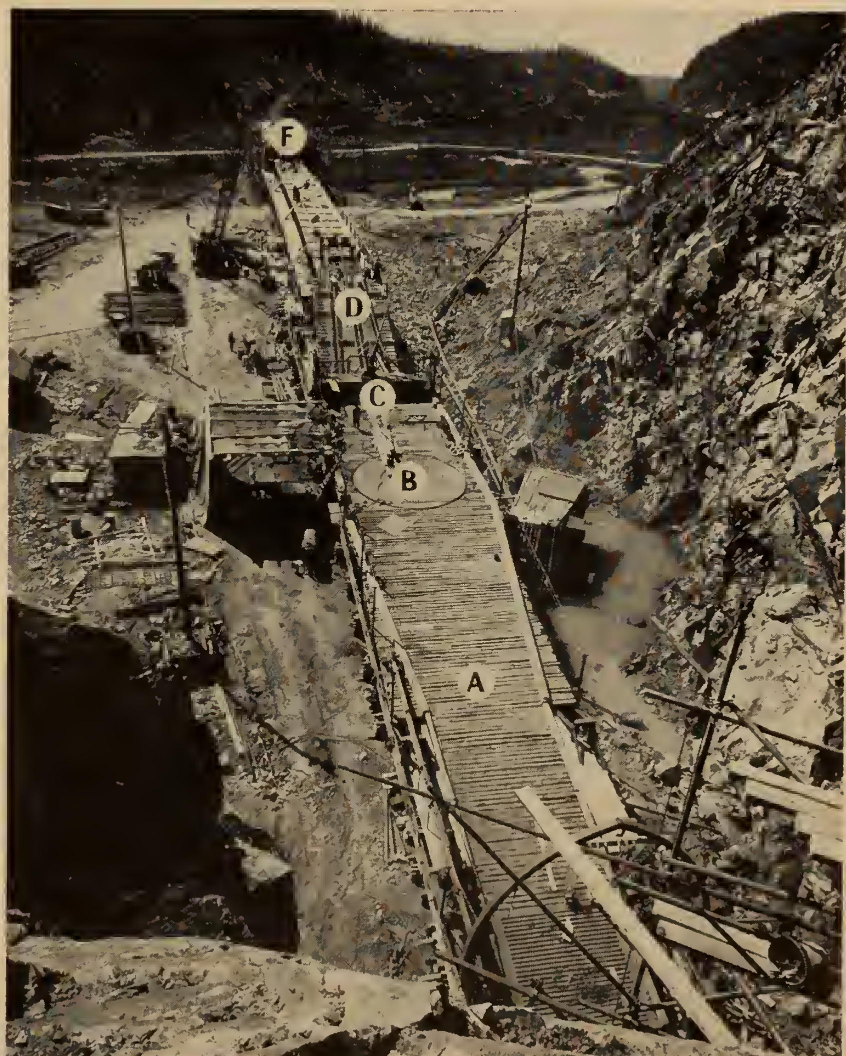
Hydro-Quebec preferred to let the work to six different contractors instead of letting the entire development to a single contracting firm. The reason was twofold: to create more stimulation on the job and to benefit from the experience of a greater number of key men than a single organization could make available.

All equipment, materials, supplies and spare parts have been purchased by Hydro-Quebec. Construction stores, payrolls, accounting, cost accounting, transportation, distribution of construction power and the catering for the men are handled also by the Commission. Common use of all these services could not but result in appreciable savings. Hydro-Quebec feels there is ample justification for this method of handling a big assignment providing, of course, that the project can be handled and co-ordinated efficiently by the owner's organization. The contractors were relieved of some of the inherent worries of the trade and were therefore free to concentrate all their efforts on performance.

Very appreciable economy was realized by forming an equipment pool from which contractors could draw the equipment they required. Endeavour was made to arrange the construction schedule in such a way as to make continuous use of the equipment on any part of the job, equipment being shifted from one contractor to another. Standardization was achieved to a certain degree, resulting in a lesser variety of spare parts being kept in construction stores. Only new equipment was purchased and the job benefited from the best years of the equipment's lifetime. All this could be achieved only through Hydro-

Fig. 18. Tunnel concreting jumbo at portal before entering tunnel (total length including forms 440 feet).

- **A. Truck ramp**
- **B. Truck turntable**
- **C. Receiving hoppers on top of placing equipment**
- **D. Pipe support ramp**
- **F. Steel tunnel form**



Quebec owning the equipment.

At that period when the contractors were required to start the work, there was insufficient information about the project to have the work carried out on a unit price basis. Accordingly, the contracts were let on a cost-plus-fixed-fee basis. To effect maximum economy on that type of contract, it was decided to provide some incentive for efficiency by interesting the contractors financially in the resulting savings. For that purpose, target prices were established whenever possible and the contractors were entitled to a generous share of the difference between the actual cost and the cost set by the target prices. This is working well and helping to keep cost within the estimate.

The estimate was $150,000,000 for the entire project, excluding the transmission line. Up to now, 80 per cent of the work has been done and there is every reason to believe that the cost will not go over the original estimate.

The demand for power in the Province of Quebec keeps increasing continually in staggering proportions. In fact, all the power that can be generated at the Bersimis development will be absorbed within a few years. Is it not logical, therefore, to conclude that the construction of power plants will be a continuing process until all water power potential in this Province has been harnessed?

This paper has dealt with the general aspects of the Bersimis-Lac Cassé development. There are many interesting studies and phases of construction which deserve to be treated more thoroughly. Other engineers who have had much to do with the execution of such work will contribute papers or talks on specific problems when circumstances so arise.

Under the supervision of the Commission's technical staff, eight general contractors were engaged in the planning and construction of the overall Bersimis-Lac Cassé Development.

These were: H. G. Acres, consulting engineers; Atlas Construction Co. Limited, Cartier Construction Limited, and Perini (Quebec) Limited, excavation of tunnels and powerhouse, and concrete lining of tunnels; Angus Robertson Limited, construction of dams; Dufresne Engineering Limited, preparation of concrete and construction of powerhouse; Komo Construction Limited, construction of buildings and public utilities at Labrieville and of wharf at Forestville; Anglo-Canadian Pulp and Paper Mills Limited, construction of roads, supply of lumber, boat unloading at Forestville, and transportation of materials to job sites.

Fig. 19. Aerial view of Labrieville showing camp site (left), permanent town site (right), and permanent machine shop (right foreground).

Air Pollution Control Problems

E. A. Allcut, M.E.I.C., Fellow ASME,

Professor and Head of the Department of Mechanical Engineering, University of Toronto.

During the past six hundred years, many sporadic attempts have been made to control the amounts and kinds of pollutants in the atmosphere (Fig. 1). In the earlier attempts, the problem was somewhat simpler because concentrations of industrial activity were fewer and smaller than they are now and also because the control was limited to visible impurities or "smoke". Since the beginning of the present century, the problem has increased in seriousness and complexity to such an extent that its very name has been changed from "smoke abatement" to "air pollution control". Its importance has been made manifest by the smog episodes in the Meuse Valley, Donora, and London respectively and by the continued and chronic condition of Los Angeles.

The word "control", however, implies a knowledge of what is to be controlled as, unless the contaminant can be identified and measured, the only criterion is opinion or judgment, which is a personal and variable factor. These considerations apply particularly to "odours" or "nuisances", which are frequently referred to in codes and by-laws, but can be defined only in terms of general consent or public opinion. For legal and testing purposes however, the definitions, measuring instruments, techniques and methods of control must be made specific and uniform. Unfortunately, these vary in different control areas so that, while valid comparisons can be made at different times in each individual area, to determine whether the degree of pollution is rising or falling, it is frequently impracticable to compare the results obtained in one area with those obtained simultaneously in another. This is obviously a very undesirable situation, which can only be rectified by agreement on an international basis. It is somewhat analogous to the confusion that existed with regard to the properties of steam before the International Steam Tables Conference of 1929, and calls for similar action before it is too late for useful action to be taken.

Air pollution has become a problem affecting whole communities and extending beyond the scope of purely short-term remedies or legislation. Lack of agreement on definitions and on techniques of measurement and control, have led to an unsatisfactory situation that can only be rectified by agreement on an international basis. Action to achieve this must be taken before it is too late. The paper is to be read at the Annual Meeting of the Institute, May 1956.

The difficulties encountered in practice may be divided roughly into three classes, as follows:

(1) Measuring devices and techniques.
(2) Surveys and identification of sources of pollution.
(3) Administration and control.

It is evident that some of the factors concerned can be included in more than one of these categories and that, therefore, the classification will be, and must be, arbitrary in some respects.

Measuring Devices and Techniques

The identification and, therefore, the control of any pollutant depends upon the specification implied by its name.

Definitions

Definition is thus the initial stage of control and the various definitions of smoke, fumes, and soot, illustrate the confusion that exists at this point.

Smoke is variously described as:

(a) Small gas and air borne particles consisting essentially of carbonaceous material in sufficent number to be observable.[1]

(*b*) A product of combustion . . . the particle size being generally less than 0.5 micron.[2] (1 micron=1/25,000 inch).

(*c*) The gaseous products of burning organic materials . . . when rendered visible by the presence of small particles of carbon which finally settle as soot.[3]

(*d*) The exhalations, whether visible or not resulting from oxidation or other chemical action and containing either liquid or solid particles less than 1/10 micron in mean diameter.[4]

Thus, smoke may be either solid, liquid, gaseous, or any combination thereof, it may or may not be visible or carbonaceous and it may or may not be defined in terms of particle size.

Fumes are defined as:

(*a*) Gases or vapours of such a character as to create an uncleanly, destructive, offensive or unhealthful condition.[1]

(*b*) A product of combustion, sublimation or condensation . . . with a particle size generally less than 1 micron.[3]

(*c*) Solid material suspended in a gas . . . formed by condensation from the gas phase.[3]

(*d*) Gaseous mixtures containing solid particles between approximately 1/10 and 1 micron in mean diameter. These may result from distillation, oxidation or other chemical reaction.[4]

Fumes, therefore, are variously defined according to particle size, what they are, how they are produced and the undesirable conditions they create.

Dust is always tacitly considered to be solid, but is described as follows by different authorities:

(*a*) Gas and air borne particles larger than 1 micron in mean diameter.[1,4]

(*b*) A product of mechanical disintegration with a particle size between 1 and 150 microns.[2]

(*c*) Finely powdered earth or waste materials. The median size of outdoor dust is 0.5 micron; industrial dust 1.5 micron.[3]

Here there is less confusion but the sizes cited are respectively minima, median and range.

These are but a few of the variations that might be quoted, but they are sufficient to illustrate the point that, if there are so many different starting points, what degree of uniformity or correlation is to be expected in the final results?

Sampling Procedures

Where there are a large number of variables, it is evidently necessary for the sampling procedure to be chosen carefully, so that the samples may be representative of the prevailing conditions, both in quality and quantity. The classical way of dealing with problems of this kind is by the application of statistical methods,[5, 17] but this is rarely possible in practice and therefore other and less accurate methods of approach must be used.

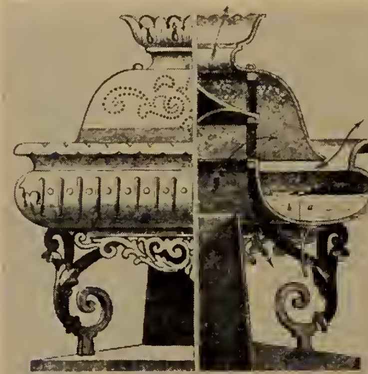


Fig. 1. Capping piece for chimneys to wash flue gases before entering the atmosphere (1869). (Courtesy "*Smokeless Air*").

The principal requirements for a practical air sampling equipment have been outlined as follows.[6]

(1) Must be capable of collecting a large number of samples without excessive labour requirements.

(2) Must be inexpensive enough to allow several instruments to be used simultaneously.

(3) Must be versatile enough to enable specific determinations to be made in the presence of various interfering compounds.

(4) The volume of samples must be large enough to provide a reasonable degree of sensitivity.

(5) Samples must be adaptable to rapid and accurate analysis.

(6) Time of sampling must be short enough (in some cases) to allow for changing weather conditions.

(7) Provisions must be made for relating concentrations with time.

(8) Must be adaptable (in some cases) to the determination of several different contaminants.

When these requirements have been met, there still remains the problem of suitably locating the sampling equipment, having regard to local variations in fluid velocity and, if pertinent, the general effect of environmental conditions. With regard to the time factor, recording instruments are desirable if they are available, but questions of initial cost, servicing, transferring and interpreting the data may, and often do, restrict their general use. On the other hand, where hourly variations occur (as in wind direction or velocity) an average sample taken over a lengthy period may be misleading. Nevertheless, comparisons are often made on the latter basis, but such comparisons should be made with care and discrimination—if they are made at all!

The importance of uniform design is indicated by the case of the collecting bowls or cans, which are widely used for measuring rates of dustfall. These bowls are of various shapes and sizes; the four examples shown in Fig. 2 being respectively 18 inches, 12 inches, 11 inches and 6 inches in diameter. From the solid materials collected on these small areas, the monthly deposit per square mile is calculated, on the assumption that the sample does not depart materially from the average, in spite of variations in local conditions and activities. Comparisons made at the University of Toronto [7] showed that, when duplicate equipment (Type A) was used in a single place, the average rates of deposit in the two bowls were 224.4 and 225.9 tons per square mile per annum respectively, a difference of less than 1 per cent. Comparisons between Types A and C, made under similar conditions over a period of three months, gave the figures shown in Table I.

Types A and C are employed constantly in two different cities and it is evident that, when these variations exist, no reliable comparisons of relative cleanliness can be made. Also, when dustfall readings are averaged over an area of (say) 50 square miles, valid comparisons with other areas are practically impossible, particularly as, in some cities, the sampling points are located mostly in the dirty areas while in others, they

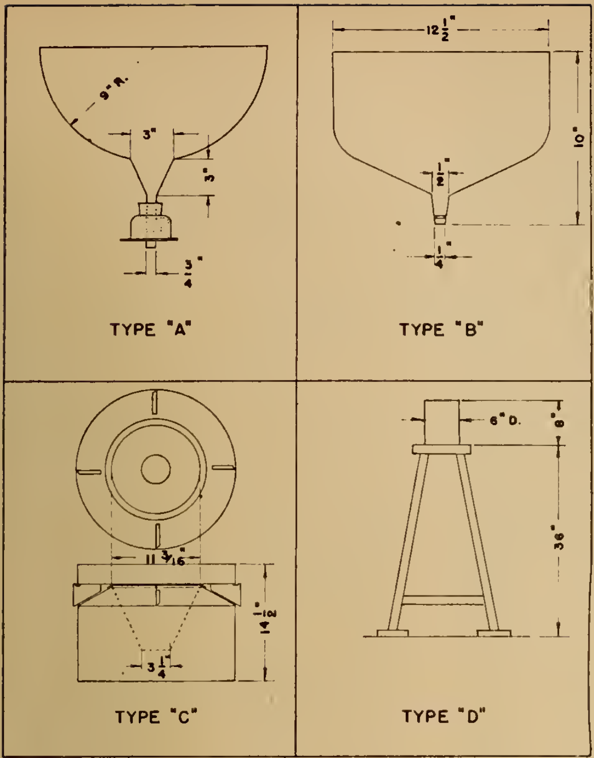


Fig. 2. Four types of gauge for measuring dustfall.

are distributed more uniformly. Yet, these kinds of comparison are demanded by the public and by their elected representatives, who provide the money to carry out the work and who want the results to be stated in terms that they can understand.

The above considerations relate to the sampling of gas-borne dust in the open air. Many (and perhaps most) of the codes and by-laws also limit the amount of dust that may be emitted from stacks and the following quotation indicates that there are some differences of opinion and practice regarding the maxima permissible. [8]

"Three major cities have a standard of 0.40 grains per cubic foot under standard conditions. Two cities report 0.30 grains per cubic foot. Two cities use 0.85 lb. per 1000 lb. of flue gases at approximately 12 per cent CO_2. One city allows 0.75 grains per cubic foot but not to exceed 0.20 grains of such a size as to be retained on a 325 U.S. standard sieve. One city specifies that there shall be 90 per cent removal of particulate matter at the 20 micron level. Still another city applies a rule of reason based on individual nuisance cases actually reported."

It is evident that, where such stipulations exits, [11] [12] it is possible to evade them without in any way reducing the amounts of dust entering the atmosphere, by diluting the effluent gases with air. In some instances, this situation may be met by prescribing the maximum emission of solid matter in pounds per hour [4] but, even so, it is necessary to determine the facts by using a standard sampling procedure such as that recommended by the A.S.M.E., [32] employing special sampling devices which are not usually available. It is also necessary, in practice, for the inspector or observer to have access to the premises which are under observation and for him to have sufficient scientific knowledge or training, so that the readings taken may be reasonably accurate (Fig. 3). This combination of conditions seldom exists in practice and it is doubtful, therefore, whether the inclusion of stack-loading requirements in civic codes is of any particular value. Similar criticisms may also be made regarding stipulations as to the efficiencies of the dust collecting appliances. These are meaningless, unless the size ranges of the dust particles are known.[2, 10]

Smoke densities are mostly based on the Ringelmann chart or its derivatives and the limitations of this method of measurement are so obvious and well known that they will not be repeated here.[9] Alternative appliances that may be used by an inspector in the field, such as the Umbrascope and Smokescope have been utilized in a few cities but, so far, have not been widely adopted.[11] Some clarification of this situation is urgently required, so that a single standard of comparison may be specified.

The amount of finely divided suspended matter in the atmosphere is important, not only because it affects cleanliness generally, but also because it controls visibility. The composition of these fine particles is frequently very different from that of the deposited matter ("dustfall"), as is evident in the following example taken from the Leicester survey.[5]

	Suspended Matter	Deposited Matter
	% by weight	
Tar	14	1
Other combustible matter	71	30
Ash	15	70 approx.)

This suggests that the finely divided material originated mostly from small (domestic) installations and the deposited matter from large (industrial) furnaces. The influence of suspended matter on visibility is illustrated by Fig. 4 and 5, which show the appearance of University Avenue, Toronto, on June 6th and August 24th, 1955, respectively. An A.I.S.I. automatic smoke sampler was used in Toronto to filter measured samples of air through a paper strip, which was moved to expose a fresh area for each two-hour period. The records obtained at two different stations in September 17th, 1955, are shown in Fig. 6. The results are expressed in "Coh" units, one of which is defined as that quantity of light scattering solids on the paper as will produce an optical density of 0.01 when measured by light transmission. The optical density is defined as log (incident light)/(transmitted light). On clear days readings of 1 - 1.5 Cohs are obtained, but on murky days they may increase to

Table I. Comparisons between types of dust collectors

	Type A	Type C	Ratio C/A
	Tons per square mile per month		
April 1955	36.1	65.0	1.80
May 1955	27.6	50.8	1.84
June 1955	22.8	50.5	2.21

6 or 12 Cohs. In the early part of 1955, the Toronto averages varied from 3.1 to 4.4 Cohs. These results are interesting and informative, as far as they go, but they are not directly comparable with results obtained in other places where different types of measuring apparatus are used [9] although attempts have been made in some instances to correlate the results obtained and to express them in terms of mass. The calibration curve given for this purpose in the Leicester report [5] (p. 9) is stated to represent "average conditions accurately to about 5 per cent, but may also have an unknown persistent error". In view of the importance of visibility, particularly in relation to aircraft operations, a greater degree of standardization and calibration in this field of measurement is evidently required.

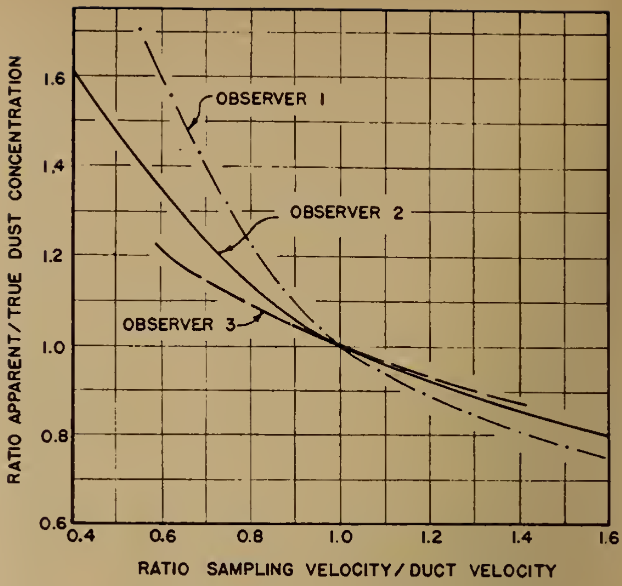


Fig. 3. Errors caused by differences of velocity when sampling dust laden gases.

One of the most important and potentially dangerous pollutants is sulphur dioxide and most surveys make some provision for measuring and recording the amount of SO_2 present in the atmosphere. Parker [13] states that "with highly efficient boiler installations achieving complete combustion and producing flue gas containing 12 to 15 per cent of carbon dioxide, the concentration of sulphur dioxide in the flue gas is ordinarily less than 0.1 per cent by volume. As the volume of flue gas produced for each (long) ton of coal burned is roughly equivalent to 360,000 cubic feet at ordinary temperature, the volume to be discharged every hour from a large boiler installation using (say) 2000 tons of coal a day is about 30 million cubic feet". The problem of removal, therefore, is one of bringing very large volumes of gas into effective contact with a solvent or reagent that will rapidly dissolve or react with sulphur dioxide to give a solution or product that is easily removable from the gas. This procedure is only possible in large installations and consequently, in practice, most of the sulphur dioxide produced enters the atmosphere where it is liable to affect health, vegetation and structures.[15]

Various standard chemical tests and kinds of apparatus are available for measuring SO_2 concentrations,[5, 9] but they are usually expensive or difficult to service in the field and therefore comprehensive records of this constituent are generally limited in practice to a few locations in any one area of jurisdiction. The lead peroxide instrument[14] is simple, cheap, is not unduly affected by external conditions and requires no ancillary services in the field. It would appear, therefore, that these instruments have considerable advantages for comprehensive surveys but, as far as can be ascertained, they are not widely used outside the United Kingdom. Certainly a simple, reliable, and cheap method of measuring small concentrations of sulphur dioxide in different locations is badly needed. A case in point is that of Toronto, where the SO_2 concentrations at a sampling station exceeded the desirable limit of 0.5 parts per million on 17 occasions between April 19th and July 28th, 1955, and on one occasion (May 2nd) the concentration reached 1.2 parts per million. If this situation is general, and is not peculiar to that location, it is a matter of some concern. The recording instrument used, however, is expensive and somewhat difficult to get, so that only one of them was available.

These are some of the principal difficulties met with in the day to day program of sampling and measurement which constitutes the basis of the control procedure. Obviously, the list is far from complete and it may be enlarged considerably when the disposal of

Fig. 4. University Avenue, Toronto —good visibility (1955).

Fig. 5. University Avenue, Toronto —bad visibility (1955).

radioactive waste matter becomes an acute problem.[16]

Surveys and Identification of Sources of Pollution

It is assumed that the general purpose of a survey is to determine systematically the condition of the air in different places at various times, so that the nature and extent of the air pollution problem may be determined for one or more of the following purposes[17]:

(a) To plan an abatement program for the whole or some part of the area concerned.

(b) To identify individual offenders and to determine the nature and extent of the offence.

(c) To check the performance of remedial or other equipment.

(d) To monitor processes for the purpose of preventing financial losses or to determine the possibilities of by-product recovery.

(e) To study the deleterious effects of various pollutants on plant and animal life.

It is evident that the nature and extent of the facilities required and the organization of the survey itself cannot be determined unless and until the objectives of the study have been clearly defined. For instance, if the problem is one of discovering whether or not a nuisance is being created, the circumstances of the case and the location of the offending plant are important factors.

"In considering what constitutes a nuisance, it should be realized that a nuisance in a residential area may not be considered a nuisance in an industrial area. The concept of restricted legal liability for nuisances in industrially zoned areas is gaining some acceptance in air pollution regulations. However, it is advisable to remember that the topography and meteorology of the country surrounding the industrial area, as well as the height of industrial stacks determines what air pollutants reach ground level in industrial, business and residential districts."[18]

Thus, in addition to the measurement of the amount and kind of pollutant that is being emitted from a chimney or other opening, it may be necessary to find out what happens to it afterwards. Calculations, wind tunnel experiments, and direct observation (Fig. 7, 8, 9) have been made

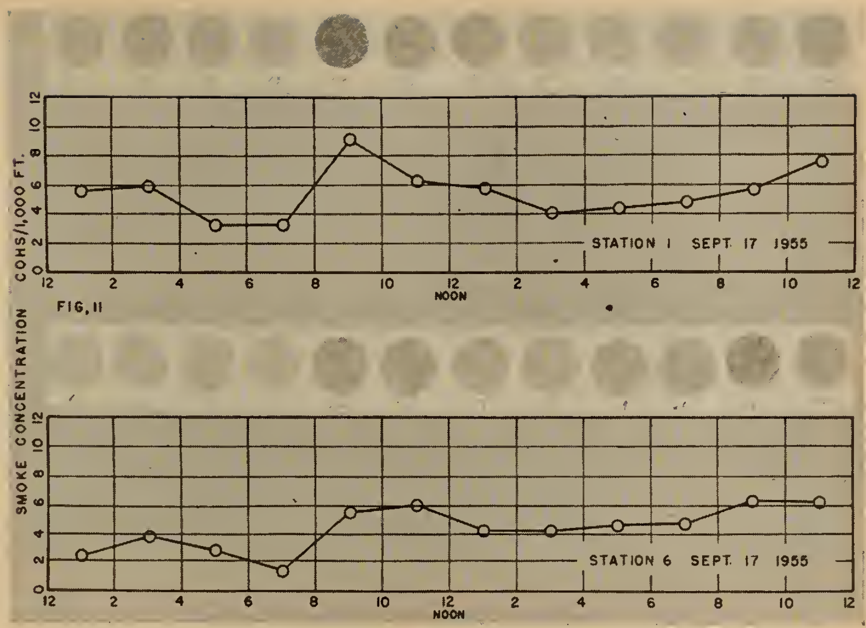


Fig. 6. Records from automatic smoke sampler, Toronto (1955).

to determine the paths taken by smoke plumes from chimneys in different circumstances and, in one recent investigation regarding the advantages of washing flue gases, the conclusions were[19]:

1. The loss of buoyancy resulting from washing the flue gases from a chimney destroys the advantage of removing SO_2 if the air turbulence is less than that corresponding to a wind speed of 15 miles per hour.[21]
2. The advantages of washing increase with wind speed and turbulence.
3. With a given volume rate of discharge there is a critical exit diameter for the stack, above which the maximum concentration of SO_2 is greater for the washed than for the unwashed gases. For chimneys higher than 100 feet, this effect is not important.
4. For unwashed gases and chimneys higher than 200 feet and with wind speeds of about 20 m.p.h. the maximum concentration of SO_2 on the ground will not exceed 1/1000 of the concentration at the chimney exit.
5. With increasing chimney heights the maximum concentration of SO_2 (at ground level) decreases and occurs further from the stack.
6. With washed gases the velocity of exit should be as high as possible.
7. The distribution of pollutants from a chimney is influenced by the contours of the surrounding country and by the arrangement of nearby buildings.

Mountain barriers and river valleys also are effective in restricting the volume of air into which waste effluent is discharged and variations of wind velocity and direction [22] will prevent a smoke plume from continually sweeping over the same area. Moreover, the presence of a heavy layer of smoke haze at the ground, particularly when it is thickened by fog into a "smog", resists the penetration of sunlight from above, thus preventing the heating of cold air in a valley. In this manner an accumulation of pollution may be built up, with fatal results.[15] In some instances, as at Trail, B.C., and Brookhaven, N.Y.,[20, 22] industrial operations are controlled by the prevailing meteorological conditions. In any event, atmospheric turbulence must be relied upon to remove most of the finer particles and this is a very complex problem containing many variables, which add to the difficulties of analysis and prediction.[22, 23] Its importance becomes manifest to the general public when temperature inversions occur on windless days.

The problems that arise and that call for solution in dealing with stationary plants are themselves sufficiently numerous and serious, but the rapidly increasing use of mechanical transport adds to their complexity and potential seriousness. The contributions of automotive vehicles to the Los Angeles problem are well known, if they are not entirely under-

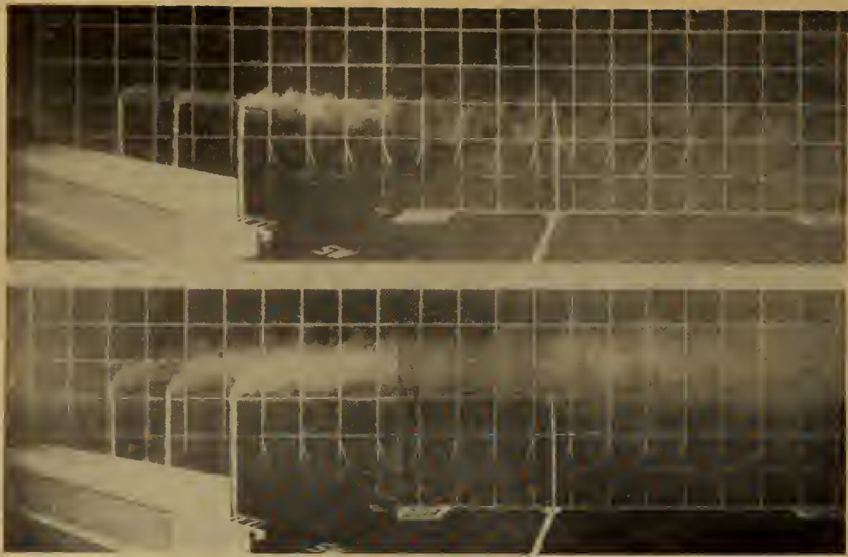


Fig. 7. Smoke plumes in wind tunnel tests (New York University).

stood, and Katz[23] comments on the general situation in the following terms:—

"The contributions to this problem from the general activities of the public must not be underrated. Thus, in a city where half a million automobiles, trucks and buses are operated, there may be consumed a daily total of one million gallons of gasoline and oil, releasing nearly one billion cubic feet of exhaust gases."

Gasoline engines, working on rich mixtures give off large volumes of carbon monoxide which is a very dangerous gas when present in sufficient concentrations[24, 15] and, in addition, diesel engines which are overloaded or poorly maintained emit large amounts of smoke at or about the breathing level. Diesel engines working on lean mixtures also produce aldehydes, which are smelly and irritating[21, 15] (Fig. 10) and may also produce dangerous oxides of nitrogen. The carbon dioxide produced is rarely harmful to health and some of the other gases may be removed, wholly or partly by washing or by catalysts,[25] but washing is difficult to apply in a moving vehicle and catalysts are not always effective at comparatively low exhaust temperatures. Most vehicles offend in one or more of these respects and, although the concentration of harmful pollutants from this source in cities rarely reaches dangerous levels,[24] it could become serious in periods when heavy traffic coincides with a prolonged temperature inversion. The difficulty in these cases is that of identifying the chief offenders and bringing them to book effectively.

In the case of locomotives and steamships the problem of air contamination is not that of identification but (in Canada) is almost entirely that of jurisdiction, because the local and provincial authorities have no legal control over these transportation agencies. This has caused many disputes and, after several conferences with railway officials, representations are now being made by several municipalities to the Board of Transport Commissioners, for the purpose of amending the regulations regarding smoke emission from steam locomotives and other pollution produced by diesel engines. The steamship problem is also bad, particularly in waterfront areas and in this case there seems to be no general agreement as to where the jurisdiction lies. When the St. Lawrence Waterway comes into operation with, presumably, a greater concentration of shipping and more diversification of ownership, this problem will probably become progressively worse.

Pollution caused by cupolas, metal processing plants, cement plants, and others is frequently difficult to check because, either the emission of dust and other pollutants is not concentrated in one or a few places, or cooling and washing facilities [8, 18, 26] are difficult to provide, and also because measurements are frequently impracticable. In such instances it is usual to take action under a general nuisance clause in the by-law.

Domestic incinerators, which have proved to be so troublesome in Los Angeles and other places are in a similar category. These have been dealt with recently in Toronto by the addition of a new clause to the by-law, which lays down regulations limiting the type and design of incinerators which may be installed. These approved designs are intended to promote complete combustion of garbage and are based on the experience of cities in the United States.[27] As the legislation has only been in operation for a few months, it is too early to say whether or not this procedure will be effective in reducing, to negligible proportions, pollution and odours from these sources.

The effectiveness of any program of air pollution control depends on the possibility of locating the offender. In some cases, as in isolated plants or where the products have distinctive charac-

Fig. 8 (left.) "Looping" smoke plume (Brookhaven National Laboratory).

Fig. 9 (right). "Fanning" smoke plume (Brookhaven National Laboratory).

teristics, this is a simple matter.

"Thus, if the offending stack is isolated, the dust is in big chunks, its colour is dark, a snow has freshly fallen and an inspector can get to the area before the snow melts, any air pollution control inspector can walk right to the offending stack and have little trouble in convincing plant management of their responsibility in the matter. Black fly-ash on white snow is impressive. On the other hand, if a suspected source of a justifiable complaint is buried deep in a maze of plants, several of which are potential sources, then the job calls for all the knowledge and skill the air pollution enforcement officer can muster." [28]

It is evident that, in most instances, the funds and staff available will not allow the provision of as many fixed sampling points as are necessary to arrive at a reasonably correct average for the area being surveyed. Special consideration, therefore, should be given to the following types of area.[22]

(1) Critical areas such as residential areas, gardens, parks.

(2) Areas of maximum air pollution complaints, to determine cause and justification.

(3) Areas of theoretical maximum and minimum concentrations of pollution.

(4) Areas delineated by special topographic features.

For the detection of individual offenders, directional sampling (Fig. 11-12) or, more appropriately, mobile sampling laboratories, may be added to obtain additional information from particular areas. Alternatively, spot checks using simple apparatus such as sticky paper or local observations on car surfaces, vegetation or snow are sometimes used to pin-point an offender or to provide supplementary evidence. When an exhaustive scientific survey can be made it is obviously desirable, but the procedure is lengthy and expensive. It is considered[5] that for ordinary purposes in Great Britain, five years is the probable ideal time in which to estimate the annual variation of pollution (Fig. 13). Few communities, however, are willing to wait that length of time for the information and the usual result is the adoption of some kind of compromise between the desirable and the practicable.

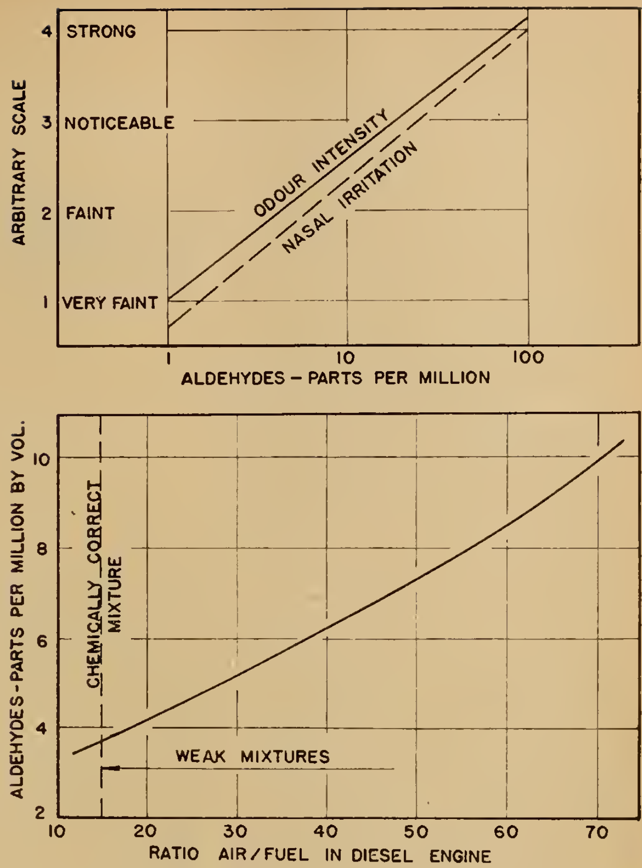


Fig. 10. Aldehydes in diesel engine exhaust gases.

Administration and Control

It has already been remarked that, although smoke is the most evident, it is not necessarily the most important factor in air pollution. Nevertheless many, and perhaps most of the local air pollution control procedures have been built round an existing organization which was designed originally for handling smoke abatement. The Committee on Atmospheric Pollution in Canada was appointed in 1949 to study these matters and to suggest standardized procedures that might be applied, with some local modifications in different parts of the Dominion. Among other things the report stated:[4]

"It is strongly recommended that the problem should be dealt with on a regional basis by means of appropriate control areas to be set up by the various provincial governments, because only those governments have the power to take such action. Cases where the control area must necessarily cross provincial boundaries could be dealt with by the two governments concerned."

Examples of this kind of problem on an international basis are the Windsor-Detroit[20] and Sarnia-Port Huron[21] areas. The recent transfer of the responsibility for air pollution control from the City of Toronto to the Metropolitan authority will give an opportunity of trying out this recommendation in an urban residential-industrial area of about 240 square miles. The government of Ontario has also set up a committee to study air pollution control on a provincial basis but, at the time of writing, that committee has not yet reported.

The controlling committees or boards are usually responsible to various municipal or governmental departments[29] such as Health, Works, Property or Planning but, in any event, they must be set up in such a manner that they are relatively free from political interference. However, as stated above, they are still dependent in some measure on politicians for the finances necessary to enable them to carry out their responsibilities. In this connection, the importance of good public relations must not be underestimated.[30] In the Toronto program the support of service clubs, civic and business organizations, the Council of Women, and other similar bodies has been enlisted by means of talks, illustrated by slides and exhibits. Also, the local press has given valuable publicity to these activities and this can be quite effective in influencing legislation, if the statements published are simple, correct and interesting.

"The average newspaper reader has little interest in a technical description of electrostatic precipitation or a detailed analysis of stack effluents. He, probably, is not more than casually interested in what is being done to abate air pollution on a national scale. What he does want to know in simple, easily understood language, is what *local* plants are doing to reduce the smoke and soot that dirty his house paint and blacken the family wash, and the fumes that offend his nostrils and blight the trees and gardens in his neighbourhood."[31]

The fundamental principle for reducing smoke and other pollution is quite simple—keep it from getting into the air. Many of the troubles are caused by incomplete combustion or by lack of facilities for cleaning or filtering plant effluents. In most instances this condition is met by a system of "installation" and "operating" permits, which certify that the plant is properly designed and constructed. This procedure, however, takes care of new construction only. Most of the difficult problems occur with old plants, where it is frequently claimed, with some reason, that the cost of providing the necessary remedial measures would put them out of business. In some instances, the pollution control staff can suggest ways of improving operations without excessive outlays.

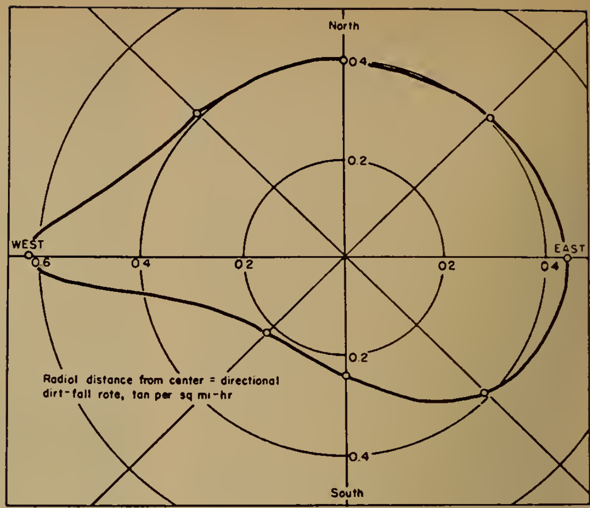


Fig. 12. Polar diagram from directional collector and wind-hour meter (Battelle Institute).

Sometimes, also, annual inspections of plants are made,[30] but generally the size of the staff available is too small to enable this to be done systematically. In fact, the number of inspectors that can be appointed and paid is insufficient in most cases to cover the prescribed area adequately. An attempt was made recently to improve this situation by requesting the police to report instances of flagrant and repeated violations of the law but, while collaboration was promised by them, very few reports were received. In practice, therefore, action must usually be based on information received from local residents.

The composition of the air pollution control board varies in different areas. In some municipalities, the members are chosen to be representatives of the various interests concerned, such as property, labour, chamber of commerce, and in others the composition is restricted to technical personnel such as chemists, engineers and medical men who have some specialized knowledge of the different aspects of air pollution. It would be useful to obtain some concensus of opinion regarding the relative advantages and disadvantages of these two kinds of composition.

Finally, the following principles may usefully be observed in adopting a policy.[15]

(*a*) Complete elimination of air pollution is not economically attainable and therefore a balance must be struck between the need for a decent living environment and the need for the economic support of local industries.

(*b*) The legislation must be enforceable and have the support of the community.

(*c*) The enforcement policy must be one of continual adjustment and education.

(*d*) Except in the case of definite hazards to health or safety, plants should not be closed down. The cooperation of industry generally must be sought and encouraged. Ar-

Fig. 11. Directional dustfall indicator (Battelle Institute)

The Battelle Memorial Institute points out that various difficulties of maintenance of the working parts of the collector have led recently to development work on a much more versatile system. This would employ motor-actuated covers for each jar and each jar could be set separately from all the others. All the covers would be controlled electrically from a central point. One advantage of this would be that the jars would be replaced by gas and aerosol samplers. The performance of the trial units has been encouraging.

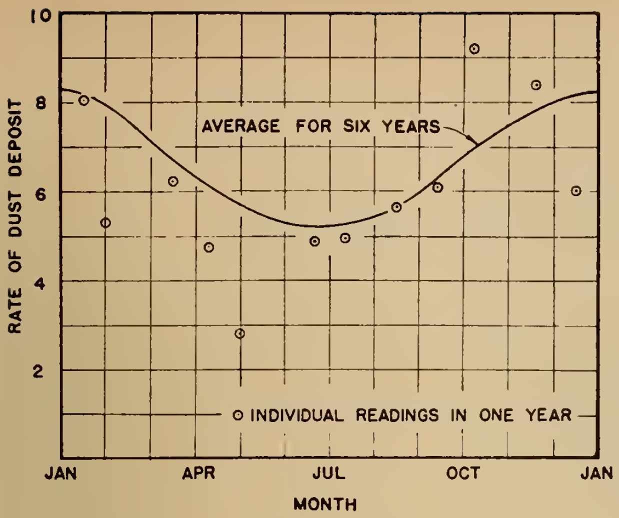


Fig. 13. Individual monthly dustfall readings compared with the average over a six-year period (Leicester Survey).

bitrary and stringent legal procedures cause irritation and result in non-cooperation.

(e) The program undertaken must be of the long range type and implemented with adequate funds and competent personnel. Results must not be expected too soon, as there is no prompt and universal cure. Each community constitutes a new and different problem which can only be solved by arduous and persistent effort.

Acknowledgements

The help of Dr. A. M. Fisher, of the Department of Physiological Hygiene, and of Mr. A. B. Allan and Mr. E. D. Dainty, of the Department of Mechanical Engineering in the University of Toronto, is gratefully acknowledged.√

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Extending Winter Work

The joint committee formed to combat the problem of winter unemployment in the construction industry reported after its second meeting in March that there was less unemployment in the building trades this winter. The membership of this committee, in which the Institute has a representative, was described in last month's *Journal.*

Good results had been obtained from a concerted promotional campaign on the federal, provincial and local levels. It was agreed that the general public was now more aware of this problem which affects a large segment of the Canadian population. Last year about 125,000 construction workers were laid off by late February. The committee will carry out an extensive campaign this summer.

The Department of Trade and Commerce has forecast a phenomenal 19% increase in construction work over 1955 for a construction program totaling $6.2 billion. The forecast also indicates that limits on the availability of materials, manpower and investment might well prevent the accomplishment of a program of this size. Committee Chairman Raymond Brunet, O.B.E., Hull, Que., noted, "The industry expects there will be a shortage of certain materials this summer, especially of steel and cement. These shortages will tend to delay the commencement of the construction of larger structures until late fall deliveries and so increase the volume of work carried out during next winter".

Expansion in the

Pulp and Paper Industry

Recent Developments Undertaken by Canadian International Paper Company

W. T. Bennett, M.E.I.C.
Chief Engineer,
Canadian International Paper Company,
Montreal, Que.

The pulp and paper industry in Canada is in the midst of an extensive program of expansion and development. To illustrate the growth of the industry this paper, covering the activities of a leading organization in the field, is presented.

For many years Canadian International Paper Company has been a leading producer in Canada of newsprint, dissolving pulps for rayon, cellophane, acetate, staple fibre, etc., building boards, and hardwood plywoods. Last year the company entered the field of kraft pulp and started expanding into kraft paper and board for the first time through purchase of the Canadian assets of Brown Corporation on December 1, 1954. In this important transaction it acquired a kraft pulp mill in La Tuque, P.Q. and additional forest acreage in the St. Maurice Valley. This assured the company of adequate wood supply for the Three Rivers and La Tuque mills, and makes it possible to continue the pulpwood harvest according to best conservation practices.

Fig. 1. Before starting excavation for the sewer shown here it appeared that there was virgin soil in this area. Excavation revealed an old concrete Venturi flume used at some time to measure effluent.

La Tuque Mill

The La Tuque mill had a rated capacity of 550 tons per day of high grade bleached sulphate pulp. The forward planning was such that, with the completion of the deal with Brown Corporation, Canadian International Paper Company was able to start a $20,000,000 expansion program in the La Tuque mill. The mill's daily pulp capacity has been increased to 900 tons per day, the increment to be primarily unbleached kraft products, such as board for the manufacture of corrugated paper containers, and paper for kraft wrapping, bags, and so on. The project at La Tuque is the most spectacular part of the present expansion program, since it involves a major addition to a large existing plant and the installation of a 276-in. Beloit kraft board and paper machine, which is the widest machine yet installed in North

America for production of these grades and has a potential capacity, when it is required, of 1,000 tons per day. The project has been substantially completed within a period of approximately 15 months as the machine started production on March 15, 1956. The project also involves expansion of wood handling facilities, a 225,000-lb./hr. power boiler, a similar size recovery boiler, a new causticizing plant for lime burning, six additional digesters, a sextuple effect evaporator with a capacity to provide for the full 900-ton/day output, brown stock washers, and all the equipment associated with a board machine.

The design was carried out by Foundation of Canada Engineering Corporation Limited under the direction of Canadian International Paper Company personnel with additional technical assistance from the Southern Kraft Division of International Paper Company. Fenco were also responsible for adapting design information as used in the United States to Canadian conditions. The Foundation Company of Canada Limited were the general contractors.

The La Tuque mill was originally built close to the turn of the century and it has had many additions and alterations since the original construction. As is usual with an old mill, plans and specifications for the early construction are either scanty or non-existent and when new construction is involved, unexpected problems are often encountered as soon as excavation is started. This project was no exception with the result that even when excavation was started in what appeared to be virgin ground, old foundations, pieces of machinery, etc., which had been buried during previous alterations, had to be dug out. It was necessary to solve the problems of supporting new structures as excavation proceeded.

The mill is located on a well drained sand site and soil bearing values of 2 tons per square foot were used. In a few cases, involving temporary loadings, a 25 per cent increase in soil bearing value was assumed.

The new machine room is a building 943 feet long by 98 feet wide, plus an additional area on one side devoted to warehousing. In laying out this building it was found that the southwest corner projected over a 48-inch water main supplying both the mill and the town. Re-location of this main was not desirable, and it was therefore decided to leave it under the corner of the building. To protect the building foundations from being undermined in case of breakage of this main, it was encased in reinforced concrete designed to carry the full water pressure of 60 lb. per square inch. Since one of the building columns came directly above the main, it was necessary to span the main with a beam carrying the load to footings on either side of the main.

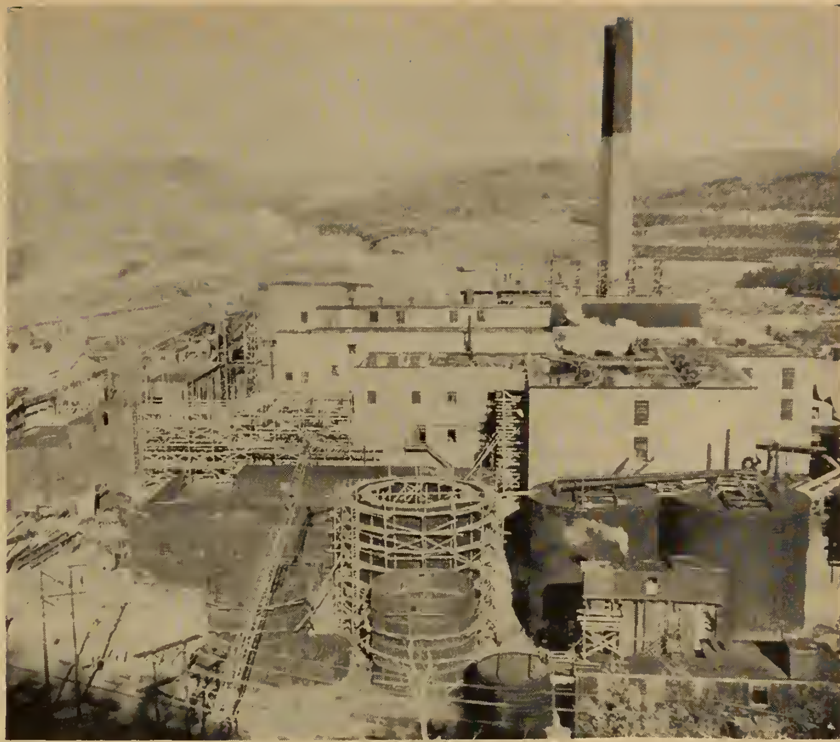


Fig. 2. Erection of a brown-stock washer and evaporator building together with some of the many tanks required in a pulp and paper mill.

The machine room was designed for extension to the west to take a second paper machine in the future. To provide for this the foundation wall on the west side was designed as the future machine beam on columns. The space between columns under the beam was closed with concrete panels designed so that they could be knocked out at a future date. Machine anchor bolts were placed in the beam, covered with grease, and buried in a concrete curb designed for future removal.

Roof trusses were designed for a future clear span of 132 feet. This provided clearance for two machines with a working aisle between them. Panel points of the trusses were arranged so that one came over the temporary west wall and the initially installed shortened trusses were supported on columns at the wall.

The paper warehouse building adjoins the machine room on the east side and was designed for a 600-lb.-per-square-foot live load on the storage floor, which was built on backfill at the same level as the machine floor. The basement wall of the machine room adjoining the warehouse had therefore to be designed as a retaining wall for the 18-foot height between machine floor and machine room basement floor. In order to economize on concrete in the section beside the machine opening, it was decided to design this retaining wall, the machine floor, machine room basement floor and the two rows of columns between the machine opening and the west wall as a rigid frame. This caused some difficulties during construction since it was decided to backfill and use the warehouse before sufficient information was available on the machine to pour the machine floor. This difficulty was overcome by tieing back the retaining wall to dead-men.

The hydrapulper was placed in a deep pit in the machine room basement and because no greater than a 30° slope was permitted between adjacent footings set at different levels, it was decided to enclose the excavation with sheeting which was left in place.

Because of the depth of the machine room basement, it was necessary to build a new 36 in. sewer to the river. This sewer was of reinforced concrete and was covered with up to 37 feet of sand backfill. After backfilling, an inspection showed that a great many of the lengths had cracked both in the invert and directly opposite. Investigation revealed that more lightly reinforced pipe than specified had been supplied. Because of the depth at which the pipe was buried, it was found to be more economical to line the concrete pipe with asphalt coated liner plate than to re-excavate and replace the concrete pipe. The liner plate was placed through two manholes and through an intermediate shaft sunk for the purpose. After the liner was in place the space between it and the concrete pipe was filled with grout placed under pressure.

Foundations for the brown stock washers presented a difficult problem because it was decided to locate the washers over the old machine room in which two machines had to be kept in operation. Columns were located so as not to interfere with the old machines. This required that the beams supporting the brown stock washers had to be framed into very heavy girders to carry the loads to the columns. The columns had to be brought down very close to an existing wall and footings had to be elongated in the direction of the wall so as not to interfere with the adjacent machine foundations. The existing wall had to be underpinned and carried on these new footings. Provision was made in the design to construct the new footings in short sections so that the wall could be underpinned.

The evaporator room is adjacent to the salt cake storage building in which 20 feet of salt cake had to be stored above ground level. When excavating for evaporator room footings, it was found that old pump pits, machinery foundations and a sewer existed well below the present ground level. In one location it was necessary to carry the evaporator footings to a depth of over 15 feet below ground level. Fortunately, it was possible to step up the footings in the direction of the salt cake storage buildings. A retaining wall was designed for the storage area with a toe extending under salt cake.

The location of the 16-in. main carrying 250 lb. steam at 500°F. between the boiler house and the machine room presented some difficulties since it was preferred not to follow the road. An examination of the site revealed that it would be very difficult to locate the line in and through the buildings. A route was therefore selected following the outside of the buildings. This route made it possible to support most of the line from the buildings and at the same time permitted giving it a grade for drainage. Following the building line also provided sufficient changes of direction to give flexibility for expansion.

Heating and ventilation of No. 3 recovery boiler room and No. 8 boiler room presented a problem since the intakes for the forced draught fans supplying the two boilers are located inside the boiler rooms. With a combined fan capacity of about 140,000 c.f.m. and a boiler room net volume of about 870,000 cubic feet, there would have been over six air changes per hour. This could have resulted in uncomfortable working conditions and possible freezing of pipe lines in the winter time. In addition neither of the air heaters was designed for minus 40° air intake, and air at this temperature would have been especially unfavourable for the No. 8 boiler air heater as low air temperature would have probably caused condensation on the tubes.

In the No. 3 recovery boiler house an air intake was located in the boiler house wall near the forced draught fan intake. Hand-operated dampers are provided so that the fresh air through the dampers can be tempered with warm air from the building to provide a suitable temperature for the steam coil air heater. In summer the air intake dampers could be closed and the doors and windows in the lower part of the building opened. This would provide ventilation of the building from the ground level up to the sixth floor where the fan is located.

In the No. 8 power boiler building a forced draught fan is located on the ground floor in the coolest furnace area. The intake opening is located about 70 feet higher

Fig. 3. Clearing the site for erection of a new building within an existing plant is a major undertaking as indicated by the steel erection shown in this view of the recovery boiler building during construction.

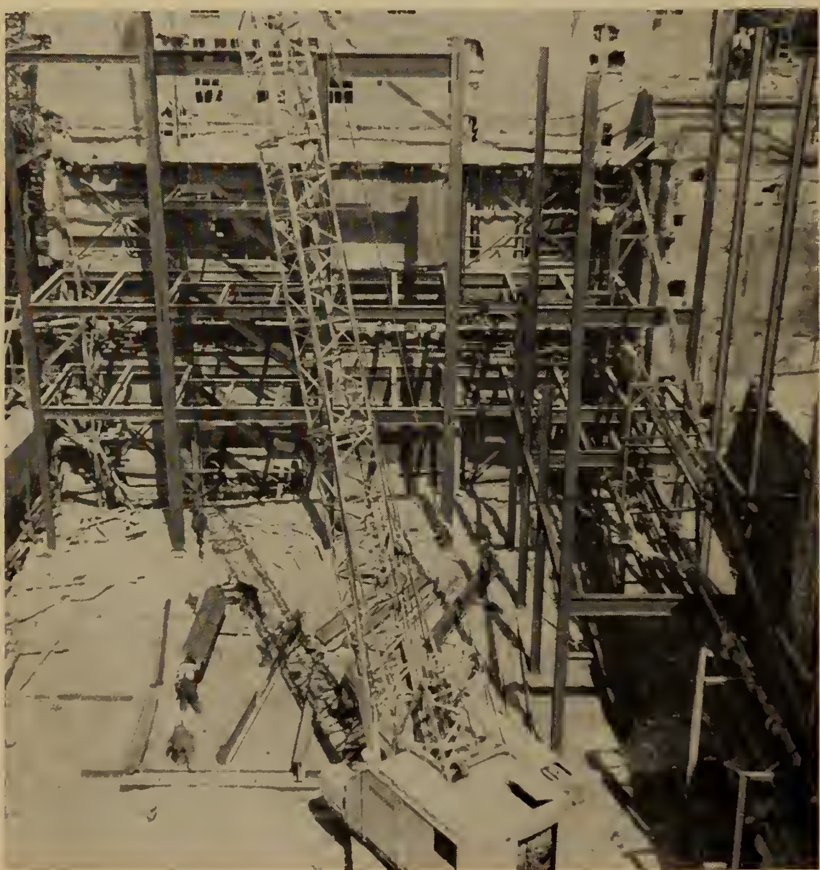


Fig. 4. New 250-ft. concrete brick-lined stack for the recovery furnace. Tanks connected with the caustic plant are seen under construction, and beyond this the lime kiln has been erected. The structural steel frame under the lime kiln is for a roof, to be installed, but no side walls will be provided despite temperatures reaching 50 deg. below zero. Heat radiated from the kiln, which never stops, keeps the ground dry under the roof.

and the entering air passes through a steam coil heater to bring it up to plus 40°F. in the winter time and is further heated by boiler radiation before reaching the forced draught fan inlet. Hand-operated dampers are provided in the intake. In the summer the forced draught fan will be supplied from adjacent doors and windows and the air intake opening will be used to ventilate the upper section of the boiler room.

The construction of such a project in the limited time between December 1954 and March 1956 is a highly creditable performance, especially in view of delays beyond the control of the construction organization, such as the strike in the United States of the company which had the contract to supply a major portion of the electrical equipment required. Particular credit should go to Mr. A. T. Jeffreys and to the electrical contractors, for working out many substitutions for unavailable electrical equipment and for completing the electrical installation within the required time.

Container Plants

A second development of major importance, closely related and complementary to La Tuque, was Canadian International Paper Company's entry into the corrugated shipping container business through the purchase of Hygrade Containers Limited. With this purchase the company acquired a modern corrugated shipping container plant in London, Ontario. C.I.P. has since built a new plant at Pointe-aux-Trembles at the eastern end of Montreal Island, involving an expenditure of $2,500,000; this new plant commenced production February 1, 1956. A third container plant in Toronto figures in future planning and a building site has been acquired; engineering for this plant is proceeding at the present time.

The plant at Pointe-aux-Trembles is built on a 33-acre lot with adequate space for future expansion and contains approximately 150,000 square feet in two main buildings: the manufacturing section 360 feet x 300 feet with all the bays 60 feet by 50 feet, and a warehouse building 360 feet by 90 feet and 50 feet high, equipped with a crane for handling the raw material for the plant. This is a typical light manufacturing building; however, soil conditions were out of the ordinary in that the maximum allowable bearing load was between 500 and 700 lb. per square foot. Even under this loading it was predicted that some settlement could be expected. To provide for stability of the structure, a total of sixty-eight 100-ton and one hundred and thirty-eight 50-ton Franki tube piles were driven to bed rock at the various column points. These piles had an average length of 85 feet. The outside foundation walls of the building were then designed as a beam to stand between the pile clusters and to support the masonry construction.

Linerboard and corrugating medium produced at La Tuque will be shipped in rolls to container manufacturing plants at Pointe-aux-Trembles, London and Toronto, where this product will be converted into all sizes and shapes of corrugated paper containers, designed to package the whole field from canned goods to refrigerators.

Newsprint Expansion

Although the emphasis during the past year has been on entry into the kraft manufacturing field, newsprint expansion has not been neglected. Canadian International Paper Company operates newsprint mills at Gatineau, P.Q., Three Rivers, P.Q., and through a subsidiary, New Brunswick International Paper Company, a third mill at Dalhousie, N.B. In the last ten years a speed-up program for expansion of newsprint capacity has cost more than $40,000,000. When this program was begun in 1946, the rated capacity of the three newsprint mills was 2,150 tons per day. When this program is completed by the end of this year, the rated capacity will be nearly 3,000 tons per day. Because the programs have been nearly continuous since the war, and often new programs are started prior to completion of existing ones, it is difficult to separate those which could be considered current expansion; however, the ones which are presently in progress or nearly completed at the various mills are as follows.

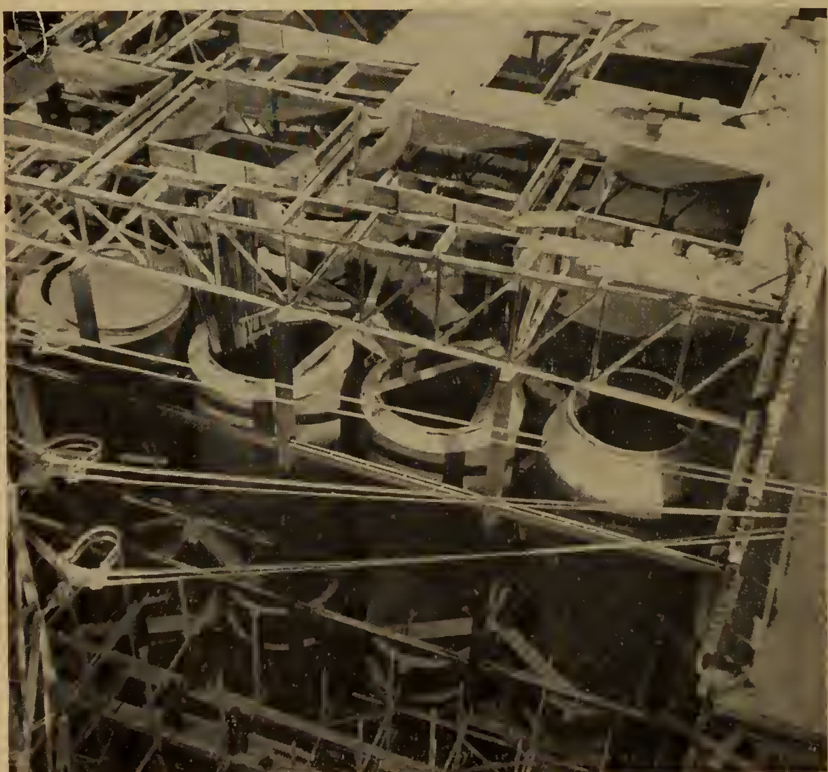
Fig. 5. Extension to the digester building to house six additional digesters. The chip bin had not yet been installed.

Gatineau Mill

At Gatineau in May 1954 the initial steps were taken to prepare for an increase in newsprint production from 911 to 1,024 tons per day. The whole program, which is to be completed by the end of 1956, involves an expenditure of $4,300,000 and provides for speeding up two of the four paper machines. The work also entails the necessary additions to the basic pulp producing units, including an additional digester for sulphite production and two lines of hydraulic grinders for groundwood production. Processing this extra pulp required the installation of additional screens, pumps, thickeners, washers, and other auxiliary equipment.

Major improvements on the two machines to be speeded up were designed to permit operating speed increases from 1600 to 1800 f.p.m. All improvements were designed for an ultimate speed of 2000 f.p.m. in case it was decided in future to expand production further. On the other two machines minor improvements were included to increase their speed from 1470 to 1600 f.p.m.

Fig. 6. To meet the time schedule, equipment had to be installed as construction of the building progressed. The size of the sextuple effect evaporator is indicated by the workmen on the scaffold (lower left). The hatches framed on the roof make provision for future installation of new internal tubes for the evaporators. Some of these tubes are shown before installation extending through the top of one of the evaporators.



The basic design of paper machines has changed very little over the years, but the speeding-up process has necessitated refinements and improvements in the design of the many components making up a machine, so as to make them mechanically and hydraulically safe for operation at higher speeds and increased tonnage rates. Consequently, it is not unusual to find most of the components of a machine progressively replaced with improved types over a period of a few years. At Gatineau the major improvements already installed or yet to be installed on the two lead machines include new head boxes, deculators, breast rolls, couches, heavy duty presses, additional dryers, amplidyne drives, mechanical drive improvements, dryer evacuation systems, calender improvements, new reels, dry end beaters, and new roll handling equipment. Even the winder design had to be changed, with a new machine being provided for a maximum operating speed of 6600 f.p.m. as compared with the original winder designed for 3000 f.p.m. maximum speed.

Three Rivers Mill

At Three Rivers mill three separate programs are currently underway or nearly completed. The first program, involving $1,700,000, is to be completed by the middle of 1956 and covers the speed-up of two machines, including No. 5 machine which although originally designed to operate at 1200 f.p.m. has established new world records by operating at high efficiency consistently for a whole year and at speeds in excess of 2100 f.p.m. Like the 4-minute mile in sport, this was an unheard of feat just a few years ago.

The major changes to accomplish this speed-up were new pressure head boxes and deaerating equipment, larger table rolls, new heavy duty press rolls of larger diameter permitting heavier loading, a vacuum transfer to take the sheet when it is weakest from the couch to the first press, increased drying capacity, increased vacuum pump capacity, improved condensate removal equipment in the dryer, improvements to the design of mechanical parts of the drive, and sectional electric amplidyne drives.

Fig. 8. Recovery furnace required a 10-storey extension to the existing building; here, the top drums have just been installed.

A second program involving $2,000,000 is scheduled for completion by the end of 1956 and provides for machine improvements on four paper machines. Again there are new pressure head boxes, centricleaners, improved dryer drainage, new press sections, drive improvements, and breaker stacks.

The third program, involving $2,300,000 and also scheduled for completion by the end of 1956, provides for speeding up one machine and includes a pressure head box, centricleaners, new press, breaker stack, calender stack, and an improved drive. This project also includes additional groundwood pulp-producing and electric power facilities.

As part of the above programs two additional lines of super grinders, each equipped with a 5000 h.p. synchronous motor, have been provided, and this is typical of the large demand for power involved in most paper mills' speed-up programs. Incidentally, the present consumption of power at the Three Rivers mill is approximately 100,000 h.p. The additional facilities provided for supply of electric power include a new 12,000 kva. primary transformer bank and two new 7500 kva. secondary banks.

With larger and heavier rolls in the presses and calenders necessitated by the higher speed, additional equipment had to be provided to maintain them so that it was necessary to provide a new roll grinder and a large double spindle lathe scheduled for delivery late this year.

Fig. 7. Looking up through the partially assembled water cooled walls of the 250,000-lb./hr. power boiler. Arrangement of the tubing to allow installation of a tangential type burner is shown at the centre of the picture.

Dalhousie Mill

The current expansion program at Dalhousie mill involves $6,250,000 and is scheduled for completion by the end of 1956. It provides for speeding up three paper machines and the actual project is divided into three parts, namely: machine changes and mill additions; power and steam; and shipping.

The mill was started up in 1930 with four machines which have a trim of 218 in. producing 32 lb. basis weight newsprint. The production at that time was around 550 tons per day running at 1000 f.p.m. At the present time up to January 1956, the same four machines are running at 1625 f.p.m. producing about 825 tons of news per day. This increase in production was accomplished by the addition of grinders and

Fig. 10. Looking down through the machine room, showing the sole plates being installed for the side frames of the paper machine. The basement floor had not yet been poured. Reinforcing steel projecting through the floor (foreground) is to take the drives for the various machine sections.

digesters and various changes and additions to the screening and pumping systems. Apart from power, one of the major engineering projects to surmount was the lack of fresh water. At present the mill consumes about 19,500 U.S. g.p.m. of fresh water per ton of newsprint produced, which compares with up to 50,000 g.p.m. per ton in other mills. This was made possible by a program of reclamation of water within the mill and re-use of water in the process. Water which was sewered when the mill started up, such as from the vacuum pumps, was reclaimed and used as dilution water for the digester blows in the sulphite mill.

Part of the speed-up program involves increasing the production of No. 2 paper machine 25 tons per day by increasing the speed to 1800 f.p.m. and this program is just about completed. In designing higher speed equipment for this machine, a 2000-f.p.m. ultimate objective was used. A grinder line was added and the refining system re-located from the east to the west end of the mill in order to make room for additional coarse screens and provide space for more refiners and still have all the refiners in one area for operating purposes. Additional fine screens were added in the screen room. A new roll grinder is now being installed to take care of the accelerated roll grinding schedule due to the increased speed of the machines. On the machine itself a pressure head box had been previously installed with a vacuum deculator for deaerating the stock.

Larger table rolls have been installed increasing the size from 11 in. diameter to 13 in. diameter for increased water removal. A 54 in. couch had previously been installed. Heavier press framing for the second press will be installed shortly. The granite press roll on the second press has been increased from 28 in. to 36 in. to improve water removal before the dryers. This was done previous to this program. Heavy duty rubber covered stainless iron suction press rolls were previously purchased for the second presses of all machines to accommodate the heavier granite rolls and increased nip pressures.

The drainage system of the dryers will be changed starting in March. This involves removal of the present stationary syphon pipes and steam joints and replacing them with revolving syphons and new steam joints. This will provide better dryer eva-

Fig. 9. General view of the new machine room nearing completion clearly shows the arrangement of the roof trusses with provision for their extension to house an additional paper machine.

Fig. 12. Paper machine dryers partly erected in the new machine room.

cuation at the higher speeds and improved drying with the same number of dryers.

The original drives were removed and new drives of the same make installed. The mechanical type of regulators with a master shaft controlling each section were removed, and the sections are now controlled by carbon pile regulators which are connected to the machine electrically. The motor horse powers were boosted to give control of load variations at high speeds.

A high-speed winder was installed in another building to act as spare until such time as another is received which will allow the installation of both new winders on the machines. The present winders were bought for 3000 f.p.m. The new winders are good for 6000 f.p.m. New 18 in. reel bars were purchased to prevent unbalance at high speeds and snap-offs at the winder.

A more recently approved part of the current program involves increasing the speed of Nos. 3 and 4 paper machines to 1800 f.p.m. This will increase the paper tonnage per day by around 50 tons and make the total mill production from the four machines about 900 tons. In designing new equipment to be installed on these machines, an ultimate speed of 2500 f.p.m. was used, although sufficient equipment is being bought at this time only to get the two machines to 1800 feet. The work is now being engineered and all heavy equipment is on order for 1956 delivery.

Fig. 11. View of one of the basement substations gives some idea of the large number of conduits needed for electric power supply and control of the paper machine.

In the sulphite mill a new digester, an additional knotter screen and an extension to the present set of coolers are being provided. In the groundwood mill a new grinder line and hydraulic system, sliver screen, primary fine screen, secondary fine screen, tailings refiner and drainer, and a decker are being installed. In the general category a new air compressor and an additional transformer bank will be required.

In order to reclaim more fresh water for use in the mill a water reclamation plant is contemplated. A decision on the type and make of machine has not been finalized, but it will be of a capacity of 2000 U.S. g.p.m. with the provision that in the future another 2000 can be added. The water reclaimed will be used for blow pit dilution in the sulphite mill and possibly for shower water on the filters in the screen room.

On paper machines 3 and 4, pressure head boxes and a deculator for deaerating the stock will be installed. The Fourdrinier will be lengthened 10 feet increasing the wire length from approximately 81 feet to 100 feet; 14 in. table rolls will replace the 11 in. rolls. Heavier press framing is required for the second press. The dryer drainage system will be converted from stationary to revolving syphons.

Amplidyne drives will replace the present drives. This involves extensive changes on the machines, entailing the removal and replacement of 11 drive motors and speed reducers on each machine. The prime mover in the basement is now a turbine with a reduction unit and generator on each machine. The new drive will have a synchronous motor in the basement coupled to multiple generators, one for each motor on the machine, and it will also be coupled to the reduction unit on the steam turbine. In this way the machine can be driven by the synchronous motor electrically, or it can work in conjunction with the steam turbine carrying any load the turbine cannot handle. Because of the shortage of electric power at this mill, it is necessary to run the steam turbine utilizing the exhaust steam as a supply for the dryers.

A jumbo reel is now being engineered for No. 4 paper machine which will allow rolls up to 60 in. diameter to be wound as against the present 42 in. This necessitates a new crane to handle the heavier rolls. A winder will be installed on No. 4 paper machine capable of 6000 f.p.m. winding. New heavier reel bars 18 in. diameter are also being ordered to accommodate this speed.

When the mill was constructed, power was obtained from the Gatineau Power Company at Grand Falls on the Saint John River. To supplement this power a 6000 kw. back pressure turbine was installed. There were four main boilers rated at 85,000 lb. per hour each which generated at 450 lb. pressure. The 6000 turbine exhausted at 125 lb. pressure and this steam was used for process. A 750 kw. generator was installed for a standby. As the capacity of the mill increased, additional electric power was required. Also, due to the tremendous variations in the power delivered from Grand Falls caused by there being insufficient storage of water to take care of dry periods, a 10,000 kva. condensing steam turbine and generator was installed in 1936. Again in 1954 a 5000 kw. condensing turbine was installed along with a 200,000-lb.-per-hour steam boiler.

At the present time when producing 825 tons of news per day, N.B.I.P. requires 57,000 kw. to run the mill. The average offering from Grand Falls is 33,000 kw. and the balance is made up by mill generation. This, however, does not take care of offerings from Grand Falls below 33,000 kw. At these times it is necessary to put purchased groundwood into the system, which having already been ground requires a relatively small amount of power to process. This operation is very costly, the cost of purchased groundwood being double the cost of mill-made groundwood. This condition is now being alleviated partially by a tie-in with the New Brunswick Electric Power Commission, which is just completing a transmission line from Chatham to Dalhousie along with associate transformers and switching. The Commission's feeders will also be connected into the 5000 turbine generator which will be able to feed back to them in case of an emergency. This power will help reduce outside purchases of groundwood pulp. This in turn means more wood will be used from the area which will increase employment in the region. It will also allow speeding up of the machines to meet present objectives without increasing power or steam generating equipment.

It is noteworthy that in the very near future the original design capacity of Dalhousie mill will be almost doubled with the four paper machines originally installed.

Dalhousie is a shipping port and approximately 60 per cent of the paper produced is loaded directly on ships, the balance going by rail. Up until the winter of 1955 the port was closed for five months of the year as the Baie de Chaleur was frozen over. In the winter of 1955 and 1956 the port was kept open by paper company tugs which break the ice and allow ships to come in during the winter. This was the first time in history the port was kept open. This winter, facilities were installed to pump bunker oil into oil-burning ships.

Conclusion

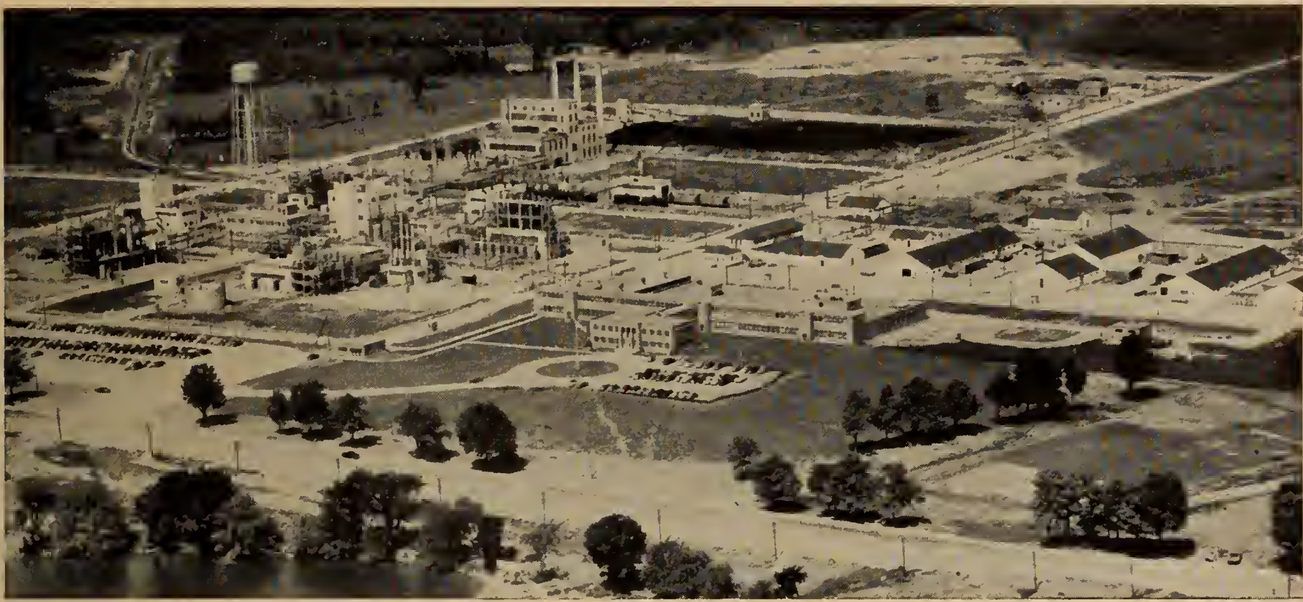
These are a few of the more important developments in Canadian International Paper Company. Together they are a part of a long-range plan to give increasing economic strength and stability to company operations, to provide more complete utilization of forest resources and greater diversification of the products made from these resources.

Seventieth

Annual General and Professional Meeting

Montreal, May 23-24-25, 1956

The advance program, published on pages 437-440, gives details of the registration requirements, the technical sessions, and associated functions and social events.



Industrial Power Distribution

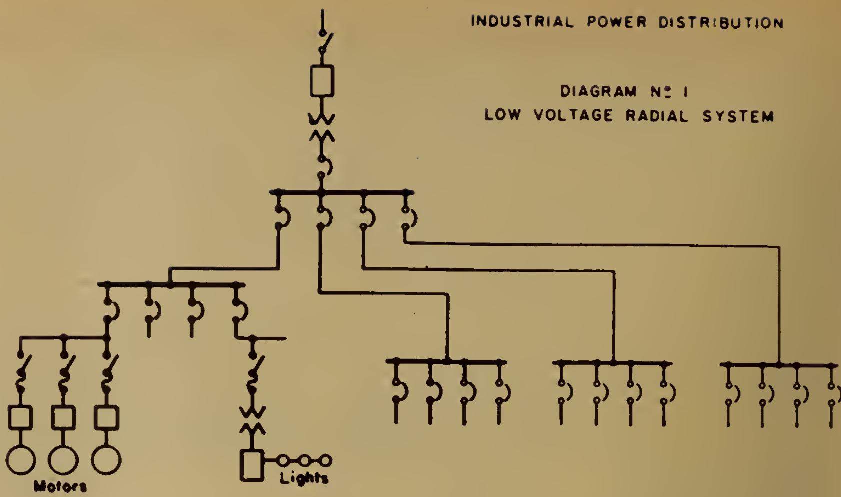
J. R. Auld, M.E.I.C.
Supervising Engineer,
Power Services,
Du Pont Company of Canada Limited

Industrial power distribution has developed only since the latter part of the nineteenth century. The author points out that engineering foresight and imagination are needed to fit a modern distribution system to the requirements of any specific job. After a general review, a particular case is discussed as an example, the installation being that made in a modern chemical plant of which a general view is seen above.

The subject of this paper is industrial power distribution, and in our modern world electricity is its secret weapon. This was not always so. Less than 150 years ago industrial power distribution did not rate even a half-hour talk. It consisted of a rough wooden shaft and wooden gears connecting a windmill to a millstone. About the middle of the 19th century the development of the steam engine brought a big change in industrial power distribution and, by the end of the century, mechanical power distribution reached its peak. Large and elaborate rope and belt drives were used to enable a large steam engine to drive a whole factory of textile machines. There are some large belt drives in use even today and I know a flour mill in Montreal that is still driven by a single motor and a continuous rope drive.

About 1875 electric lighting was first used in factories and the first industrial power distribution system of the kind we are going to consider was installed. Even in those simple days, engineers had their troubles with new designs. F. H. Ellis in a recent article[6] tells us that fires were caused by defective wiring in 21 of the first 63 factories insured by the Mill Mutual Insurance Companies. Mr. Ellis reviews the early progress of the set of rules for safe wiring now known as the National Electric Code. The first formal set of rules

A paper to be read at the 70th Annual General and Professional Meeting of The Engineering Institute of Canada, Montreal, May 1956.



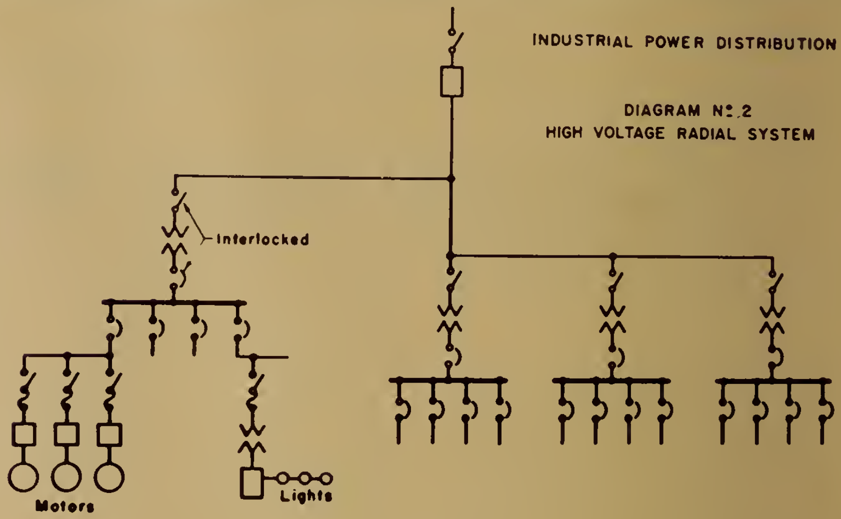


Fig. 1 (top). Low voltage radial system.
Fig. 2. High voltage radial system.

were published in 1893 and in 1896 the NEC first came into existence. Our own Canadian Electrical Code got many of its ideas from the NEC. From the article by Mr. Ellis it is easy to see why the fire insurance companies had so much to do with the first building wiring code.

FROM EARLY DAYS

It is interesting to recall that the first large scale electrical distribution system also dates back to the eighteen eighties. It was in December 1880 that the Edison Illuminating Company began installing the first 6 steam engine driven dynamos in their Pearl Street Station. At the same time they started laying 100,000 feet of cable under the New York City streets for the distribution of power.

Since 1880 tremendous changes have taken place in power generation and distribution, and electricity has been the principal means used for the purpose. This talk is about schemes for distributing electric power in industrial plants; not on wiring methods, but concentrating on systems in general and a special one in particular.

Until about the late nineteen-thirties the power distribution system in most industrial plants followed a fairly simple pattern. Power was usually distributed by radial feeders at the voltage at which it was used. In the larger plants an intermediate voltage was sometimes employed.

Just before the last war, when a great number of new industrial plants were being designed, studies were made which indicated that more economical distribution systems could be designed by using higher voltages. Since then much has been written on the subject of industrial power distribution.

About 1943 the A.I.E.E. committee on industrial power applications developed and published a very complete report[1]. Although many ideas and suggestions have been published since, the fundamentals outlined in the report are still the same. Many of the schemes suggested in the A.I.E.E. report and by other engineers have been used to a very limited extent because of their high cost, and I propose to review only six basic systems. After a general review, I will describe in more detail an actual system that only recently has been placed in service. This system has one or two special features which, I think, will be of some interest. In the single line diagrams used to illustrate the six basic schemes, all circuit breakers shown without isolating switches can be assumed to be of the draw-out type, although the draw-out symbols have been omitted for the sake of simplicity.

BASIC SYSTEMS

The first system to be considered is shown on Fig. 1. It is the familiar low voltage radial feeder system, the most economical for small plants with loads below about 1,500 kw. and which do not require twenty-four hour year-round electric service. For large plants the low voltage radial system, except in special circumstances, will cost more than some of the other types. Even in a large plant, however, it is simple to operate, and its maintenance cost is low. To make it possible to add future load the main sub-station must be designed with extra capacity, and this adds to the initial investment.

The second system, shown on Fig. 2, is also a radial system but a higher voltage is carried nearer the load and a number of unit sub-stations are used to step the voltage down to the level that is required for the plant motors. Where power can be obtained at voltages between 2,400 and 14,400 or even up to 26,000, the high voltage radial system is economical, its voltage regulation is good, and additions can be made readily as required. The high voltage radial system for large loads is considerably cheaper than the low voltage radial system, because the small size single high voltage cable costs much less than the large number of large low voltage cables required in the low voltage radial system, and also because the low voltage circuit breakers are cheaper because much lower interrupting capacity is required. The transformer cost in the low voltage radial system may be lower (if no future capacity is provided), but this is usually not enough to outweigh the other higher costs.

In the two systems already considered no provision is made for maintaining power service in the event of a failure of a main circuit breaker, transformer or cable. It is necessary to shut the power off completely to inspect or adjust the main circuit breakers or transformers. Provision for continuous electric service in a small plant operating on one or two shifts, and which is closed down on week-ends and perhaps also for a two-week vacation period is worth very little. In fact, a more complicated scheme, because it introduces more possibilities for accidents, would be less satisfactory than the radial type system in such a plant. However, in large plants and especially in plants with continuous processes in operation, it is necessary to consider the economics of providing means to service the electrical equipment and supply at all times at least some electric power.

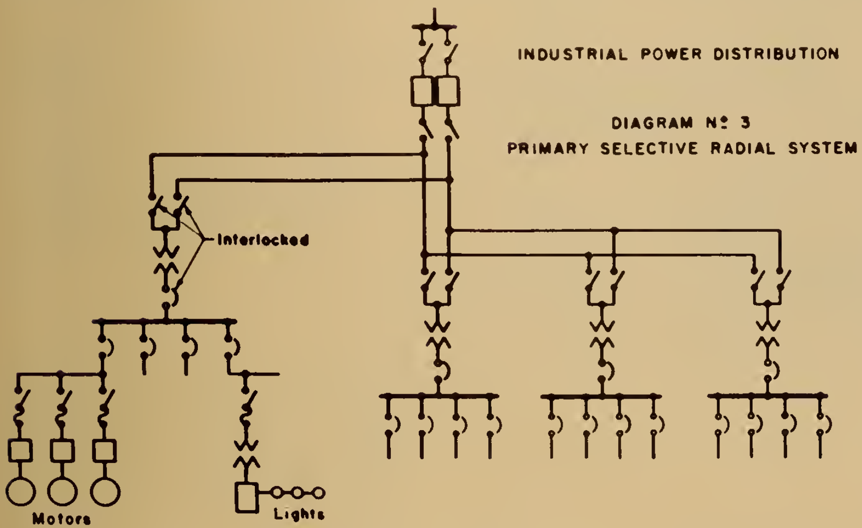
In the system shown on Fig. 3, called the primary selective radial system, additional equipment is installed in order to reduce the time that power service must be interrupted either due to faulty primary breakers or circuits or for their routine inspection and maintenance. The additional cost of this system can be checked with the possible production losses and as an insurance investment it may be worthwhile.

A variation of the primary selective radial system is shown on Fig. 4. In this scheme, secondary ties are provided to enable some load to be carried from one unit-sub-station to another in order to supply certain essential loads even if a unit-sub-station transformer has to be taken out of service. By using the tie circuits to carry some load under normal conditions, the extra cost of this scheme is often small and it can prove very useful some night at forty below zero when a ten-hour shutdown of such things as unit heaters, boiler auxiliaries, and so on would be very inconvenient.

The tie connections also overcome a feature of the system shown on Fig. 3 which is one of its weak points from a safety aspect. An objectional feature of the system on Fig. 3 is that an isolating disconnect switch may be closed in on a faulty transformer when its primary line is energized. The switch may be damaged and the operator hurt. To avoid this, both lines can of course be de-energized during the switching operation. However, if a low voltage tie connection is installed, a transformer can be checked by first energizing it from one of the other transformers through the low voltage circuit breakers. A faulty transformer will trip one of the low voltage breakers and warn the electrician not to try to re-energize the transformer by closing the isolating switch.

A more elaborate system is shown on Fig 5. This might be called the Lincoln or Cadillac system and it is designed to make it possible for the electrical maintenance engineer to go fishing, attend curling bonspiels and play golf. If any item of electrical distribution fails or needs to be inspected, a few switching operations will disconnect it from the system, and when the maintenance engineer returns he can repair it or replace it. This system also avoids those unpopular discussions that often take place between the maintenance department and the production department when a transformer or circuit breaker requires an overhaul.

The above advantages are not cheap. The initial cost may be 50 per cent more than the lowest cost radial system; the operating losses are higher; there is more equipment to maintain; and more care is



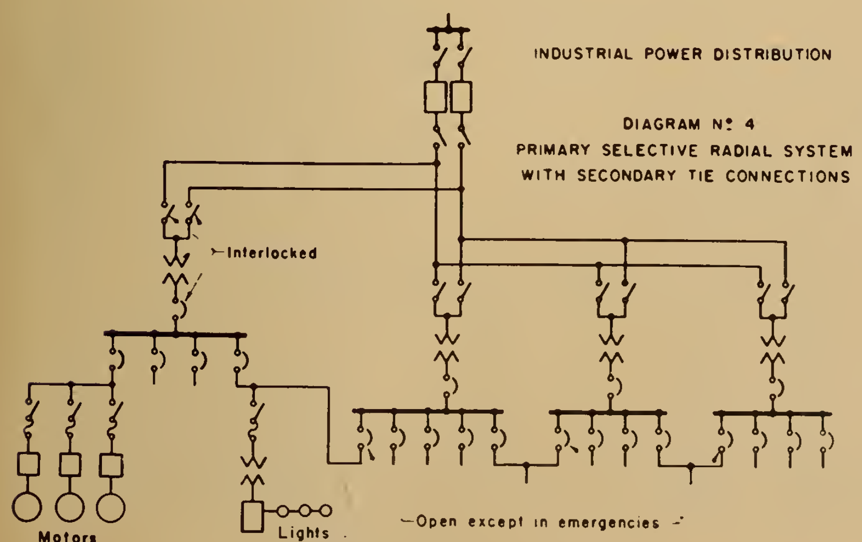


Fig. 3 (top). Primary selective radial system.

Fig. 4. Primary selective radial system with secondary tie connections.

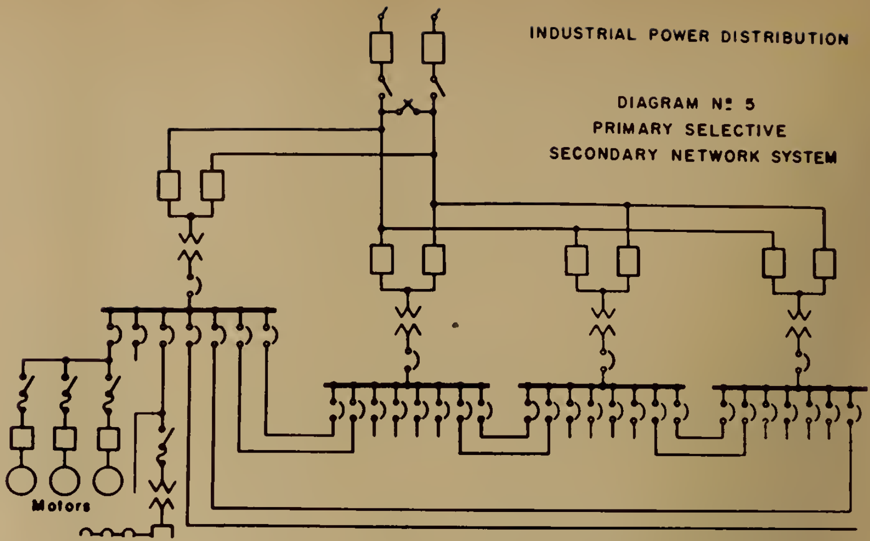
needed to avoid accidents to maintenance mechanics. In spite of this, the elaborate secondary selective system or some modification of it may be justified if power service outages are very expensive.

It is obvious to everyone that many variations of the five distribution systems are possible and many arguments have been put forward as to the merits and defects of the many alternatives. I can think of breakers *v.* fuses and disconnects; loop feeder *v.* radial feeders; double throw isolating switches *v.* two single-throw switches; overhead lines *v.* underground lines; interlocked armoured varnished cloth cable *v.* paper-insulated lead-covered cable in conduit; the frequency of 600 volt cable failures *v.* those of 4,000 v. or 15 kv. cable failures and so on.

There is one other really gold-plated distribution system, called the net-work. This system also has several variations and it is designed to give *de luxe* service. To be economically justified it should be backed up with an alternative source of power and be designed to supply a process that either is so simple that it requires practically no service or that has stand-by motors, lights and heaters, etc., and can be operated continuously.

Figure 6 shows a primary-selective spot network system designed to give uninterrupted service. Very few Canadian industrial plants require or can justify this type, which can cost from 60 to 75 per cent more than a radial system.

We will now take a brief look at an actual electrical distribution system which has been in service nearly three years. The system is



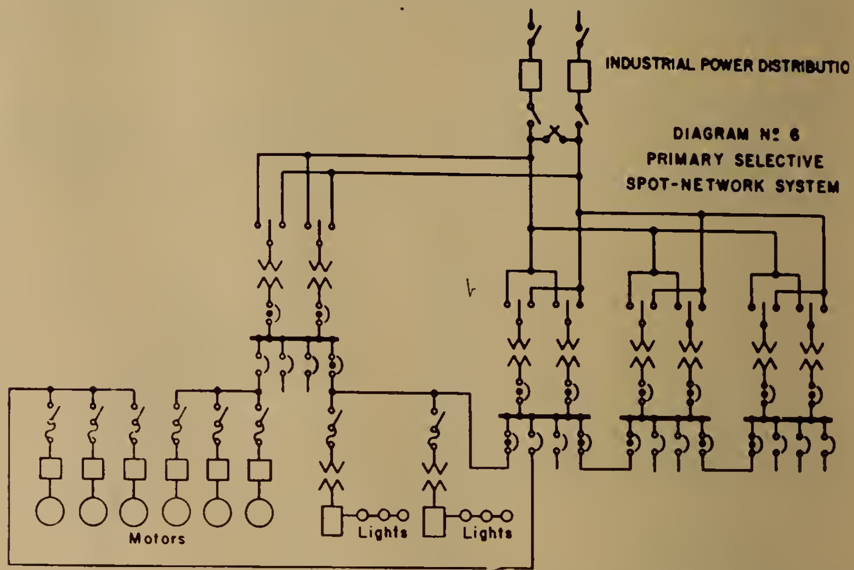
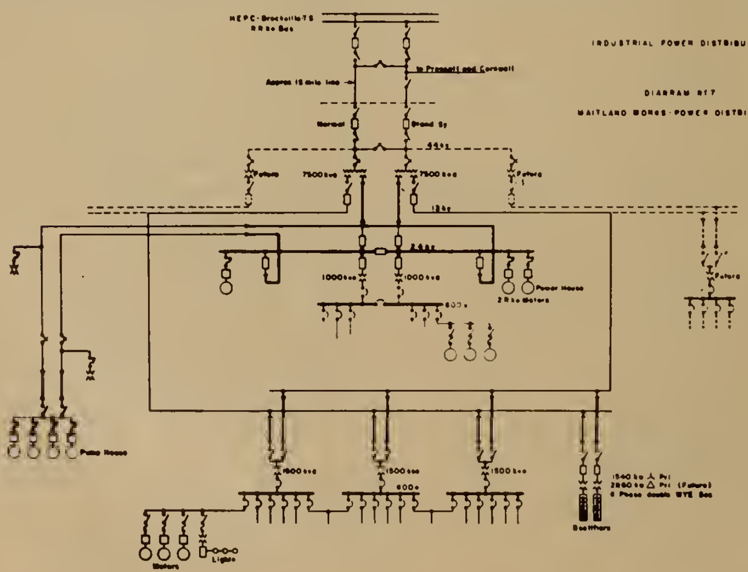


Fig. 5 (top). Primary selective secondary network system.

Fig. 6. Primary selective spot-network system.

Fig. 7 (below). Power distribution at the Maitland works.



operating at the Maitland nylon intermediates plant of the Du Pont Company of Canada Limited, between Brockville and Prescott along the St. Lawrence river.

The system was designed to take care of the present load of the plant and provide means for expansion so that loads up to four times the present load can be added. The plant site is a large one and the process is a continuous chemical operation with very elaborate automatic controls.

From the diagram of the Maitland works system, Fig. 7, the main features of the system are:

(1) Power is obtained from the HEPC at 44 kv.

(2) Two incoming lines have been provided; one is for emergency stand-by service.

(3) Four voltage systems are employed in the plant. Three-phase systems, using 13,000, 2,400, and 600 volts, are used for main distribu-

tion and motors. Lighting is obtained from 240/120 volt single-phase systems.

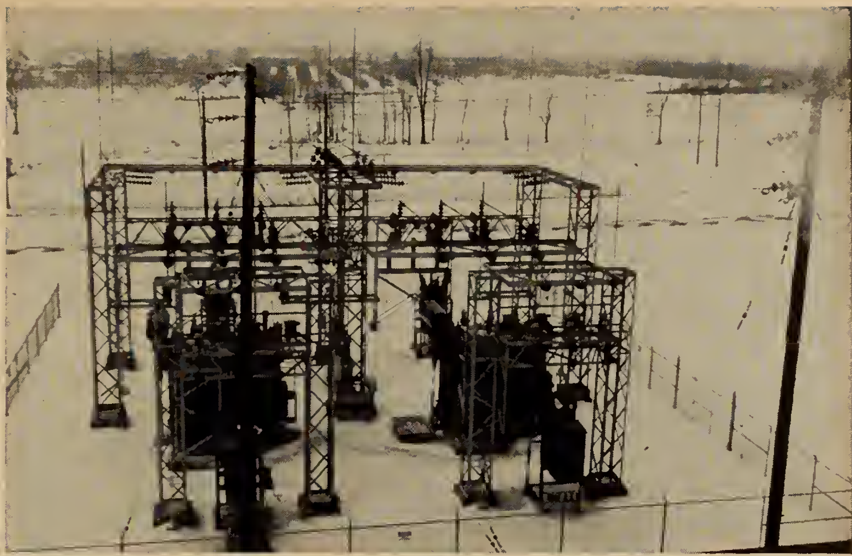
(4) The main transformers have double voltage secondaries. They are oil-immersed, self-cooled, rated 7,500 kva., and designed so that fans can be added to increase their rating to 10,000 kva. when required.

(5) The system is essentially a primary selective radial one, with some emergency cross connections at the 2,400 volt and 600 volt levels.

A cost comparison was made before any detail design was started between systems using different distribution voltages. It was found that a 13 kv. system would cost no more initially than any other lower voltage system, and that it would be much more economical when additional load was added. This choice proved a sound one because before the actual design was completed it was found necessary to take care of about 3,000 kw. more load than the early plans anticipated, and we are now planning on still other additions.

In the preliminary planning stage the system was laid out as a 13 kv. primary selective system, and unit sub-stations were to be used to supply 2,400 volt and 600 volt power where needed. When the actual loads and the building locations were known it was found possible to locate the main sub-station close to the power house. Several large 2,400 volt motors were to be located there. The pump house, where three large motors were to be installed, was close enough to the power house to make it feasible to supply 2,400 volt service directly from the power house. A comparison indicated that a considerable sum would be saved by eliminating 13/2.4 kv. unit substations at the pumphouse and power house and using, instead, double voltage secondaries in the main transformers. The 2,400 volt switchgear was somewhat more expensive due to the higher interrupting rating required but the elimination of transformers more than made up for this added cost. Double voltage secondaries in the main transformers in the ratings used, cost about 5 per cent more than standard units would cost.

A disadvantage of double voltage secondaries in the main transformers is that a future increase in plant load may have a ratio of 13 kv. to 2,400 volt load which is not the same as the capacity provided in the transformers. In other words, the 2,400 volt load



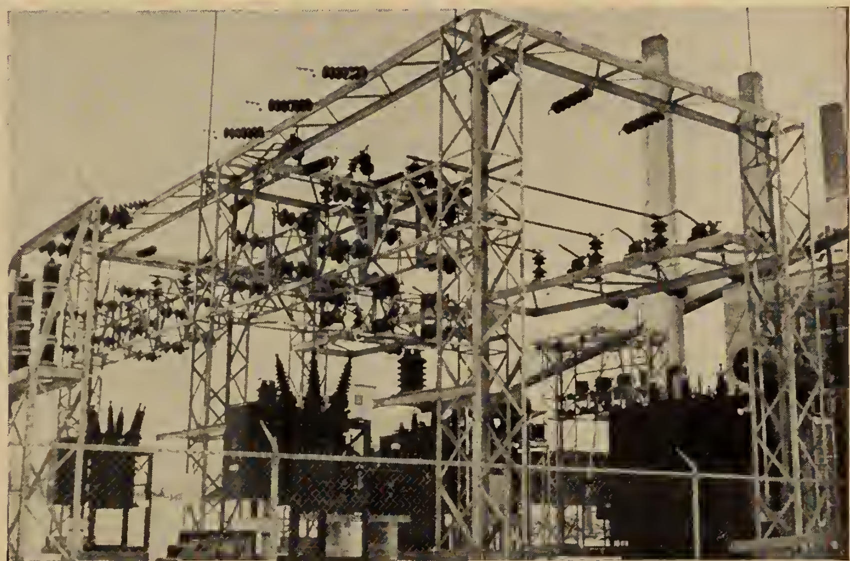


Fig. 8 (top). The main sub-station seen from the power house roof.

Fig. 9. Main sub-station from incoming line side.

Fig. 10 (below). Main control switchboard.

Fig. 11. Double ended 2400/600 volt unit sub-station in the power house.

at the powerhouse might grow so large that the 2,400 volt windings of the main transformers would be overloaded while considerable capacity existed in the 13 kv. windings. If this situation develops, it is planned to install a 13/2.4 kv. unit sub-station at the pumphouse, change the existing 2,400 volt lines that feed the pumphouse to operate at 13 kv., and thus transfer load from the main transformers 2,400 volt windings to the 13,000 volt windings. This same change may be required if a large increase in pumphouse load has to be made.

Due to the large area of the plant site, additional load may be added from time to time. To take care of this, three provisions were made. Main transformers somewhat larger than the estimated load were obtained; provision was made for adding fans to the main transformers to increase their rating to 10,000 kva.; large enough primary switching equipment was installed, and sufficient space was left, so that 2 additional 10,000 kva. main transformers can be added. These provisions increased the cost above the bare minimum required by about 8 per cent.

Fig. 12. 13-kv. poles and circuit.

Because of the importance of uninterrupted water, steam, and compressed air service, dual electric supply is provided for the pump house and power house.

To improve reliability, simplify maintenance, and make line work safer, the two 13 kv. circuits are on separate poles throughout the plant. The 2,400 volt circuits have also been kept separate as much as possible.

The two main 44 kv. circuits are also on separate poles for most of their length. The 44 kv. circuit now used for emergency service was installed before the plant was built to supply power for construction, and it has been retained.

I think it is clear from this brief review of an actual distribution system that the old adage "circumstances alter cases" is very true. Engineering foresight and imagination are needed to fit a distribution system to the requirements of any specific job. It is also evident that the six fundamental systems serve as a very good base on which to start the job and much time can be saved in using them for this purpose.

Figures 7 to 16 illustrate the actual installation at Maitland.

Fig. 13. Out-door unit sub-station, 13 kv./600 volt, 1500 kva.

COSTS

Since money is very important in all engineering work a paper of this sort would not be complete without some reference to costs. I will now give you some approximate unit cost figures for the system we have just been considering.

The approximately unit costs include equipment, foundations, ducts, cables, fences, etc., labour, construction overhead costs, and the cost of engineering.

(1) Main out-door sub-station 15,000 kva.: $ 14/kva. When required, fans can be added to the transformers; the sub-station rating will

be increased from 15,000 kva. to 20,000 kva. and the cost reduced to $11.50/kva.

(2) 2,400 volt switchgear including control relays for out-door circuit breakers: $ 12/kva.

(3) 2,000 kva. double ended 2,400/600 volt indoor substation: $ 25/kva.

(4) 1,500 kva. single ended 13 kv./600 volt outdoor substation: $ 23/kva.

(5) 13 kv. single circuit overhead lines: $ 5/ft. 13 kv. single circuit underground lines: $ 20/ft.

(6) Cost of complete distribution system not including wiring in the buildings: $ 50/kva.

(7) Cost of wiring in the buildings: $ 30/kva.

SELECTING A SYSTEM

I will conclude with a recipe for selecting an industrial power distribution system.

First. Obtain a list of the motors, heaters, and areas to be lighted, as early as possible. Even if the list is not exact or complete, estimated sizes can be used at first to fill in the unknowns.

Second. Estimate the expected kva. and kw. maximum demand load that will be required during the first, fifth, and tenth year.

Third. Make a plan of the plant showing the approximate location of the larger motors, the motor control centres or power distribution panels.

Fourth. Find out from the power company what voltage they will use to supply your load.

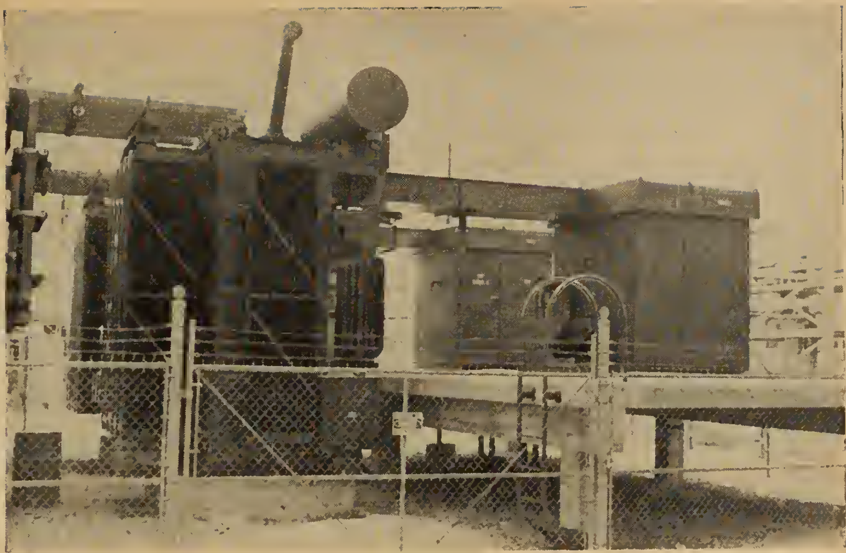


Fig. 14. Rectifier sub-station.

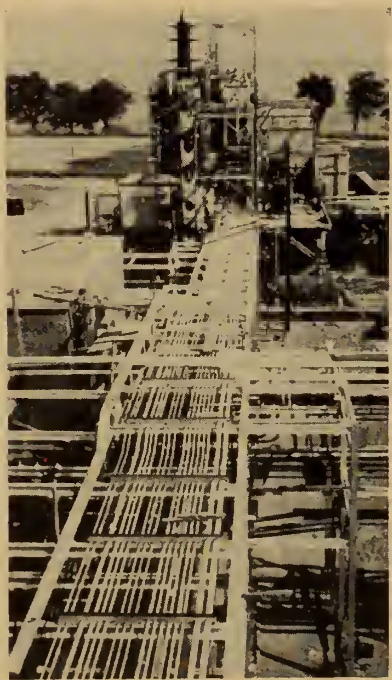


Fig. 15. Conduit on the pipe bridge.

Fig. 16. Motor control unit in one of the process buildings.

Fifth. Decide whether continuous power supply service is economically desirable. (You may have trouble with this one.)

Sixth. Draw two or three single line diagrams similar to Figures 1 to 6. One may be a low voltage radial feeder type, the second a high voltage radial feeder, the third one of the more elaborate types. The equipment ratings, the line sizes and lengths, and the future additions can be added to each diagram. With this information an approximate estimate of the present and future cost of each system can be made.

The estimates, together with a tabulation of the merits and disadvantages of each system, should make it possible to select an economical and satisfactory industrial power distribution system.

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Construction of a

New Cement Plant at Edmonton

W. Rutherford, M.E.I.C.

The great construction programs that have developed in recent years in Canada have placed heavy demands on the cement industry, which has had to expand to meet the situation. This paper deals with the construction of the new cement plant of the Inland Cement Company Limited, at Edmonton, Alberta.

CEMENT IS produced by thoroughly mixing calcareous and argillaceous materials and burning the mixture to form a clinker of silicates and aluminates of lime. This clinker, when ground with no additions except gypsum, is known as Portland cement.

Calcareous materials usually occur as marble, limestone and chalk, whereas argillaceous materials occur as clay and shale, these forming the main sources of cement making materials.

This definition varies in detail for different countries, but in general principle remains as above. The use of the term "Portland" is not patented and refers only to the original description of the properties of concrete made from this cement, which was said to be equivalent to English Portland stone.

The first successful work on this subject was done by Vicat, in 1813, who made cement clinkers by burning mixtures of lime and clay. Subsequent researches have only confirmed his experiments with alterations in detail.

Apart from the general raw materials mentioned above there are a number of additives which are used. Iron oxide is added to the raw materials to act as a flux in theburning zone of the kiln and thus allow the combination of lime with silica and alumina at a lower temperature than it would without the addition of this material. Sand is also added to raw materials when they are deficient in silica.

Gypsum is added to the clinker when grinding it to cement as it has the property of fixing the setting time of the final cement to comply with standard specifications. Though there are other additives, the above are the most usual in cement manufacture.

Not all lime, silica and alumina bearing materials are suitable for cement manufacture because they contain impurities such as magnesia, phosphates etc. which would cause the cement to have unsound properties. The former impurity can be present in cement in quantities of about 3 per cent without harmful effect and, in the factory which is the subject of this paper, adequate controls are imposed to maintain the percentage below this value. Excessive sulphate in the raw materials or fuel must be avoided, because when burning takes place in the kiln the sulphate is broken down into sulphur dioxide and sulphur trioxide which form, on combination with water, hydrosulphurous and sulphuric acids respectively. These acids have a highly corrosive effect on the metal parts of the kiln back end equipment.

MANUFACTURING PROCESS

The limestone for the cement factory comes from a deposit outcropping in the Rocky Mountains near Cadomin, Alberta, adjacent to an existing railroad track. The quarry has been opened by extend-

Fig. 1. Site of the primary crusher at Cadomin (left) with formwork for loading bay. Right, secondary crusher under construction.

ing a bench from the crusher building, running north on the limestone deposit to form a face. This stone is blasted to bring down a large quantity of limestone at one time.

A bulldozer is used to push the broken rock down the bench into a gyratory crusher, which has a maximum capacity of 1400 tons per hour when crushing stone to 7½ inches and down, and a minimum capacity of 270 tons per hour when crushing to 4 inches and down. Fitted to this crusher is a hydraulic system known as a "hydroset" which functions in two ways, firstly to act as a cushion against the effects of any uncrushable material passing through the machine and, secondly, to raise or lower the crushing head when adjusting the size of the crushed stone to be delivered from the machine.

The hydroset system is built around a hydraulic accumulator which is provided with a neoprene membrane filled up on one side with nitrogen at 700 pounds per square inch and on the other side with oil. When a piece of tramp iron enters the crusher, the movement of the crushing head will cause the oil pressure to increase above the nitrogen pressure, so that oil will flow into the accumulator, compressing the nitrogen and give a cushioning effect to the shock on the crusher. After the tramp iron has passed through, the crushing head will return to its original position.

To vary the size of the crushed stone a separate oil pump has been provided, which either pumps oil into or from a hydraulic cylinder at the base of the crusher shaft, thus raising or lowering the shaft of the crushing head relative to the skirt of the crusher.

This crushed stone is dumped from the stone box of the crusher to an inclined troughed belt conveyor, which transports it to a loading bay alongside the railroad track where it is discharged into railcars.

No outside power supply is available at Cadomin and, therefore, a small power station has been installed in the basement of the crusher building. The equipment consists of a 350 kva. diesel generator set to carry the main electrical load when the crusher and inclined belt conveyor are in operation, and a 20 kva. diesel generator set to carry the electrical requirements of the auxiliary loads, such as heating, lighting and water supply.

An electrically driven overhead crane traverses the full length of the crusher building and is primarily installed to deal with the lifting of heavy crusher parts for maintenance. It is possible to lift any one of these crusher sections out and deposit it on the ground floor of the crusher building, as removable wooden panels have been provided over the crusher and sections of the upper concrete floors have also been provided with similar panels. This is done to avoid the over-stressing of suspended concrete floors by heavy loads.

All the equipment using fuel in this crushing plant has been designed for diesel oil, for which storage is provided in two above ground tanks on the south side of the crusher building. The oil fuel piping is arranged so that a rail tank car can be offloaded through two pumps on the lower floor of the loading bay. The pumps can deliver to the main storage tanks or, alternatively, to a high level service tank under the roof of the crusher building. Oil is distributed from this tank by gravity to all the equipment.

Sufficient water for cooling and domestic use is taken from a 40 feet deep water well, about 150 feet to the west of the railroad track, which on test delivered 75 gallons per minute. The McLeod River, which runs from south to north on the west side of the crushing plant, can supply additional water if required in the summer, but its utility in the winter is doubtful because of icing.

The cement plant requires about 500 tons of crushed limestone per day to maintain its normal output of cement and the crushing plant is capable of producing this amount of stone in a very short period of each day.

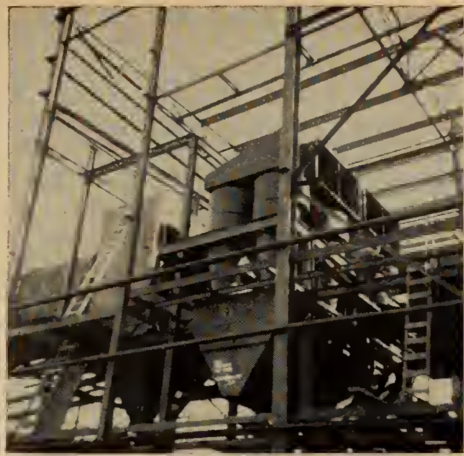


Fig. 2. Kiln dust cyclone collector (left); kiln chimney and slurry storage basin (right).

The reason for installing such a large capacity machine is to insure the cement plant against interruption of limestone supplies by inclement weather, or stoppage of rail transport. During the fall the crushed limestone storage bin will be filled completely to provide three months' reserve of stone and, if deliveries from Cadomin are stopped due to heavy falls of snow, the manufacture of cement may still proceed until communications are restored. When conditions return to normal the crusher will be worked to its full capacity for as many hours per day as are necessary, not only to supply 500 tons per day of crushed stone to keep the plant in operation, but also to fill up the depleted crushed limestone storage bin as soon as possible as an insurance against any other interruptions.

The railcars transporting the crushed limestone from Cadomin to the cement plant site are of the standard ore carrying type, with hopper bottom openings. These cars arrive at the cement plant sidings in Edmonton and are hauled to the feed track hopper of the secondary crusher at the south western part of the site.

This crushing section of the plant is built round a hammermill of the central feed reversible type, which is rotated clockwise or anti-clockwise usually for periods of 16 hours in each direction, to obtain the most satisfactory service from the machine.

The limestone cars discharge into the track hopper below rail level, which is provided with a chain curtain, vibrating feeder and stone box delivering to an inclined belt conveyor, which in turn feeds the hammermill. A d.c. magnet is installed at this conveyor head to remove tramp iron before the stone goes through the hammermill; incidentally, this machine has a conventional type tramp iron pocket provided to take care of any iron escaping the magnet.

This crusher is installed in a reinforced concrete pit covered in by a building. At ground level there is a bag filter type dust collector and induced draught fan, exhausting and cleaning the air discharged from the hammermill. On the first basement level the hammermill and electrical equipment are installed and, at the lower basement level, the crushed stone is discharged through a hopper to a belt conveyor system, which delivers to a crushed limestone bin in the storage hall, or direct to crushed limestone feed bins in the grinding area, using a standard belt tripper.

This crushing plant is also used for crushing rock gypsum and the only difference in operation is that the material passes straight through the tripper and along to the east end of the last conveyor, where it falls into the gypsum storage bin.

Clay, the other major raw material, is dug from the company's property at the cement plant site in Edmonton, and is trucked to a grabbing pit in the western gable end of the storage hall. A 10-ton travelling crane grabs this clay from the grabbing pit and deposits it in a storage bin. Other raw materials received at this grabbing pit are sand, ferrous compound, and additives for special cements, all of which are dealt with in the same way as for the clay.

The storage hall when full of material provides a reserve against breakdown, maintenance and other unforeseen events and allows the cement plant to operate continuously, providing these interruptions are not of too long a duration. The storage hall is 105 feet wide, 570 feet long and 68 feet high, and is divided into storage bins by reinforced concrete retaining walls averaging 25 feet in height, though in places these walls are increased to 42 feet in height. The travelling crane covers the whole length of this storage hall, moving raw materials and clinker from their storage bins to the feed hoppers over the grinding mills at a sufficient speed to keep these units in full operation. This crane is also used for trimming the raw materials within the storage bins when not feeding the hoppers, or in use at the grabbing pit on the western end of the storage hall.

The preparation of clay slurry is the next stage in the process and this is done in a clay washing section at the south western end of the storage hall. Clay is fed into a clay hopper by the storage hall crane, from whence it is dumped into a washmill.

The washmill consists of a rotating steel framework from which are hanging chains and heavy cast iron harrows, which thoroughly mix clay and water together until all the clay is broken down and finally suspended to form a slurry containing 50 per cent water. The washmill tank, constructed in reinforced concrete, is lined with granite blocks to protect the concrete from abrasion. Insoluble material, gravel and stones left at the bottom of the washmill tank after the suspension of the clay in water is raked out into a gravel pocket at the side of the washmill for disposal. Alongside this pocket a washwater pump is set up for cleaning out the tank.

The finished clay slurry is discharged from the washmill into a sump from whence it goes by pipeline to a suction header of the pumps under the slurry tanks. These pumps deliver this clay slurry to any one of the clay slurry tanks.

Fig. 3. Construction of the cement silos: left, excavating piles; right, sliding forms in position.

Fig. 4. During construction of the cement silos a mass pour of 650 cu. yd. was carried out.

Eight slurry tanks have been built in one block, all 69 feet in height, four being 17 feet diameter and the other four 24 feet diameter. The method of operating this storage is to reserve six of the tanks for slurries of different chemical compositions, one for use as a blending tank for finished slurry and one as a spare tank for cleaning and maintenance. This gives great flexibility in preparation of finished slurries of different chemical compositions required for burning various types of cement in the rotary kiln.

The slurries in these storage tanks must be agitated in order to maintain the finely divided raw material in suspension, and this agitation is effected by vertical compressed air lines in each of the tanks. Two rotary air compressors, each with a capacity of 336 cubic feet per minute, at 100 to 60 pounds per square inch, have been installed adjacent to the tanks delivering compressed air through air storage tanks to a distribution header under the slurry tanks. The individual air lines to the storage tanks and slurry blending basin are valved at this place which is convenient for operating the blowing of these tanks.

There is a piping reticulation arranged so that clay slurry made in the washmill can be pumped to the slurry tanks, or direct to the wet mills; the slurry can be transferred from one tank to another, or pumped to the two wet mills from any two slurry tanks; the slurry can be pumped from the wet mills to any of the slurry tanks, and cross-connections make it possible to pump these slurries from one tank to another or from any tank to the slurry storage basin or even to the kiln feed tank direct.

This complex piping system involves the use of nine slurry pumps and 100 rubber diaphragm slurry valves. The valves are specially designed for viscous fluids such as slurries and consist essentially of a rubber diaphragm which is pressed against a machined face on the bottom of the valve body when shut; when open the slurry passes between the flexible diaphragm and the valve body. This type of valve is eminently suitable for handling viscous fluids of this nature.

The pumps are specially designed to handle slurry and have a water connection for cleaning out the pumps after use. There is an easy adjustment on each pump for placing the impeller casing in the correct position to achieve the right clearance after wear takes place by passage of the slurry through the pumps. As an experiment three of the pumps have been rubber lined to ascertain whether the abrasive effect can be overcome or lessened.

As there are two slurry lines to and from the slurry mills it is possible to deliver and discharge slurries of different chemical composition before and after grinding.

Fig. 5. Lifting a section of the kiln, at the east end.

Crushed limestone, sand or ferrous oxide is placed in feed hoppers in the storage hall by the travelling crane. These materials are proportioned by automatic belt feeders which discharge to inclined belt conveyors feeding into the mills. Slurry or water is introduced at this place to the two mills.

The two slurry mills are identical two compartment attrition mills fitted with cast iron liners and carrying a heavy ball charge. Each mill is driven by a 900 h.p. 180 r.p.m. synchronous motor through a magnetic clutch and countershaft to a pinion which engages a spur wheel fixed to the mill shell which rotates at a speed of 18 r.p.m. The two mill motors and switchgear are completely shut off from the rest of the equipment in the millhouse, and a ventilating fan is installed to induce a positive air pressure in the motor room which prevents dust from entering and causing damage to the motor bearings and switchgear.

The slurry is discharged from the mills into concrete sumps and is pumped back to the storage tanks.

The next stage in the process consists of drawing off finished slurry and discharging it by gravity or pumping into the slurry storage basin on the north-western area of the cement plant. This basin is a cylindrical concrete tank with clay bottom, constructed below ground level, 70 feet in diameter and 18 feet deep. In this storage tank three to four days' kiln capacity of slurry is held and mixed to make it thoroughly homogeneous before feeding it to the kiln. An agitator is installed in this tank which uses a combination of air and mechanical agitation to mix thoroughly the finely divided raw materials suspended in water. A steel structure bridges the tank and carries a geared drive to which is fixed a hollow central vertical drive tube, guided at its lower end on an adjustable step bearing. Attached to the tube are blades raking the bottom of the tank which agitate settled raw material. At one position about halfway along each of the blade arms, air lift tubes are fixed vertically to scoop the solids off the tank bottom and raise them to the top surface of the tank, thus setting up a circulatory motion and agitating the slurry. Auxiliary air nozzles are spaced along the blade arms providing vertical air agitation over the complete tank bottom with each revolution of the agitator. The combination of mechanical and air agitation ensures that the contents of the tank are circulated continuously with no dead spaces. It is interesting to note that the nozzles on the blade arms contain circular discs of porous tile, which diffuse the air as it passes into the slurry, and also prevent the slurry flowing back into the air pipes when the air pressure is off.

Slurry, completely homogenized, is drawn off through a pumping pit alongside the storage basin and discharged to a ferris wheel slurry feeder above the feed end of the kiln.

The rotary kiln is one of the most important sections of the cement plant because it is in this furnace where the chemical change takes place, converting slurry to cement clinker. The kiln is a steel tubular shell 340 feet long and 11 feet diameter made from steel plate about 1 inch thick. This shell is supported on five water-cooled kiln bearings and has a slope of 1 in 32 from the feed end to the discharge end. The piers supporting this kiln are constructed in concrete, four of them being solid whilst the central drive pier is hollow to house the motor control centre for the electrical equipment of this section of the plant. This same pier carries the kiln drive mechanism and thrust bearing for the kiln. It is interesting to note that a stand-by gasoline motor normally disengaged from the kiln drive by a claw clutch is installed here in order to drive the kiln when a breakdown in power occurs. This emergency drive is necessary because the kiln would be seriously damaged by unequal temperature strains if allowed to remain stationary.

At the feed end of the kiln for a length of 56 feet a chain curtain is installed to lift the slurry where its moisture is removed by the exhaust gases.

The kiln is lined completely with material, which in the burning zone is a 70 per cent alumina firebrick, followed in turn by 40 per cent alumina firebrick, castable refractory and common red brick at the feed end. The care and maintenance of the firebrick lining of the kiln is of great importance in the efficient operation of the cement plant, because the high temperatures generated in the burning zone can cause fluxing of the firebrick, and it is usual practice to develop a protective coating of clinker. The kiln can then be run for a considerable period without renewal of the lining. As there is a minimum loss of production of two days for even partly relining the kiln, it can mean a loss of production of about 1,000 tons of cement and, therefore, the importance of protecting this lining cannot be too greatly stressed.

Natural gas with a low sulphur content and a calorific value of 980 B.t.u. per cubic foot is used for firing the kiln. A 15 p.s.i. gas supply to the kiln is provided with a control valve which shuts off the gas if the pressure in the line builds up above 17 p.s.i., thus providing a safety measure against overheating the kiln. The primary air for combustion is supplied in the normal manner by means of a blower and the secondary air comes from the cooler where it has already been preheated in cooling the clinker.

The clinker falls from the kiln into the throat of an air quenching cooler installed in a concrete pit below ground level. This cooler consists of an inclined grate with alternate rows of fixed and moving grate castings, which cause the clinker to move downwards to the end of the cooler in a bed of even thickness. The cooling is accomplished by passing air through the clinker bed on the grates and the principal condition to be observed is that the depth of the clinker bed on the grate and the fan pressure should be such as to cause the fan to operate at its correct static pressure. The use of a bed of insufficient thickness results in a small resistance to air flow, thus delivering a quantity of air in excess of the designed value which could overload the cooler vent stack. Because the clinker may vary in size, the temperature of the clinker may change, and the rate of delivery may vary, it is necessary to have bed speed control of the cooler. This is done by hooking up a thermal couple above the clinker bed with the variable speed drive on the cooler grates. Dampers are also installed on the cooler fan ducts to control the supply of air to the underside of the inclined grate.

Part of this preheated air passes upwards and into the kiln as secondary air, thus reducing the fuel consumption. Air which is in excess of kiln requirements is extracted through a dust collector by an induced draught fan and discharged through the cooler vent stack.

Exhaust gases from the kiln pass through a highly efficient dust collection plant, consisting successively of mechanical cyclones and electrostatic precipitators to an induced draught fan and kiln chimney. This is an elaborate and costly dust collection system which the company considered advisable to install in view of the proximity of the plant to the City of Edmonton. This equipment is arranged so that half the mechanical cyclones and half the electrostatic precipitators can be shut off for maintenance, whilst the exhaust gases pass through the other half of the dust collection plant. The dust is removed from the collecting electrodes by a mechanical rapping system and discharged into hoppers and carried to the south side of the kiln building by screw conveyors, where it is discharged into trucks for disposal.

A control panel for the kiln and cooler is located near the discharge end of the kiln on the firing platform in a convenient position for inspection by the kiln burner. The panel has ammeters indicating the operation of motor drives, temperature and gas analyses recorders for various points on the kiln, bed speed control of the cooler, and remote controls to operate dampers, fuel consumption, quantity of combustion air, slurry feed, and kiln speed. This control panel

Fig. 6. Construction of the slurry silos with sliding forms.

is set up to make immediate corrections to any one of these variables for correct operation of the kiln.

Clinker is normally discharged from the cooler at a temperature of 140° F. to an inclined grizzly where the smaller pieces pass through to two drag chain conveyors. Any oversize clinker on the grizzly is pushed into a clinker breaker of the hammermill type which breaks up these pieces and throws them back to the inclined grate for further cooling.

The clinker is then conveyed by the two drag chain conveyors and bucket elevators to the clinker bin in the storage hall.

One of these drag chain conveyors is reversible and can discharge to another bucket elevator and thence to a swivel conveyor on the northern exterior wall of the kiln building, in order to dump clinker outside if the clinker bin in the storage hall is completely filled. This outside store of clinker can be returned to the storage hall when space is again available by feeding it into a hopper at ground level to the other drag chain conveyor which feeds only toward the clinker bin. This system is now being moved to build the plant extension.

The next stage in the process is to abstract gypsum and clinker from the storage hall and place them in feed hoppers discharging into automatic belt feeders which proportion the materials being fed into the two cement mills. These cement mills are similar to the slurry mills, except that in this case the grinding is dry. The cement passes out of the south end of the mills and is discharged into screw conveyors, which in turn convey the ground cement through bucket elevators to air separators which apart from their primary function of grading the cement particles have an important function in cooling of the cement through continuous injection of cold air during grinding, thus lessening the possibility of dehydration of the gypsum which is the main cause of flash setting.

These separators receive the cement by gravity into a cone and rotating distributing plate hub, which gives the cement particles a centrifugal force outward through the hub ports to the lower distributing plate. The centrifugal force on these particles increases as they move farther from the centre of rotation until the edge of the plate is reached, at which point there is a separating zone. The larger particles are thrown further out, but as their centrifugal force decreases they begin to fall by gravity into a tailings cone, and are returned to the feed end of the mills for further grinding. The finer particles are retarded in their outward path due to their lower centrifugal force and are lifted by an ascending air current, induced by the main circulating fan, to the selective zone where the lighter particles are easily lifted by the ascending air, whereas the heavier particles have passed beyond the path of this air and settle out to join the other oversize material for regrinding in the mills.

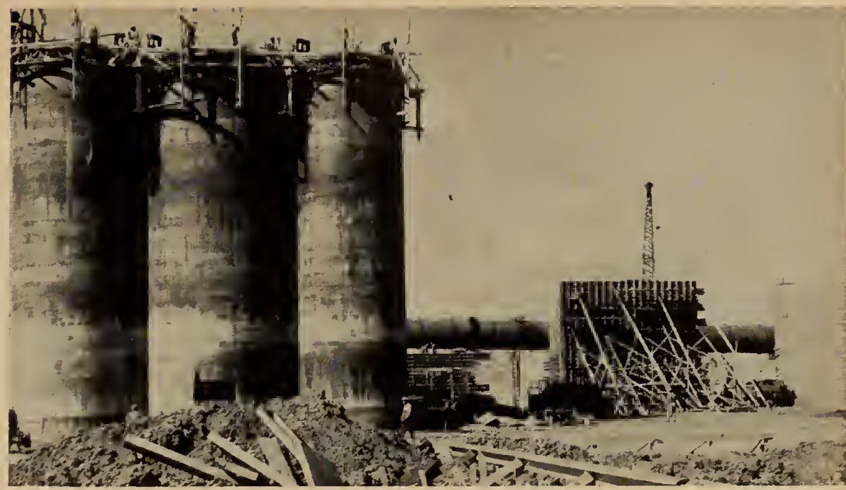


Fig. 7. Slurry silos and kiln looking north from the secondary crusher.

The dust generated in grinding is taken from the discharge end of the mills to two dust collectors and the cleansed air discharged to atmosphere, whilst collected cement dust is delivered by pipeline to the feed hoppers of the transport pumps. Each mill is completely separate with its own dust collector, air separator, pump and compressor, so that two types of cement can be ground at one time. The transport pumps are made from a short length of cast-steel screw conveyor rotating at high speed in a totally enclosed casing. The cement is fed into the casing at the inlet of the spiral and discharged into a pipeline at the remote end; when discharging it is thoroughly mixed with compressed air through a perforated ring and the aerated cement flows at 45 feet per second along a pipeline. A great advantage of this type of conveying is that there is no difficulty in transporting through a vertical line. The pipelines in this case are above ground from the millhouse until they come to the main road, where they cross in a covered concrete trench to the cement silos.

The cement silos are part of the storage and shipment section of the plant which is located in the south-east corner of the site. This section is adjacent to the railroad track to facilitate the loading of railcars, either in bulk or with bagged cement, and on the north side a large paved area in the shape of a circle is being provided for road transport either to load cement in bulk from under the silos or to receive bagged cement from the bagging plant. In this way the plant is completely flexible for delivery of cement to customers.

The two cement transport lines from the mills carry the cement to the roof in a space between the silos. At roof level the cement is piped to any one of the six silos. A dust collector with interconnecting piping to each silo is installed to remove the cement dust in the compressed air which is discharged to atmosphere from the cement silos.

There are six silos, each 113 feet high by 24 feet diameter so that a number of kinds of cement can be stored at one time.

Each of the six silos has three nozzles at the hopper bottom, one of which delivers to a telescopic chute beneath the silos for bulk loading of cement to road transport, the second delivers to air slide conveyors for bulk loading of railroad trucks and the third to air slide conveyors for delivering the cement to the bagging plant.

The air slide conveyor consists of a lower channel forming an air chamber and an upper channel for cement; the upper surface of the air channel is made from porous fabric and the air passing through the fabric fluidizes the cement above sufficiently to allow it to flow by gravity. As the fall required is about 8°, the loss in head required to install these conveyors is not excessive and, because an ordinary blower of low horsepower is required, the unit is economical in operation.

The bagging of cement takes place in a six storey building at the north side of the silos. The system adopted is to carry the cement in a bucket elevator to the top floor, where it passes through a screening screw conveyor to remove oversize particles from the cement. The cement is then discharged into a cement surge bin over a bagging machine where the paper bags are filled. The filled bags are then distributed to road or rail by bag slides, belt conveyors and chutes as necessary. In the top storey of this building a dust collector removes dust from the air before discharging it to the atmosphere. This latter section completes the description of the cement making machinery.

AUXILIARY SERVICES

A block of offices has been built, together with a separate modern laboratory complete with all necessary equipment to carry out tests on raw materials, cement clinker, etc., to standard specification.

A workshop and stores building with overhead cranes in each of the two bays has been built adjacent to the railroad sidings to accept mechanical and electrical stores, and at the same time provide working area for mechanical and electrical maintenance, with an oil store and carpenters shop.

A scale-house has been constructed adjacent to the main entrance of the plant with a track large enough to accommodate the largest prime-mover and trailer at present in use. This will be used for check weighing of trucks at entry and exit from the plant.

A standard water supply from the City of Edmonton has been installed, but because the water has a minimum pressure of 30 p.s.i., two centrifugal pumps have been installed on the supply line to boost the water pressure if required to the elevated storage tank at the top of the slurry silos. This storage tank has a capacity of 104,000 imperial gallons and forms a reserve of 75,000 gallons for fire protection, the remainder being made available for process water. These water pumps have a capacity of 800 gallons per minute against a head of 100 feet and can be used if required for boosting the fire line through a by-pass.

A natural gas supply to the cement plant is delivered at a pressure of approximately 200 pounds per square inch to a gas preparation room located near the east end of the kiln house. The gas is reduced in pressure, first to 75 p.s.i. where it is measured and, secondly, to 15 p.s.i. at which pressure it is delivered to the rotary kiln for burning clinker. A further reduction to 7 inches of water gauge is made for heating the factory buildings.

The electric supply to the cement factory is taken from the Calgary Power Company at 22,000 volts, which is transformed down

Fig. 8. The slurry mills after installation.

Fig. 9. Some of the foundation work: mill house (top) and wash-mill.

in their 6,000 kva. transformer and delivered to the cement company's main switchboard at 4160 volts.

Main transmission cables carry this 4160 volt power to four sub-stations, each of which has a 1,000 kva. transformer stepping down the power from 4160 volts to 550 volts. The grinding mill motors, two air compressor motors and a hammermill motor consume a large amount of power and they have been made for a 4160 volt 3-phase 60-cycle supply.

The general supply characteristics for other motors are 550 volt 3-phase 60-cycles, with the exception of a number of fractional horsepower motors for dampers, etc., which are on the 120/230 volt single-phase lighting circuits. A diesel generator set has been installed in the sub-station to provide emergency lighting in the event of breakdown of the normal power supply.

SPECIAL NOTES

In this cement factory clinker is manufactured by the wet process, but this is not the only method by which cement clinker can be made. Generally there are two main methods of manufacture, known respectively as the wet process and dry process. In the wet process the raw materials are broken down or crushed and mixed together with the addition of water and fired in the cement kiln as a slurry, whereas in the dry process the raw materials are crushed, dried if necessary, ground and mixed in the form of a dry powder and fired in the cement kiln in a dry state. The decision to adopt either process is an individual problem for each cement plant.

There are inherent advantages in adopting the wet process in this case; firstly there is no shortage of water which could limit the production of cement by the wet process, secondly it is easier to achieve a homogeneous mixture of limestone and clay in a finely suspended slurry than it is to achieve a dry mixture of the same materials and, thirdly, the additional fuel required to drive off moisture from the slurry in the kiln by the wet process is not so important when a cheap fuel such as natural gas is available, as in this case.

The limestone deposit is situated in Cadomin, 200 miles from the cement plant, though in many other cases in the past factories have been built adjacent to the limestone deposits to avoid freight charges on this raw material. There are advantages in siting this factory at Edmonton, because in Cadomin there is little or no skilled and semi-skilled labour available to operate the cement plant. Though coal is available at Cadomin it does not have the same homogeneous properties as natural gas, which as mentioned previously is readily available in Edmonton at a comparatively low cost.

The company in the initial stages propose to manufacture normal setting and oil-well cement, though naturally future manufacture will depend on customer requirements. The factory has been equipped with the idea of producing not only the two cements mentioned above, but also high early strength cement, masonry cement, and sulphate resistant cement.

CONSTRUCTION FEATURES

An investigation into the subsoil of the cement plant site at Edmonton was made in order to design correctly the heavy foundations necessary for this type of industrial plant.

The tests carried out showed that the upper fifteen feet of subsoil is a highly plastic clay of about 35 per cent moisture, with an unconfined compressive strength of approximately 1 ton per square foot. This layer of clay showed signs of numerous fissures due to repeated shrinkage and swelling of the soil brought about by soil moisture changes. This clay, because of the fissuring, is more than normally permeable.

Below this very plastic clay is a layer of silty clay at a depth of 16 to 22 feet, which has an extremely low compressive strength and contains about the same amount of moisture as the plastic clay above it.

Below the silty clay there is a layer of dense glacial till of considerable depth which has a moisture content of 15 to 20 per cent. This material consists of a clay containing sand, gravel, and stone pockets and has an unconfined compressive strength of at least $2\frac{1}{2}$ tons per square foot.

The first two clay layers have such a low bearing value that all the main structures for heavy equipment are founded on piles of the end bearing type, which terminate in the layer of dense glacial till. Furthermore, because of the high water content in the first two clay layers, all foundations were taken down at least 8 feet below ground level as a precaution against frost damage.

Piled foundations were constructed for the slurry silos, cement silos, kiln piers, storage hall, and mills; 1,048 caisson piles were driven, having an average pile length of 20 feet each. It is interesting to note that in a test on one of these piles on June 15, 1955, where a maximum load of 120 tons was imposed, a total deflection of the pile was 15/32 inch. The 120-ton load was maintained on the pile for 9 hours, during which time the pile settled a further 3/32 inch, and on removal of this load the pile recovered 7/32 inch, leaving a final settlement of

Fig. 10. Aerial view of the plant.

11/32 inch. This deflection was considered acceptable as the pile is rated for 90-ton loading only.

Approximately 20,000 cubic yards of concrete was required for the construction work and it was all supplied by ready-mix companies. The largest concrete pour was a 670 cubic yard reinforced concrete base for the cement silos, which was placed in about three hours.

The construction of the slurry and cement silos was done using sliding formwork raised by hydraulic jacks. Though this form of construction has been previously used elsewhere, there are a number of interesting features which are worth mentioning here. The first condition to be satisfied is that once the work has commenced it must be continuous until the completion of the silo walls. The preparation work must be made in advance so that all plant and material is available on the site before commencing the operation. Three shifts of workmen were allocated with a number of extra men to be called upon as reserves in case of illness. The actual locations of all holes, access doors, etc., were entered in a book kept on the sliding forms platform and pointed out by the engineer-in-charge to the foreman before each shift commenced, so that blockouts could be made for positioning when the sliding forms reached these locations.

The interior and exterior circular forms were held by yokes on which hydraulic jacks were mounted. The jacks were threaded on steel jack rods welded to the base dowels and the whole of the formwork hauled up on these rods. As the jacks had a stroke of 1¼ inch and pumping of the hydraulic fluid was done every 8 or 12 minutes, the formwork was raised 6 inches to 9 inches per hour on the jack rods.

Owing to slight inequalities in the stroke of individual jacks, there was a tendency for one side of the silo forms to gain on the other and this was continuously corrected by closing the needle valves controlling the flow to the jacks which were gaining. When the forms returned to a level position these needle valves were opened again. There was a tendency also for the silos to swing laterally, this being checked by plumbing to a fixed point on the base and correction was again made by operation of the needle valves as mentioned previously. The rate of jacking was checked on the jacking rods by an instrument man every hour, as this served not only as a check on the level of the formwork, but also on the rate of lift.

Due to shortage of water the curing of the slurry silo concrete was done by painting a plastic solution on the exterior concrete surface, but on the construction of the cement silos a plastic hose with water sprays was hung just below the bottom of the sliding forms to spray on the exposed concrete. This method proved very successful.

In forming the lower part of the cement silos a second circular concrete wall was necessary inside the silo to support the hopper bottoms, and this wall was constructed in a novel manner. The jacks were fixed above the top level of this inner wall and jack rods were threaded through them down to the basement and fixed to an inside sliding form. In this case the jacks were installed inverted so that the rods were hauled up through the jacks, instead of the standard method where the jacks climb up the jack rods. As the jack rods were hauled up, the concrete was placed in the forms in the normal way. This operation also proved very successful.

PLANT EXTENSION

In November, 1955 the company announced that the factory would be extended to double the output of cement. In the original design arrangements had been made for this event, so that adjustments were minor to the existing foundations and buildings. The necessary work involved in the driving of piled foundations has already been commenced.

The additional equipment includes a new travelling crane for the storage hall, a complete new kiln with auxiliary equipment, a new cement mill and a new cement storage bagging and shipment section. The other parts of the cement factory already have a sufficient capacity to handle the materials necessary for the increased output.

CONCLUSION

The work on the cement plant site in Edmonton started in April, 1955 and proceeded without interruption to meet the tight schedule imposed to bring this project to an early conclusion. The weather conditions during the summer of 1955 were ideal for the excavation and concrete work, but with the early commencement of cold weather the construction works were made extremely difficult. By the installation of temporary heating, and concreting with the addition of calcium chloride, the progress of this work was maintained. It was fortunate that this possibility was foreseen, so that a large proportion of the underground work such as sewers, water piping, gas piping, and cable ducts were completed early in the construction program.

The project was under the direction of the Company's consulting engineers, Cimenteries et Briqueteries Réunies of Belgium and their Canadian associates, Kemet of Montreal, who designed the process and supervised purchase of equipment, construction and starting up of the plant. The Company also retained special consultant services of Mr. Norman Edgar and Dr. Stanley of Edmonton. The detailed engineering drawings, specifications and construction management were made by Foundation of Canada Engineering Corporation, Montreal, in conjunction with R. M. Hardy & Associates, consulting engineers, Edmonton, who were also responsible for the original foundation investigation.

The main contractor was Burns & Dutton Concrete & Construction Company, of Calgary and Edmonton, who were responsible for the construction of all the cement process work at the factory site in Edmonton, including civil, mechanical and electrical work. The architects for the plant were Durnford, Bolton & Chadwick, Montreal and their Edmonton associates, K. C. Stanley & Company.

The organization of the professional associates in their particular spheres, together with the excellent collaboration between the contractors' staff and machinery suppliers has been largely responsible for the fast and efficient progress of this project.

The factory is the first venture in Canada of this Canadian company, whose intention it is to maintain production ahead of the foreseeable demand.

Engineering for a New Petroleum Refinery in Montreal

J. Alexander, M.E.I.C.
Refinery General Manager,
Canadian Petrofina Limited

E. Alzner, M.E.I.C.
Chief Estimator,
Industrial Engineering Division,
Canadian Vickers Limited

In September 1955, less than two years from the awarding of the project contracts, the Montreal refinery of Canadian Petrofina Limited went on stream. Although the main refining operations are based on standard practice, the design and construction of the plant presents several interesting engineering aspects, and its operation is exceptional in the degree and extent of automatic control and recording that are incorporated in the process layout.

The basis for design was Middle East crude, which has a high sulphur content (a "sour" crude). The present alternative feed-stock, Venezuelan crude, is also sour. Problems of corrosion and contamination by sulphur products were therefore involved.

The final selection of process units was largely governed by the aim of obtaining the maximum yield of saleable products of high quality and maintaining flexibility of operation to deal with variations in crude feed-stock. Present capacity is based on a throughput of 20,000 bbl./day of crude.

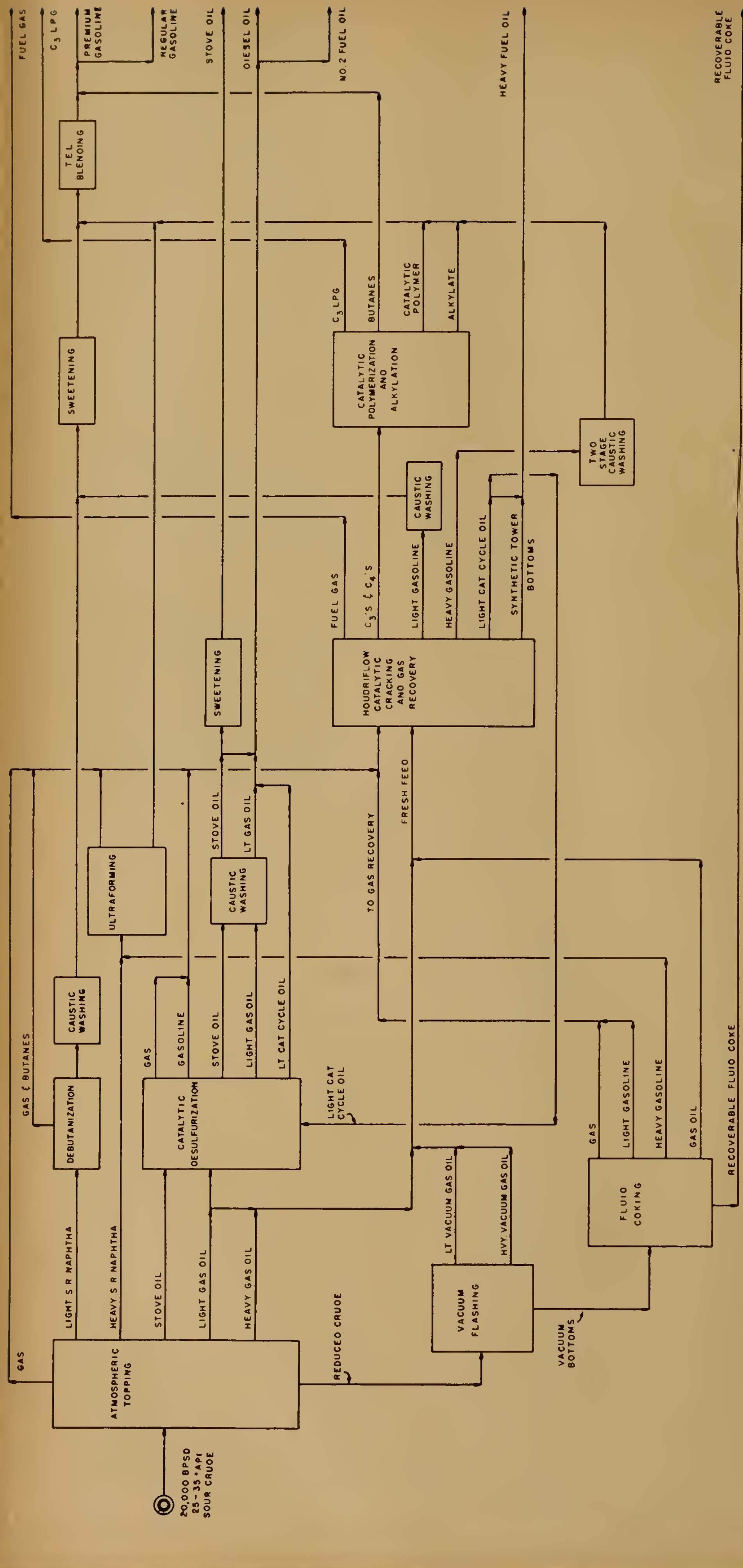
The newest of Canada's major industries, petroleum, has expanded vigorously in recent years. Bulk transportation, by tanker and pipeline, has made feasible the refining of petroleum in convenient marketing areas far from the original sources of crude. A recent addition to Canadian petroleum product capacity is the refinery of Canadian Petrofina Limited, at Pointe aux Trembles, Que., which not only incorporates the latest process and control techniques, but involves many interesting engineering problems.

Basically the process consists of fractionating the crude in a combined topping and vacuum distillation unit, from which the products require such further treatment as removal of sulphur, reforming of certain light fractions to increase octane rating, cracking of heavier fractions to obtain gasoline, and alkylation and polymerization of vapour fractions also to produce gasoline. A schematic flow diagram is shown in Fig. 1.

It is not proposed to discuss the refining process in detail, but rather to bring out the major engineering features of the refinery, including the offsite facilities. To exemplify the construction of the process units, the fabrication and field erection of the catalytic cracking unit will be discussed in greater detail, particularly as the size of this unit (nearly 300 ft. high) posed several interesting problems.

THE PROCESS AREA

The heart of the refinery is the process area, in which are grouped



the main process units indicated in Fig. 1; in area, however, it occupies only a small fraction of the total system. The whole process area was excavated and prepared at one time, although subsequent installation of units in the area was in the hands of two main contractors.

The main process vessels were pre-fabricated in the manufacturers' shops and (excepting the catalytic cracker, which is discussed in detail below) were transported to the site by rail and road and erected by mobile cranes.

To meet the corrosive conditions imposed by sour crudes, fairly extensive use is made of alloy steels, particularly in regions of high temperature and pressure operation.

The bottom section of the crude fractioning tower is clad with 11/13 chrome steel, the middle section of the tower is extra thick carbon steel, and the top three bubble trays are made of Monel. As a further precaution a proprietary material is added to the crude feedstock to give a surface plating effect within the vessel.

Chrome alloys are also used in such places as the furnace tubes on the catalytic reformers; inlet lines to the reformers operating above 600°-650°F. are chrome steel, but below this temperature range are usually of carbon steel.

Similarly, chrome alloys are used in the fluid coking unit for temperatures above 600°-650°F.

Hydrogen embrittlement of steel is liable to occur where hydrogen is present at high pressures and temperatures, and alloy steels are used in vessels under these conditions. The catalytic reforming reactors consist of a separate aluminized steel shroud within an external pressure vessel. Aluminizing is used in regions liable to attack by hydrogen sulphide (present in the reaction phase). The formation of iron sulphide must be avoided in the presence of certain catalysts, which would be adversely affected.

Welded fabrication was largely used throughout. Most of the alloy pipework was shop fabricated, but some of the carbon steel pipe was welded in the field.

Fig. 1. Schematic flow diagram of the 20,000 b.p.s.d. catalytic refinery.

CATALYTIC CRACKING UNIT

Supported by a huge concrete structure, which rests on a massive concrete block embedded in natural rock, the catalytic cracking unit has a main diameter of 24 feet and towers to an elevation of almost 300 feet — the tallest catalytic cracking unit ever built in Canada.

For the purpose of incorporating into a single unit all operations such as recirculation of the catalyst (which is in the form of small beads), the cracking reaction, regeneration of the catalyst by burning off the carbon deposit, and cooling of the catalyst, use is made of gravitational flow. This results in the immense height of the complex vessel.

The intricate internal components of this one-vessel arrangement consist of 12 heads pierced by thousands of catalyst distribution- and transfer-pipes, catalyst distribution screens, and a shell-piercing cooling coil system comprising over 700 pipes.

Some 75 various types of ferrous materials such as carbon steels, low alloy and austenitic steels were used to withstand possible operating temperature well over 1000°F.

In addition to the design complexity, the really great problem in furnishing this refinery unit was that of the field erection — carried out under the particularly severe winter conditions of 1954-55.

Sub-freezing temperatures, the deep snow and high winds of a typical Canadian winter, plus the transportation to the erection site of the shop fabricated assemblies weighing up to 85 tons — one of the largest trucking jobs ever undertaken within the city limits — made this task unusually difficult.

A job of this magnitude obviously has too many details to be included within the space of this paper. There are details of apparently minor importance which, however, when overlooked could result in a serious setback in the course of operations.

Careful and detailed planning was the secret and the key to the successful completion of this project.

The geographical relation of shop to field was opportune—both located in the East end of Montreal. The clearances for transport purposes from shop to field were relatively good, except for a few electric wires which could easily be raised or temporarily removed. It became evident that the most efficient way of handling this project would be to accommodate work as much as possible in the shop and make this project shop pre-assembled rather than field-erected, in the usual sense of the term. From these general considerations the pattern of overall planning began to take shape and continued until the finest detail was clearly laid down.

This pattern of planning may be outlined in its main points.

(1) A study of the vessel structure. This included the sectionalization into a number of sub-assemblies, with due consideration being given to the ensuing problems of shop fabrication, transportation to the site, and assembly at site.

(2) A study of shop-fabrication procedure for individual sections.

(3) A study of method of pre-fitting and pre-alignment of shop completed sections for the purpose of reducing to a minimum costly and difficult fitting operations in the field.

(4) An investigation into the various available means of transportation of the sub-assemblies from shop to the site.

(5) A study of the various lifting schemes, the corresponding equipment, and its availability.

(6) A study of the site (after selecting the most practical erecting equipment) to ensure proper location of the equipment, as well as deadmen, etc.; subsoil survey.

(7) A study of all welding procedures, including pre-heating operations, for both shop and field work.

(8) A study of field working conditions, with special emphasis on maximum accessibility of working area and, for efficient handling of vessel sections, arrangement of work platform, suitable location of welding generator station, propane gas pre-heating distribution system, office and service shacks.

(9) A study of safety precautions and regulations.

(10) A study of the problems presented by test requirement.

(11) Liaison with local weather offices.

Figures 3 to 9 illustrate some of the stages involved in the resultant construction and erection.

Shop Fabrication

The catalytic cracking unit was divided into 18 main sections. Each section was completely shop assembled with all internals, nozzles, etc. in place. The weight of each section varied from 35 tons up to 85 tons. Segments of the heads, up to 1-5/16 in. thick, were heated and shaped by pressing, and assembled by welding together in intricate jigs. The material specified for these heads was in the main chrome-moly steel which requires preheating the weld seams to 400°F. and this problem was solved by incorporating into the assembly jig a con-

Fig. 2. Crude tower, stripper, and furnace. Excavations and forms in foreground for coke unit. Control house at extreme right.

trolled propane gas heating system. This took the form of radially arranged pipes fitted with thousands of tiny burner tips. These pipes extended underneath the seams to be welded. This system was also capable of controlling the required post-heating of welds. Welders worked inside the head from rotating hammocks of asbestos. Temperature chalk was used to check the amount of preheating obtained.

The shop fabrication of the shell-piercing cooling coil system was a most difficult problem. Great skill and craftsmanship were required to comply with the specified close tolerances—uncommonly exacting in plate work. Some 1400 sleeves had to be fitted and welded into the 1½ in. thick shell casing. These sleeves had to be in perfect parallel alignment to each other. The task was also to place each sleeve on the one side of the circular section in perfect alignment with the corresponding sleeve on the opposite shell side. Finally each sleeve had to match with the corresponding holes in a series of flat beams located within the shell in transverse arrangement, which served as supports for the cooling coils. It was indeed gratifying to the boiler makers when cooling coils were introduced into the completed and erected section without the slightest difficulty.

A number of other sections had complicated internal components, such as internal decks pierced by hundreds of welded-in catalyst transfer pipes or other distribution systems oriented to a definite pattern with close tolerances. The alignment requirement of these internals was most severe in order to assure uniform distribution of the catalyst in its downward flow through the various superimposed process zones of the unit.

Much engineering and workmanship went into the so-called catalyst disengager, the top component of the cracking unit. This shop assembly (with the catalyst lift pipe stubs inserted in the withdrawn position for transportation and lift) measured 18 ft. 6 in. in diameter by 70 feet high, and weighed 85 tons. Its internals consisted of an intermediate deck and a series of bellow-type expansion joints into which the 9 catalyst pipes could expand. Needless to say, the transportation of this component, and its erection in a single lift to a height of over 300 feet on a severe winter day was an outstanding event. Though much heavier lifts have been handled in the past, it is extremely rare that a load of 85 tons is lifted to a height such as this.

Prealignment of Sections

All sections before shipment to the field were prefitted and then prealigned by means of transit survey. The relative position of sections one to each other with allowance for a 3/32 in. to ⅛ in. wide welding gap was predetermined and then in this position fixed by the attachment of angle-bolting bars spaced equally around the circumference of the adjoining sections. Fitted bolts were used for these bolting bars, to assure simulation of alignment at field assembly. Prealignment was not carried out only with the intent of reducing the costly field operations to a minimum — it was an absolute necessity from purely meteorological considerations. Sudden weather changes are characteristic for the Montreal area. Especially during the winter season wind speeds might change in a space of only two hours from a breeze to a storm. On account of the heights involved all operations at field were limited to a wind speed of 27 miles per hour. Experts of the Dominion Weather Bureau advised that a guaranteed forecast for stable weather conditions could not be given for a time longer than

Fig. 3. Part of the plate shop during the fabrication and assembly of the 18 main sections of the catalytic cracking unit. Weights of sections ranged from 35 tons to 85 tons.

Fig. 4. Large jigs were built for the assembly of the heads for the catalytic cracking unit. Welders worked from rotating asbestos hammocks inside the head. Seams were pre-heated by controlled propane burners, of which a closer view is seen in the left-hand picture.

one to two hours. It was, therefore, clear that sections would have to be raised, placed and secured against high winds within this available time limit. In view of these uncertain weather conditions, the shop prealignment program proved invaluable. The complete operation, including lifting and securing each section for welding, in no instance took longer than 45 minutes.

This ease of field assembly prevented a serious setback on the occasion of the second to last lift. Immediately after securing this particular section, the wind velocity increased to 45 miles per hour.

Transportation

Transportation of sections from shop to site was carried out during low traffic hours at night and early morning under police escort. Low bed trailers from 50 to 120 tons capacity were used which deposited the sections directly beneath the derrick.

Lifting Equipment

The unique features and principles incorporated in the main guy-wire derrick used for this erection job were of great interest.

After an extensive search for a lifting rig that could handle this work, a derrick was acquired from western Germany.

This derrick is of the Meccano-set type and can be assembled into a variety of forms to suit special job conditions. For the Petrofina project components were assembled into the form of a huge guy-wire derrick of an overall height of 427 feet. The cross section of the main column was 6 ft. 8 in. square; the guyed mast, 215

Fig. 5. The 1½-inch shell of the cracking unit had some 1400 sleeves fitted and welded to stringent tolerances, to accommodate cooling coils. Several complex welding jobs were involved in fabricating other internal components (such as the deck in the top picture) to close tolerances.

feet long, stood in a ball joint on a reinforced concrete block embedded in natural rock. The boom, 185 feet long, had a cross section of 3 ft. 4 in. square. Provision was made for heavy lifts on an eight-fall hook and a separate arrangement for light and fast lifts. The bullwheel, 33 feet in diameter, arranged at the base of the mast, carried on its platform all operational equipment, consisting of four electric winches, a special mechanism for swinging operation, and a control room for housing the electric controls, recorders and operating crew. The heavy lift system was hooked up to two 12.5 ton winches and the fast lift to a 7.5 ton winch. Movements of the hook for heavy lifts could be controlled to ⅛ in. accuracy. Ladders within the derrick structure with landing platforms every 28 feet lead from the base of the derrick to both tip of the mast and tip of boom for maintenance purposes.

The guywire system was hooked to a series of winches located on 4 deadmen, each a concrete block 20 feet square embedded 13 feet deep into natural rock. The winches served for the adjustment of the required prestress in the guywires. Such adjustments had to be carried out periodically and especially in cases of sudden temperature changes. The amount of prestress (10 tons) was checked by means of special hydraulic jacks.

Erection of the derrick was in itself a rigging job of considerable proportion. On the ground, preassembled sections of the structure were raised and set in place by means of an auxiliary creeping mast. The boom was a single-lift operation. Under most adverse weather conditions erection of the derrick was completed within 35 working days.

Derrick Placement

The selection of a suitable location for placement of a derrick of this size in the midst of a site, which in its final stage of erection would become a most crowded set-up (typical of refinery construction) was a matter of prime importance. Besides considerations of the most efficient handling in a certain sequence of all lifts at various reaches and corresponding load capacities of the derrick, further thought was given to locating the equipment (also the deadmen), so as not to cause an obstruction in the final phase of erection. It was later discovered. that a small deviation of a couple of feet only from the actual derrick location would have caused a considerable delay in the overall refinery erection schedule.

Welding Procedures

On account of the various types of materials involved, elaborate welding procedures had to be prepared. Welding operators had to be qualified involving numerous tests for various positions. Especially the welding of dissimilar materials, particularly of stainless steel clad, chrome-moly and chromium alloy steel to carbon steel called for special attention to technique and procedure. Preheating problems in field at sub-freezing temperatures were successfully solved by means of specially designed propane gas heaters. A total of over 10,000 feet of welding was completed without a single case of repair.

Some Notes on Field Erection

As already stated, shop-fabricated sections were hauled directly underneath the derrick. Heavier sections—weather conditions permitting—were lifted directly from the trailer and set into place. Lighter sections were unloaded on to the work platform secured together and welded while on the ground. This procedure kept the number of lifts as well as the number of high altitude welding operations to a minimum.

Scaffolds were fastened to the sections before lift. Rope ladders were mostly used from scaffold to scaffold. For work at higher altitudes crews were usually lifted in a specially designed cage by means of the derrick. Specially laid out tents of fireproof tarpaulin were fastened around the scaffold platforms at levels of the circumferential joints for protection of welders and the weld joint against the weather.

Routine checks of plumb of the vessel during assembly had to be carried out in cloudy weather, or before sunrise in days of fair weather, in order to assure uniform temperatures within the shell wall. The temperature differences, and consequently uneven expansion introduced in the shell wall through radiation from the sun, are of sufficient magnitude to cause deviations of nearly 5 in. from the true horizontal measured at the top of the vessel.

Safety Measures

Tight overalls, safety belts, and safety hats were worn throughout by the field crew. Loose parts and tools were removed from scaffolds and platforms as soon as these were not longer required. The job was carried through without a single accident.

Tests

The process vessel was built in conformance with the A.S.M.E. code for unfired pressure vessels. Gamma-ray examination of welds were periodically carried out and

Fig. 6. The catalyst disengager, 70 feet long and 18½ feet in diameter, presented a major transportation problem. This unit and other components were carried by low bed trailers (up to 120-ton capacity) and deposited below the lifting derrick.

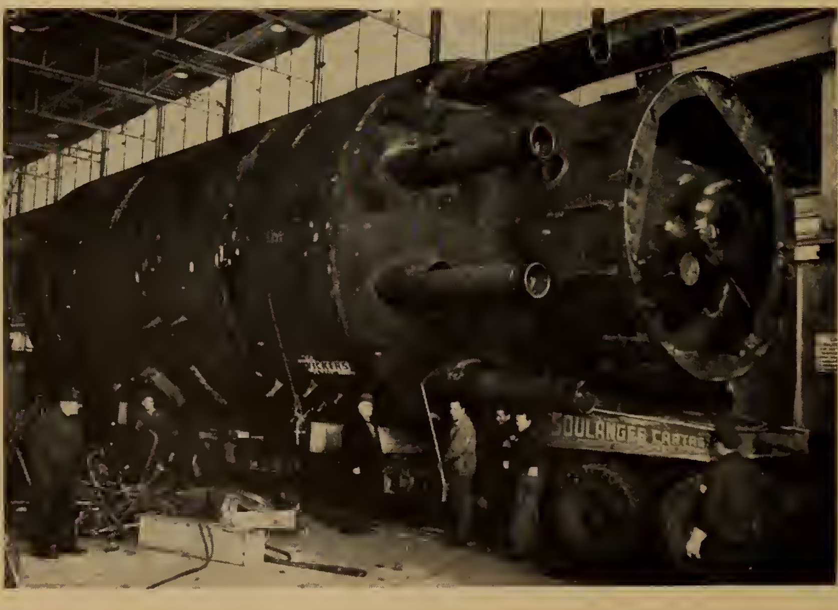


Fig. 7. The 85-ton catalyst disengager nearing the top of the cracking unit.

Fig. 8. The top unit of the catalytic cracker, the 85-ton catalyst disengager, is finally placed in position after a single lift of over 300 feet.

recorded in special log books. In general one or two shots per week on each welding operator's work served to keep a close control on weld quality. Welds in the reactor portion were fully X-rayed to assure highest quality of joint. These examinations, besides pneumatic, hydraulic, and hammer-tests, to which individual portions of the vessel were subjected, formed the basis for the final acceptance of the completed tower.

A notable operation in this connection was the hydraulic test in a single procedure of the regenerator portion, extending between elevation 37 feet and 107 feet. The required test pressure at elevation 107 feet of 17 lb./sq. inch meant—on account of the hydrostatic head—a pressure of 48 lb./sq. inch measured at the bottom head (24 feet diameter). This pressure introduced into the head stresses which at critical points came close to the yield strength of the material. The admissible deflection before yield was calculated, and measured under actual test as a safety precaution. At a total actual deflection of 11/16 inch calculations proved to be within an accuracy of -1/16 in.

Other safety measures for yield-observations were applied, such as white-washing the head at critical points. Pressure tests were carried out at near to freezing temperatures. Over one million gallons of preheated water had to be pumped into the vessel. Temperature recorders were arranged to measure the outside skin temperatures of the shell at different points during test.

Liaison with Local Weather Bureau

Arrangements were made with the weather bureau at Dorval for the supply of detailed weather information at short notice—especially with regard to changes in wind speeds. Such information was of vital importance for the safe disposition of all field operations. As already stated, all operations at height had to stop at wind speeds over 27 miles per hour. A number of precautionary measures had to be taken before wind speeds would increase to such values: The derrick had to be set into its resting position: the bottom had to be withdrawn to its steepest position pointing into the direction of the wind, the hook had to be lifted to its highest position, winches and various cables had to be secured and all crews had to descend from the derrick platform and the tower in safe time. In many instances there was not much time left. No heavy lift was started before assurances of stable weather conditions were obtained. It would be a serious omission to mention the invaluable services rendered by the weather bureau in this respect.

AUTOMATIC CONTROL

A feature of the refinery is the use of one central control room for all eight process units and the installation of a single automatic logger which covers the complete process plant and can record up to 480 operating variables.

All refinery units are coloured in accordance with a code used to identify different products; in general, dark colours for heavy products (coke, crude, etc.), and light colours for light materials (vapours, air, steam). This colour code is reproduced exactly on a graphic panel that lines the wall of the control room and depicts the entire refining process. The graphic panel incorporates all the operating and control instruments (of the "miniature" type) and uses symbols rather than words to simplify the operator's grasp of the presentation.

Purely informative instruments are grouped in consoles, which can be seen in the general view of the control room (Fig. 10).

Completion of the automatic logger will abolish the written operating log which is usually recorded by the operators, and is always subject to human error, especially during periods of emergency or rapid change. Data are received either on electronic or pneumatic instruments and are converted for use by the logger. For example flow (time-rate) data are continuously scanned and are converted by a computer to volumes.

At pre-set intervals the logger can automatically record up to 480 variables on an automatic typewriter. Punched tape storage and a tabulated digital log are produced simultaneously. A recording cycle is also started (and an alarm sounded) if conditions become abnormal, in which case any abnormal values are distinguished by being recorded in red. The operator may manually start a recording at any time he wishes.

The tabulated log is set out on prepared forms designed for operating requirements and colour coded for easy identification.

Eventually, feed-back from the recording instruments could be used to obtain automatic correc-

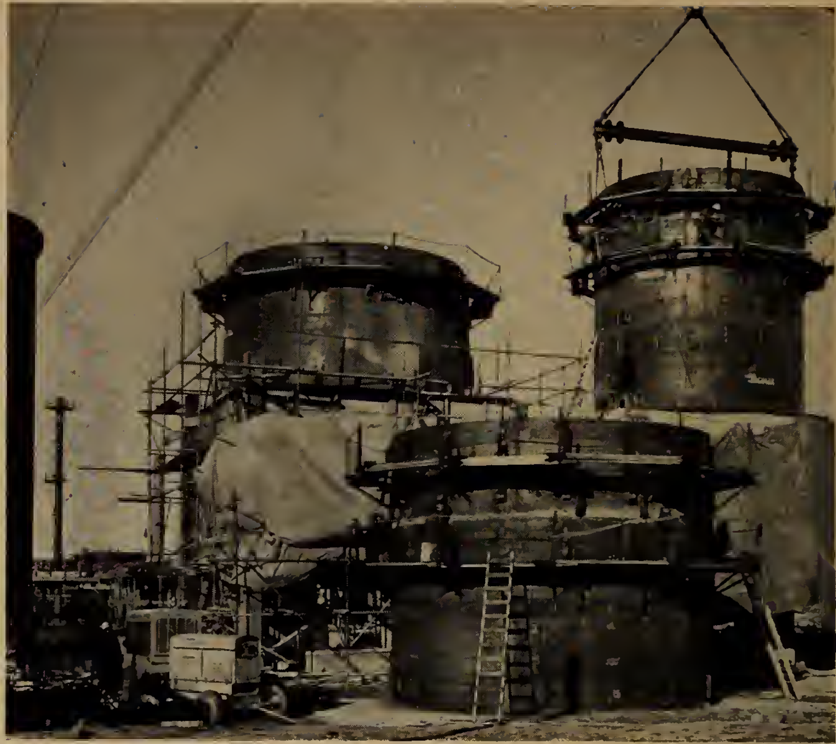


Fig. 9. After being transported to the site, some sections of the cracking unit were assembled on the ground and welded before being lifted into position. This reduced the number of lifts and minimized high altitude welding. Scaffolds were fastened to the sections before lift.

Fig. 10. Interior of the control house, showing the graphic panel, lining the walls, and the separate instrument consoles. The panel is coloured to correspond with a colour code that is followed on the actual refinery vessels and pipes.

tion of process conditions and to achieve almost fully automatic control.

Pneumatic control is used for nearly all processes except high-temperature measurement. Pneumatic lines, mostly of ¼-in. copper tubing, are laid between the control room and the process units as "multi-tubing" or multi-stranded tubes in units of 6, 12, 24, etc., made in the form of a cable and run in ducts in the same way as pipe or electrical conduit. This multi-tubing has previously been used only in one other Canadian refinery.

The panel board was entirely pre-fabricated by the manufacturer and shipped in sections to the control room. Despite the great complexity of the piping and wiring involved, no undue difficulty was experienced in assembling the complete panel and joining the sections.

A specific example of the automatic control provided is the time cycle for operation of the catalytic reformer. This unit includes four reaction vessels, of which three are operating while the fourth is cut out for regeneration; the vessels are cut out in turn, on a definite time cycle, by electrically-operated 6-in. positive shut-off valves. These valves are fully interlocked and are controlled automatically for correct operation and to avoid any possibility of introducing oxygen into the process, which produces a high proportion of hydrogen. The positions of the valves (open, mid-way, closed) are indicated by lights on the control panel.

Skin temperatures of high internal temperature insulated vessels, such as the reformer, are recorded as a check on their internal condition, defects in the insulation being shown up as excessively high skin temperatures.

SERVICES AND FACILITIES

Because of its cheapness, electric power is used primarily for driving compressors and other heavy equipment throughout the process, only essential services being spared by the use of steam-driven units.

The main supply from Hydro-Quebec is by two 12-kv. feeders to the main sub-station, where two 7500 kva. transformers, each dealing with half the plant load, convert the supply to 4160 v. This 4160 v. supply is distributed by individual circuit breakers to all process and off-site facilities. Further reduction to 550 v. is also made at off-site substations and at process units, and lighting is provided at 120 v. Supply is duplicated, with automatic switch-over in case of failure.

Some 200,000 lb. of steam an hour are required for full operation. Of this, most is provided by two 80,000 lb./hr. boilers fired by gas or fuel oil, and the remainder by process steam from the exothermic reaction in the catalytic cracker (some 40,000 lb./hr.).

Boiler feed water is pre-heated in process cooling exchangers to about 150°F.

Supply and make-up water are obtained from the St. Lawrence river via an intake flume. A closed recirculating water system is used, water from process units being passed through a 27,000-bbl. storage tank and cooling tower basin. The storage tank also acts as a fire-fighting water supply. Any oil contamination is removed by an API separator. Water from the cooling tower is circulated at 22,000 gal./min., for which 800 h.p. is required.

EFFLUENT

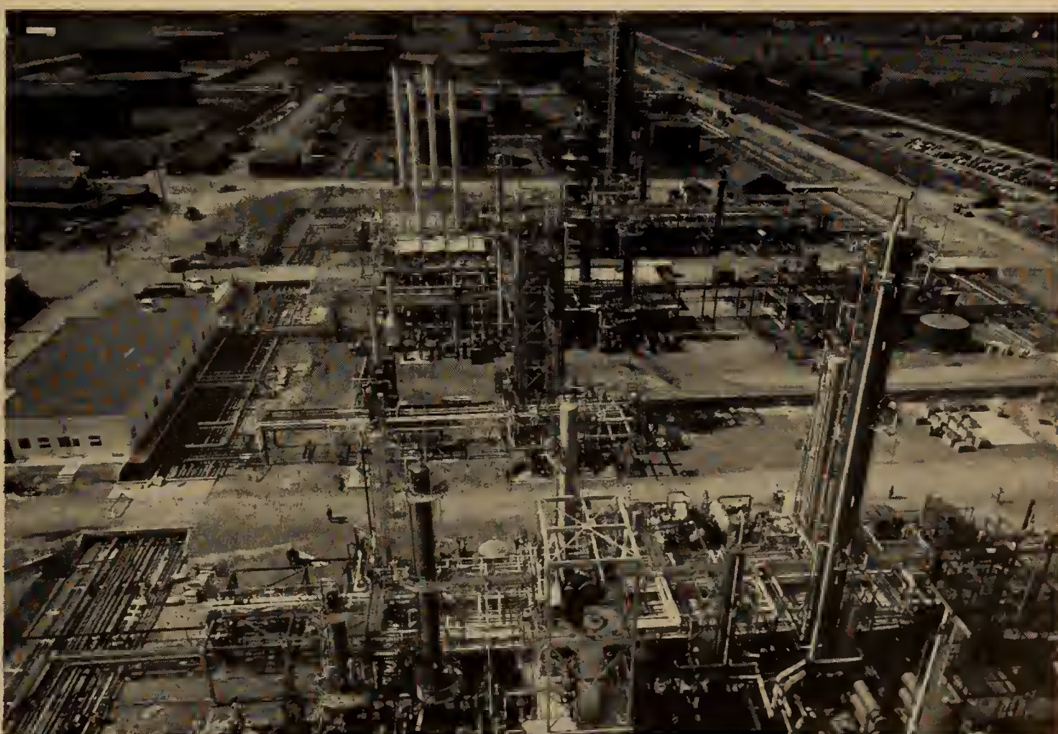
Since a closed water circuit is used, most of the effluent from the site comes from surface drainage. However, precautions have to be taken to avoid contamination from certain areas.

Where process acid is used, acid-proof paving is laid and any spillage is neutralized with caustic before dumping to sewers. Similarly, spent caustic is also neutralized.

The oily water sewer leads to an oil separator, which is in series with a holding basin provided with a surface skimmer; the holding basin also gathers some run-off from other areas.

Waste gases from process are passed to the flare and burnt.

Fig. 11. The central control house (left) serves all the process units, some of which are seen here. Alkylation and catalytic polymerization unit in foreground; hydrodesulphurization unit; ultraforming and acid treating; crude treatment units at far end of process area, beyond which are the crude tanks. Pipe runways are seen flanking the process area.



STORAGE AND MARKETING

Crude oil is brought in by tanker or by pipeline from Portland, Me., and stored in six 150,000 bbl. tanks which are provided with heating coils. Products are stored in a series of tanks with capacities of 150,000, 80,000 and 27,000 bbl.

Tanks for light products are interconnected and have vapour domes; the roofs of volatile product tanks are painted white to reduce radiant heating. Process rundown tanks for volatile ends are linked to a vapour sphere. Contrary to more common practice, tanks are painted with high quality materials and given an enamel finish. Despite the relatively high initial cost, it is anticipated that the resultant long paint life (5-7 years) will prove economical in the long term.

Provision is made for in-line blending of lead and colour into gasoline, so that, for example, a ship may be loaded directly from process tanks.

There are some 13,000 feet of rail siding, one of the longest commercial installations of its kind, extending along one side of the tank farm, with spurs for lubricating oil receipts and shipments, and spurs to process and other areas for receipts of such materials as catalyst, process acid and caustic, salt, T.E.L., and warehouse stores. Rails were laid on continuous columns bearing on rock some 2-3 ft. below the surface, and special clips were used for anchoring the rails.

Road tankers are supplied with products in a separate marketing area; products can be taken on at 550 gal./min. One man can control all deliveries from a central room in the tanker-supply area; the invoice for the delivery is printed automatically in this control room. Deliveries from storage are automatically remotely controlled.

Railbed and pavement in both the rail and road delivery areas may be heated in winter by subsurface pipes through which is circulated light oil preheated by steam in an exchanger.

GENERAL CONDITIONS

Excavating cost and time were high because of the prevailing rock base in the area. Some 120,000 yd. were removed, mostly by blasting, to prepare foundations, trenches, sewers (to a depth of 20 ft.) and even for line poles. The refinery is designed to meet earthquake conditions.

One of the main aspects to be considered was the cold winter weather encountered in Montreal. The heated pavement in delivery areas mentioned above is one result of these considerations. Particular attention had to be paid to insulation of process and steam lines and heating certain storage tanks; steam-tracing is widely used, but is replaced by electrical heating for some above-ground process lines.

The Houdriflow unit and the vapour recovery and desulphurization units were contracted to Lummus Company of Canada (with Canadian Vickers Limited fabricating and erecting the Houdriflow cracking unit); the Canadian Kellogg Company was responsible for the remaining process units and all the off-site facilities.

Fig. 12. Behind the tank car loading rack (lower picture) can be seen one of the vapour dome tanks. Delivery from storage to outlet is remotely controlled, both for rail shipments and at the road tank truck loading rack (top picture). Loading areas can be kept free from ice and snow by buried heating coils, carrying light oil heated by steam in an exchanger.

DISCUSSION

of Technical Papers

The Professional School in the University

by

Dr. C. T. Bissell, Vice-President, University of Toronto.

The Engineering Journal. February 1956 issue, page 131

R. M. Hardy, M.E.I.C.[1]

It was a privilege for me to have had the opportunity of hearing Dr. C. T. Bissell, vice-president of the University of Toronto, address the annual dinner of the Engineers' Council for Professional Development in Toronto in October 1955 on the subject "The Professional School in the University". One could not help but be impressed by his insight into the problems of professional education and the difficulties of imparting knowledge in specialized fields while attempting simultaneously to foster intellectual qualities of the mind. His remarks were addressed to a group who in general were well aware of the wide divergence of opinion on many of the points discussed, and were most conscious of the inherent difficulties in attempting to formulate policies providing a satisfactory compromise of such differing views. Dr. Bissell's comments were admirably provocative to this gathering, but it is unfortunate that the nature of the meeting did not permit discussion of the several most controversial points he brought forth.

In reprinting a condensed version of his remarks in the February 1956 issue of the "Journal" you comment editorially that it "will be of interest to all engineers, but particularly to those not long out of college". My concern is that many of this group will not be aware of the controversial nature of some of Dr. Bissell's comments, and that strong opposing opinions are held by many, both within and without the Universities.

If one goes back to the original reports of the committees whose studies led to the current practice of dispersing the general educational content throughout the curriculum, it will be found that the recommendations were arrived at only after very careful consideration of the relative merits of pre-engineering years. The practice in pre-medical and pre-dental education was available for evaluation. The decision in favour of dispersion throughout the professional course was arrived at, not so much because of a reluctance to extend the formal educational period, but rather because of the considered opinion that if courses in the humanities were to serve their best purpose, they were better integrated as closely as possible with the technical content of the professional curriculum.

Courses in the humanities and social sciences of a post graduate nature to be taken after a period of experience in professional work are an interesting possibility. However it is difficult to see how in fact they could become available to more than a very small percentage of engineering graduates. Therefore they could hardly be considered as an adequate substitute for a general educational program properly integrated into the formal curriculum of all engineering students.

Dr. Bissell also deals with the merits of technical institutes as a means of meeting the increasing requirements for technically trained personnel, and as an expedient for relieving the pressure on university facilities. While he acknowledges that professional education must emphasize the "know why" as opposed to the "know how", he also subscribes to the British concept that "The difference between the two types of institution is not in status or grade, but in kind". The technical institute is primarly concerned with the "know how". It is therefore difficult to conceive how these two conceptions can be compatible.

One, of course, may argue that the contribution of the "know hows" to the functioning of our economy is equal to and just as essential as that of the "know whys". But both cannot satisfy an acceptable definition of "professionalism". Moreover one can scarcely justify extending this equality to include factors of edu-

[1]Dean of Engineering, University of Alberta, Edmonton.

DISCUSSION

The editor invites discussion of papers appearing in the *Journal*.

Readers may contribute to this section by sending appropriate comments to the *Journal* office.

cational background and quality of mind. It is the confusion of thinking on this point that is responsible for the continual pressure on the professional organizations on this continent to recognize purely technical training as meeting the requirements of professional education.

Dr. Bissell undertook to speak for the universities in reserving to them the final decision in educational matters, and in expressing suspicion of the value of the system of accreditation of professional engineering curricula presently practised by our American friends. It is on these questions that I would take greatest issue with him.

Authority for Curricula

He sets forth the principle that, "The final decision about university policy must be made within the university, by men and women who have devoted their lives to education and who are in a position to see the ramifications throughout the whole university of a policy shift in one of its parts". One must certainly give Dr. Bissell credit for a statement that in its philosophical neatness is at least the equal of the "mathematical neatness" he ascribes to the conclusion of engineering educators that one-fifth of a curriculum should well be devoted to general educational courses. An intriguing picture is suggested of a group of dedicated university administrators thoroughly ensconced within their ivory tower, concerning themselves with the interrelationships of faculties and schools and serenely oblivious to external pressures, financial or otherwise—truly an academic paradise. Unfortunately, as a generalized conception of university administration, particularly amongst the provincially financed universities, it is a fact neither in theory nor practice.

The final authority in most university administrations is a board of governors and/or a senate, or their equivalent. In the case of provincial universities these bodies in turn, at least in financial matters, must conform to the policies of the current government of the province. Frequently the members of these governing bodies are men or women who are devoting their lives to education, but they also frequently are publicly minded, well-meaning and capable citizens frankly representative of specific economic, religious or political groups. Rarely are those who are devoting their lives to education more than a small minority, and even more rarely is a specific profession represented on these bodies.

It is seldom that any major change in curriculum or policy in regard to facilities or quality of teaching staff does not have its financial aspects. As an example, consider a proposal to add a course in English to a first year class of 350 students in a faculty of engineering at a provincial university of say 4,000 enrolment. It may require four new instructors in the department of English. It certainly has a disrupting effect on the existing interrelationships of faculties and schools, but unfortunately these may be largely irrelevant to the basic problem as to whether it is desirable to expose this group of students to the new course. However assuming these internal disturbing influences are finally reconciled the proposal must still run the gauntlet of a provincial legislature in competition with demands for increased funds for a host of purposes including roads, bridges, buildings, other areas of education, the sick, the mentally infirm and the penal institutions. If the democratic process functions as it should under these circumstances surely the final decision will be made on the basis of the general public benefit with its effects on the internal balance within the university very much of a secondary consideration. Again, if the democratic procedures are to properly function those with the final responsibility may be expected to need and to welcome reliable and informed opinion on the merits of a policy. Where better can these be forthcoming than from a professional body dealing with a subject of special concern to its welfare and dedicated to manage its affairs in the best public interest?

Dr. Bissell points out that professional education has been a responsibility of universities since mediaeval times. There are examples of universities coming into being as an outgrowth of training offered at a center by a particular professional group under its own responsibility. It is a moot point as to whether the universities can rightly claim more than trusteeship for professional education and for the body of specialized knowledge upon which the practice of a profession is based. One needs only to consider the national or provincial examinations in force in such fields as accountancy, surveying and medicine to appreciate that all professions do not grant complete trusteeship of educational requirements to the universities. A similar situation exists in some cases with facilities. The mere suggestion that a hospital used for medical instruction purposes no longer conforms to a certain minimum standard as rated by the medical profession rightly becomes a matter of grave public concern rather than a problem of the interrelationships between schools and faculties within the university.

Accreditation in Canada

No Canadian university has to date officially used the American accrediting system in rating their engineering curricula. However the boards of examiners of the various professional engineering associations do find it most helpful in assessing the educational qualifications of American trained engineers. As bitter a "pill" as it may be for a university administration to have to accept recommended curricula and certain minimum standards for facilities and academic staff or risk "academic ex-communication", it scarcely is more severe than to condemn in their ignorance a potential group of embryo professional engineers to a sub-standard educational background.

The engineering profession in Canada relies completely upon the universities for the standard of engineering education, but the universities have no inherent right to the responsibility. If one grants that they hold it in trust for the profession they surely should not be adverse to an accounting of their trusteeship, nor should they be adverse to accepting cooperation, well informed criticism, suggestions and recommendations from the profession. In my judgment the best interests of professional education in engineering will be best served by as close cooperation as possible between the universities and the engineering profession; and if they will be better served by accreditation, then let's have accreditation.

ABSTRACTS . . .

OF RECENTLY PUBLISHED ENGINEERING LITERATURE

DOES FULL MECHANIZATION PAY IN LOW-VOLUME PRODUCTION?

Joseph Cooper, *Iron Age*, v. 176. n. 26, December 29th, 1955, pp. 70

Standards people sometimes raise dubious eyebrows at the thought of applying automation techniques to any but mass production lines. Yet, this fully mechanized metal treating line fully paid for itself in a year, despite irregular production and low volume.

Results so encouraged a paper machinery manufacturer that the firm now phosphate coats many components previously painted. Money previously spent in shipping the material elsewhere to be surface treated is sufficient to pay the entire cost of the operation.

A side benefit showed up when the mechanized line proved so efficient that open production time became available. Lodding Engineering Corporation now phosphate-coats many other paper machinery parts that formerly were painted. In addition to cutting manufacturing costs, the coating provides added protection.

To realize the benefits of full automation, all heating tanks are designed with covers that lift during the loading cycle. Immersion time is controlled by accurate timers. Fluid is kept at a predetermined level by a float and solenoid-operated valves. No operator is needed once the process starts.

The automated line employs microswitches, timers, and solenoid valves to guide the material through its various cycles. A master push-button starts movement of the load over the first tank. There a microswitch stops it in the correct position. When the microswitch holding circuit for forward movement is broken by a timer, a contact is made simultaneously that starts downward motion.

The only other controls required are two solenoid valves to initiate flow of water in the rinse tank when the load stops directly over it. Water continues to flow until the unit is moved to the next tank.

Manual operation of the treating line is accomplished by means of push buttons. The buttons bypass the automation mechanism.

The entire installation costs considerably less than one year's bills for phosphating from the previous outside sources.

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NUCLEAR ENERGY TODAY

L. N. Rowley and B. G. A. Skrotzki, *Power*, v. 99, n. 12, December 1955, pp. 73-101.

Nuclear plants are taking concrete form and will soon be feeding kwhr into major utility systems. Thus it seems a good time to see where this new energy source stands today and what the future holds.

This special report does just that. After a brief review of fundamentals it plunges directly into a roundup of developmental and commercial-scale nuclear projects—what the equipment looks like, what advantages are claimed for various designs, what problems remain.

This, then, is the nuclear-energy picture at year end 1955—as we move out of the laboratory and experimental phase into what might be called the "hardware" stage. From the experience gained with these plants, and with others just a gleam in some reactor designer's eye, will come the economically competitive nuclear plants of the future.

All the heat we use comes from converting solid matter to energy. The amount of matter that disappears as energy in our ordinary fires weighs so little that we never miss it. For instance, one pound of any kind of matter equals a total of 11.3 billion kwhr or 38.6 trillion Btu of energy.

This means that when we get 14,000 Btu from burning a pound of coal, less than one billionth of a pound of the coal disappears in converting to the heat produced. No wonder we never are aware of this process.

About 150 designs have been proposed for steam-generating power reactors. We will look at just a few to understand the basic principles. Thermal reactors use moderators to slow the high-speed neutrons to a level where they react more readily to fission U-235. Such reactors, fueled with natural uranium or uranium slightly enriched with U-235, must use moderators. On the other hand, fast reactors fueled mostly with U-235 need no moderators.

In addition to graphite, we can use heavy water as a moderator for natural uranium, or light water for enriched uranium. Thus, water can do double duty—act as (1) moderator and (2) as a coolant to carry heat out of the reactor core.

In a nuclear power plant, the reactor and its coolant circuit replaces the steam boiler of a conventional power plant. As you might suspect from the elementary circuits the nuclear reactor has auxiliaries like other main power equipment. The auxiliaries have familiar forms and parts — but some have radically new designs and jobs.

One of the striking features of nuclear power plants will be large tanks or containment vessels completely sealing the reactor and the coolant circuit. These guard against radioactive gases from a reactor or coolant-circuit accident spreading through the plant and vicinity.

Most of the reactors built and operated to date have been research or experimental units, designed to test nuclear effects on materials or to check the safety and performance of new reactor ideas. And new ideas keep coming along — consider the variety of materials available as fuels, moderators, and coolants, and the number of forms in which they can be used. With so many possibilities, it can be seen that the search for desirable power-reactor types would be a herculean task if each were investigated on a large scale.

The pressurized - water reactor fueled with slightly-enriched uranium uses light water as both moderator and coolant. This reactor may be classified as a thermal, heterogeneous type. The fuel elements and control rods making up the core mount in a pressure vessel. A pump circulates the water through the core and vessel to an external heat exchanger. These form a closed circuit.

Like the PWR's just covered, the boiling-water reactor also uses light water as coolant and moderator, with solid fuel elements. It differs from the pressurized-water reactor, however, in that steam is generated in the reactor vessel and goes directly to the turbine generator. There is thus only a single loop, no heat exchangers, and reactor pressure is essentially the same as steam pressure. This permits a higher thermal efficiency for a given reactor coolant temperature than with a PWR.

In the dual-cycle unit boiling is limited to a short upper section. At the core exit, per cent of steam by weight may be of the order of 3 per cent. The 600-psi steam formed in the reactor goes to steam-separator drums for moisture removal and then directly to the first turbine stage.

Now we come to a reactor type using graphite as moderator and liquid sodium as coolant. The liquid-metal system permits high temperatures without high pressures. It thus offers the possibility of steam-cycle efficiencies like those of modern conventional plants.

The nuclear "dream cycle" was described by Dr. L. R. Hafstad, former director of reactor development for AEC, as "a pot, a pump, and a pipe". The homogeneous reactor aims at this ideal of simplicity. As the name implies, fuel, coolant and moderator (if any) are combined in a solution, slurry, or metallic fluid.

It is certainly too early to say which of today's reactor types hold most promise for the future. Or even whether tomorrow's reactors may not stem from concepts not yet explored. One thing can be said with assurance, however: The years will be as exciting for power men as those when electricity was first coming into use. And they should be as fruitful of developments beneficial to all mankind.

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A STUDY IN HIGHWAY FINANCING

R. A. Draper, *Roads and Engineering Construction,* December 1955, pp. 62.

The inescapable results of greatly expanded post-war roadbuilding programs are the many difficult questions of finance: what methods governments should use to pay for new and reconstructed roads and streets, and how the financial burden will be distributed among road users and the general public.

A recent study by the Canadian Tax Foundation, of Toronto, entitled "Taxes and Traffic," is the result of two years' work by the staff of the Foundation and does much to rectify these shortcomings. It takes a substantial stride in bringing into focus the elements of road fiscal problems.

Growth has now reached the point, "Taxes and Traffic" notes, "where the financing of roads, streets and highways now represents one of the major problems of local and provincial finance."

By levels of government, the provinces accounted for 68 per cent, municipal governments for almost 28 per cent, and the federal government for less than 4 per cent.

A great deal of the money required for highways, roads and streets has come from the road-user in the form of gasoline taxes, license and registration fees, etc.

In the years from 1930 to 1953 the federal government collected $1,770 million from the sale of motor vehicles and related products.

For the years 1930 to 1952 federal road expenditures totalled $175 million, some 10 per cent of estimated federal revenue during the same period.

Roads and streets are becoming "a progressively greater drain" on the budgets of the provinces and municipalities, "Taxes and Traffic" states. In the current year provincial net current and capital expenditures for roads, highways and bridges are estimated to account for 27.6 per cent of provincial budgets, ranging from 37.8 per cent in Alberta to 19.5 per cent and 19.7 per cent for Saskatchewan and British Columbia, respectively.

The Foundation sees no prospect of a let-up in the number of automotive vehicles coming onto the road.

A general lack of planning for future building of highways and streets is pointed out by the study.

"It is evident that a comprehensive statement of the future financial requirements for roads, streets and highways is not now available. This fact in itself is an indication of the lack of study in the past of the all-important implications of the subject."

Comprehensive studies, predicted upon present and estimated future traffic conditions, should be made to determine on a long-term basis, our total road and street needs. At least two approaches should be considered—the modernization and rebuilding of existing facilities to permit maximum use of our present plant, and the provision of new facilities to supplement and complement existing roads and streets.

Broad studies are necessary to establish the relative responsibilities of motor-vehicle users and other taxpayers towards the various classes of homogenious roads and streets.

Allocation of the motor-vehicle users' share of total outlays for roads and streets should be in accordance with principles that distribute costs to the various classes of vehicles on an economic basis.

The present basis of taxation of private, and public, motor carriers should be reconsidered.

A system of provincial aid for municipal road and street programs should be predicted on a basis which conforms closely to responsibility and need.

Responsibility should be assumed by provincial governments for street extensions of primary highways and other arterial city streets where the motor users' responsibilities substantially exceed 50 per cent of the total, with compensating adjustments to the other grants-in-aid for road and street purposes within the municipality.

There should be acceptance of responsibility for development of roads as a general charge on budgets.

The federal role in roads of national importance should be reexamined.

In most provinces increases in gasoline taxes or motor-vehicle licenses are warranted if the present relationship between user revenue and road and street outlays is valid for the future.

The adoption of the toll-road principle is justified for economically feasible projects if required roads cannot be financed in the usual manner and when not inconsistent with broader governmental action.

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AIRBORNE GEOPHYSICS IN CANADA

Canadian Mining Journal, v. 76, n. 12, December 1955, pp. 43-48.

Like all new inventions, airborne geophysical instruments required dramatic demonstrations before their value was recognized. What Marmora and New Brunswick did for the airborne magnetometer in Canada, The International Nickel-American Metals find in New Brunswick did for airborne electromagnetic gear. The airborne scintillation counter is still awaiting its fulfillment. By putting all three of these devices in the same aircraft, their usefulness is compounded, and the shock of expense softened.

Obviously, the chief reason why airborne methods are particularly suited to Canada is because of the vast expanses over which ground transportation is archaically slow and expensive. Along with the study of aerial photographs and reconnaissance geological information from government maps, information is acquired without the necessity of showing one's hand by staking and attracting competition to the area.

The airborne magnetometer records the magnetic effects of the underlying rocks and is unaffected by overburden or water. Different types of rock have different magnetic effects and thus an aeromagnetic map can be regarded as a specialized type of geological map.

There is still room for considerable improvement in the use of the airborne magnetometer. If costs could be reduced and if lightweight instruments could be developed for use in small aircraft, more of the "tree-top" type of survey would be done to replace ground work. It is on the interpretational side, however, that there is most need for improvement. In the meantime, there is every reason to believe that the magnetometer will continue to be used as it is now — for assisting mapping and for prospecting for iron ore and magnetic pyrrhotite.

Many proponents of airborne geophysics have recently transferred their affections from the airborne magnetometer to the airborne E.M., not because they are dissatisfied with the performance of the airborne magnetometer but rather because they are dazzled by the successes airborne E.M. has had in its short history. Thus airborne E.M. and E.M. in general is considered to be a direct method for locating base metal deposits.

There is evidence already that airborne E.M. will also have possible uses as a means of obtaining geological information under overburden. The history of the airborne scintillation counter in Canada has been fairly well documented. On the whole it has been a disappointment in Canada, especially in the Canadian Shield. In the six years of use, only about fifteen uranium occurrences out of five thousand or more known in Canada were discovered with the airborne scintillation counter. None of these fifteen has proven economic.

With the decrease in costs which will follow the development of lighter-weight equipment, and with the advent of the helicopter, it is predicted that airborne geophysics will be used extensively for more detailed work in the future.

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HOW TO RECAPTURE LOST PASSENGER MILES AT A PROFIT

Railway Age, v. 139, n 26, December 26, 1955, p. 23.

The most promising measure now in sight for restoring to the rails passenger-miles and passenger profits is to acquire passenger cars of new designs in the development of which the inhibitions of past practice are abandoned. The goals of the new design are (1) low first cost, (2) reduced operating and maintenance expense, and (3) higher average speeds without excessive top speeds.

In this issue appear the ideas and designs proposed by four railway equipment builders for meeting these objectives. All four emphasize the importance of keeping weight to a minimum — in order to reduce both first cost and operating costs. All four seek a low centre of gravity to permit high average speeds, without discomfort to passengers. In many other respects, the approaches of the four companies differ.

The four current developments for providing light-weight low cost, high-speed railway passenger trains are set forth in detail for critical appraisal. Two employ low-contour, articulated cars, with low centre of gravity, one with dollys under one end of the uncoupled cars. Another has lightweight low-centre-of-gravity cars each carried on two single-axle trucks, but the floor is at approximately conventional height. The fourth employs cars of refined structure, but the bodies are carried on conventional four-wheel trucks and they couple at standard height for interchange with conventional rolling stock. All achieve weights under 1,000 lb. per passenger seat, exclusive of motive power.

Among the trains' features are innovations in heating and air-conditioning equipment. The use of head-end power will have an opportunity for a good workout. The adaptability of air-ride suspension to railroad cars will also be determined. The popularity of several novel methods of dispensing food will be tested.

A year's service will probably be enough to indicate the all-important reaction of the traveling public to the quality of service which these trains can render. It will take longer to appraise fully the ultimate economics of ownership of the new equipment. But radical improvements in railroad passenger service are passing out of the stage of talk and are entering that of concrete experience.

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WATER-LUBRICATED WOOD ROLLS BEVEL ALUMINUM

A. F. Schub, *Iron Age,* v. 176, n. 26, December 29, 1955, pp. 68

Valuable production time on a 10-stand progressive rolling machine has been saved by transferring a second aluminum forming operation to home-grown, two-stand equipment. A development of the Douglas Aircraft tool design department, the low-cost machine also eliminates a degreasing operation. Water-lubricated male rolls of laminated wood are used, which with only minor resurfacing, have formed more than a million aluminum aircraft parts to accurate contours.

Costs are reduced even further by conventional design of the two-stand machine, eliminating the need for special parts. Standard parts are used wherever possible to permit interchangeability with other forming machines, and to reduce maintenance. Machine downtime while wood rolls are redressed does not exist, for a duplicate set is built into the equipment.

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A CONTROLLED EXPERIMENT IN CONFERENCE LEADERSHIP

William M. Fox, *Advanced Management,* v. 20, n. 12, December 1955, pp. 13

This article gives a report of the results of a controlled experimental study of positive and negative styles of conference leadership, involving four discussion groups and two conference leaders, who were trained in and used the different styles of leadership alternately. The findings indicate that the positive style led to greater satisfaction and acceptance of group solutions and was more effective in changing the attitudes of the participants.

One survey shows that the average executive devotes from one-fourth to one-half of his time to conferences. Yet surprisingly little is known about conference leadership. The typical author who writes in this area usually bases his "principles" upon feelings or hunches which he has derived from limited experience in leading discussions. Although some good practical points can be found in such literature, the general inadequacy of the approach is made clear by the lack of agreement among various authorities.

The value of this training approach is pointed up in the opinions expressed by the discussion leaders at the conclusion of the experiment. They admitted that though they had understood the conceptual distinctions between the two styles of leadership at the conclusion of their leader training, they had definitely doubted the value or utility of these distinctions; but that by the time of their last experimental meetings, as a result of their experience with the groups, the basic importance of the distinctions had become crystal clear.

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HOW TO INSTALL PVC PLASTIC PIPE

Heating, Piping & Air Conditioning, v. 27, n. 12, December 1955, pp. 112-116.

Polyvinyl chloride plastic pipe, being rigid, can be installed overhead with pipe supports or underground. Fittings are attached by any of four methods: solvent cementing, threading, heat welding, and adhesives.

Rigid polyvinyl chloride plastic pipe is available in two types: normal impact and high impact. Installation procedures for the two are the same, with but a few exceptions.

The normal impact type, which can be used at temperatures up to 150 F. and at higher working pressures than can the high impact type, is also more resistant to chemicals. However, the high impact type, is recommended where rough handling during transportation and installation is expected and where the properties of the normal impact type are not critical.

In applications where underground installation is required, care should be exercised so that the pipe is not damaged in the laying operation. Ditches should be smooth and regular, so that the localized bending stresses are not imposed. The pipe should be laid below the frost line if water is to be conveyed, since the pipe may fail due to expansion of the water if it freezes. High impact PVC plastic pipe is best suited for most underground applications.

Flow charts are given to assist in the design of polyvinyl chloride plastic pipe lines. For a given flow rate or pressure drop, the most economical pipe size and schedule may be chosen through the use of these charts.

Tables are included for determining maximum operating pressure of PVC plastic type at any temperature, and for maximum allowable operating pressures for high impact type pipes.

70th
ANNUAL GENERAL
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PROFESSIONAL MEETING
OF
THE ENGINEERING INSTITUTE OF CANADA
IN ASSOCIATION WITH
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AND
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AT THE
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Publicity . . . . M. Benoit
Reception . . . . A. Deschamps
Technical Papers . . . . E. R. Smallhorn
Transportation . . . . G. H. Hoganson
Ladies . . . . Mrs. C. G. Kingsmill

TECHNICAL PAPERS

E.I.C.

Chairman: W. H. Gauvin
R. Brais
R. M. Hardy
A. R. Harrington
H. C. Karn
W. H. Paterson
W. B. Pennock
H. S. Van Patter

ASME and ARS

E. A. Allcut
J. J. Clyman
R. F. Dauer
H. Ernst
J. J. Harford
W. E. Hopkins
J. A. Thomas
N. J. Viehmann

VISIT THE ST. LAWRENCE SEAWAY DEVELOPMENT - SPECIAL TRIPS - SATURDAY, MAY 26th

For the benefit of those who are interested visits have been arranged to both the Montreal and International Sections of the Seaway development. Buses will leave the Sheraton-Mount Royal at 9.30 a.m. and will return as follows:

Montreal Section:	1.30 p.m.	Bus Fare — $1.00 per person
Cornwall Section:	7.00 p.m.	Bus Fare — $3.00 per person

Members taking the latter trip who do not wish to return to Montreal will be able to catch the west-bound express at Cornwall at 4.47 p.m. E.S.T.

ATTENTION - MEMBERS! - PLEASE NOTE

Prices for meals include gratuities and provincial tax. Tickets must be obtained in advance and refunds cannot be made less than three hours before any function.

Attendance at social functions will tax all available accommodation. Members are urged to indicate their ticket requirements by completing and mailing advance registration cards well before the meeting. Tickets not paid for will not be held for less than three hours before any function. To ensure admission to all social affairs send remittance for all tickets with advance registration whether from out of town or not!

REGISTRATION

Foyer - Convention Floor

3.00 p.m. to 6.00 p.m. — May 22nd
9.00 a.m. to 6.00 p.m. — May 23rd-25th
*Members $5.00
*Juniors $3.00 — Non-Members $6.00
Ladies, guests of the Institute, speakers, authors and students — complimentary.

*ASME and ARS members will be registered at E.I.C. Member rate.

"MURIEL'S ROOM"

The hospitality of "Muriel" will be extended, as usual, to all registered members, ladies and guests, thanks to the continued co-operation of Canadian industry.

Registration Badges Must Be Worn

All times are Eastern Daylight Saving.

*PROGRAM

Wednesday, May 23rd

9:00 a.m. REGISTRATION - FOYER

10:00 a.m. CHAMPLAIN ROOM

ANNUAL GENERAL MEETING

12:30 p.m. LUNCHEON

SHERATON HALL—
$2.75 per person
Chairman: E. D. Gray-Donald, Chairman, Montreal Branch
Speaker: Dr. R. E. Heartz, President, The Engineering Institute of Canada

2:00 p.m. BALL ROOM
INDUSTRIAL POWER DISTRIBUTION
J. R. Auld, M.E.I.C.,
Supervising Engineer, Power Services,
Du Pont Company of Canada Limited,
Montreal

CHAMPLAIN ROOM
GENERAL DESIGN OF THE ST. LAWRENCE SEAWAY — MONTREAL AREA
D. M. Ripley, Jr.E.I.C.,
Senior Assistant Engineer, Hydraulics,
St. Lawrence Seaway Authority,
Montreal

BRITTANY ROOM
APPLICATION OF WELDED DESIGN TO HYDRAULIC TURBINE AND VALVE MANUFACTURE
J. G. Warnock,
Head, Hydraulic Department,
English Electric Company Limited,
St. Catharines, Ont.

3:00 p.m. BALL ROOM
THE GROWTH AND DEVELOPMENT OF LARGE ELECTRIC POWER SYSTEMS
W. R. Way, M.E.I.C.,
Vice-President and Chief Engineer,
Shawinigan Water and Power Company Limited, Montreal

CHAMPLAIN ROOM
THE USE OF HYDRAULIC MODELS IN THE ST. LAWRENCE SEAWAY DESIGN
Duncan McIntyre,
Senior Assistant Engineer,
Hydraulics,
St. Lawrence Seaway Authority,
Montreal

BRITTANY ROOM
THE KAPLAN TURBINE IN CANADA
G. D. Johnson, Mem. ASME.,
Chief Hydraulic Engineer,
S. Morgan Smith Company,
York, Pa.

4:00 p.m. BALL ROOM
THE CROSS-ROPE SUSPENSION SYSTEM OF THE KEMANO-KITIMAT TRANSMISSION LINE
H. B. White, M.E.I.C.,
Power Transmission Engineer,
Aluminum Company of Canada Limited, Montreal

CHAMPLAIN ROOM
THE MECHANICAL DESIGN FEATURES OF THE ST. LAWRENCE POWER PROJECT
Otto Holden, M.E.I.C.,
Chief Engineer, and
P. Pemberton-Piggott,
Assistant Mechanical Engineer,
Generation Department,
Hydro Electric Power Commission of Ontario, Toronto

BRITTANY ROOM
LATERAL RIGIDITY OF BUILDING FRAMES
J. L. de Stein, M.E.I.C.,
Associate Professor, and
J. O. McCutcheon, M.E.I.C.,
Assistant Professor,
Department of Civil Engineering,
McGill University, Montreal

6:15 p.m. COMPLIMENTARY BUFFET SUPPER
Courtesy the City of Montreal
THE CHALET, MOUNT ROYAL

6:30 p.m. ADDRESS OF WELCOME
His Worship, Mayor Drapeau

7:00 p.m. REFRESHMENTS -
Courtesy of "MURIEL"

8:00 p.m. BUFFET SUPPER

Badges Must Be Worn

Buses will leave The Sheraton-Mount Royal Hotel for The Chalet at 5:45 p.m. and return at approximately 9.30 p.m. Bus tickets must be purchased in advance — Price $1.00 per person.

HOTEL ACCOMMODATION AND TRANSPORTATION

The Sheraton-Mount Royal is the headquarters hotel and all meetings and functions will take place there unless noted otherwise. All those planning to attend are urged to make requests for room reservations as early as possible. If desired accommodation is unavailable, delegates will be assigned to the next best that can be obtained. Unaccompanied delegates should indicate whether they will be prepared to share twin-bedded double rooms. It is most satisfactory of course if such sharing arrangements can be worked out in advance and indicated on the application for reservations.

All requests for convention reservations should be addressed to:—

THE GENERAL SECRETARY, THE ENGINEERING INSTITUTE OF CANADA,
2050 MANSFIELD STREET, MONTREAL 2, QUE.

Reduced convention fares have been authorized for rail travel in Canada. A special fare certificate will be mailed to you from headquarters if requested on your registration card. This entitles you and members of your family to round-trip tickets at one and one-half times the one-way fare plus twenty-five cents.

Trans-Canada Air Lines have special family and group rates. Your local T.C.A. agent will gladly supply details.

No matter how you travel, be sure to make your reservations now to avoid disappointment.

***Subject to minor changes.**

9:00 a.m. BALL ROOM
A RAPID ANALYTICAL METHOD FOR CALCULATING THE EARLY TRANSIENT TEMPERATURE IN A COMPOSITE SLAB
W. F. Campbell, M.E.I.C.,
Senior Research Officer,
Division of Mechanical Engineering,
National Research Council,
Ottawa.

CHAMPLAIN ROOM
BERSIMIS POWER DEVELOPMENT
F. P. Rousseau, M.E.I.C.,
Chief Engineer, Power Development Division,
Quebec Hydro Electric Commission,
Montreal

BRITTANY ROOM
AIR POLLUTION CONTROL PROBLEMS
E. A. Allcut, M.E.I.C.,
Head, Department of Mechanical Engineering, University of Toronto,
Toronto

SALON J
THE METAL BONDING OF AIRCRAFT ASSEMBLIES
J. J. Waller,
Chief Materials and Process Engineer,
Canadair Limited, Montreal

10:00 a.m. BALL ROOM
THE TRANS-CANADA RADIO RELAY TELEPHONE SYSTEM
A. J. Groleau, M.E.I.C.,
Area Chief Engineer,
Bell Telephone Company of Canada Limited, Montreal

CHAMPLAIN ROOM
SURVEY OF THE HAMILTON RIVER
E. N. Webb, M.E.I.C.,
Consulting Hydro Electrical Engineer,
British Newfoundland Corporation Limited, Montreal

BRITTANY ROOM
CURRENT DEVELOPMENTS IN AIR POLLUTION IN THE UNITED STATES
L. C. McCabe, President,
Resources Research Incorporated,
Washington, D.C.

SALON J
THE CHALLENGE OF PROGRESS
R. C. Sebold,
Vice-President, Engineering,
Convair Division,
General Dynamics Corporation,
San Diego, Cal.

11:00 a.m. BALL ROOM
CO-OPERATIVE RESEARCH IN THE BRITISH ELECTRICAL INDUSTRY
Jerzy Miedzinski, A.M.I.E.E.,
Development Engineer,
Department of National Defence,
Navy, Ottawa

CHAMPLAIN ROOM
MECHANICAL SERVICES IN A MODERN BREWERY
R. E. J. Layton, M.E.I.C.,
Chief Mechanical Engineer,
T. Pringle & Sons Limited,
Montreal

BRITTANY ROOM
THE CONTROL OF AIR POLLUTION IN ENGLAND
S. G. G. Wilkinson,
Ministry of Housing and Local Government, London, England.

SALON J
PROJECT VANGUARD — THE IGY EARTH SATELLITE
F. R. Furth, Rear Admiral,
United States Navy,
Naval Research Laboratory,
Washington, D.C.

1:45 p.m. CANADAIR VISIT AND AIR SHOW - Cartierville, P.Q.
Buses will leave The Sheraton-Mount Royal at 1:45 p.m. and return at approximately 6:00 p.m.
Bus tickets must be purchased in advance — Price $1.00 per person.
Badges Must Be Worn

6:45 p.m. ASSOCIATION OF CONSULTING ENGINEERS OF CANADA
ANNUAL DINNER
SHERATON HALL
Chairman: J. G. Chenevert, M.E.I.C.
Speaker:
(Tickets obtainable from Association or E.I.C. registration desk)

8:00 p.m. BRITTANY ROOM
JUNIOR PANEL DISCUSSION — WHAT CAN A YOUNG ENGINEER DO IN DEVELOPING PROFESSIONALLY?
Co-Chairmen: N. J. Viehmann, A.M., ASME, Jones and Lamson Machine Company, Springfield, Vt.
G. L. MacLean, Jr.E.I.C., Foundation Company of Canada Limited, Montreal

8:30 p.m. INFORMAL RECEPTION
E.I.C. HEADQUARTERS
2050 Mansfield Street

***LADIES' PROGRAM**
Morning coffee: 9:30 a.m. daily — Salon B
Wednesday, May 23rd, 11:00 a.m.
Montreal Museum of Fine Arts
Tour of Museum followed by lunch and Fashion Show by Doreen Day — $1.50 per person.
Friday, May 25th, 10:00 a.m. City Bus Tour and visit to Botanical Gardens — $1.75 per person.

9:00 a.m. BALL ROOM
AUTOMATION, MEN, AND MACHINES
J. J. Brown, Consulting Engineer, Montreal

CHAMPLAIN ROOM
A PROGRESS REPORT ON CANADIAN ATOMIC POWER
I. N. MacKay, M.E.I.C., Manager, Engineering Civilian Atomic Power Department, Canadian General Electric Company Limited, Peterborough, Ont.

BRITTANY ROOM
HIGH SPEED PHOTOGRAPHY IN CHEMICAL ENGINEERING
A. I. Johnson, Professor, Department of Chemical Engineering, University of Toronto, Toronto

10:00 a.m. BALL ROOM
AUTOMATING THE ENGINEER'S TASK
Josef Kates, President, K. C. S. Data Control Limited, Toronto

CHAMPLAIN ROOM
EXPERIMENTAL WORK ON COAL BURNING GAS TURBINES
D. L. Mordell, M.E.I.C., Chairman and Professor, Department of Mechanical Engineering, McGill University, Montreal

BRITTANY ROOM
MODERN ALLOYS FOR INDUSTRIAL USE ABOVE 1200 DEG. F.
J. P. Ogilvie, M.E.I.C., Shawinigan Chemicals Limited, Montreal

11:00 a.m. BALL ROOM
HOW THE MACKINAC BRIDGE WAS DESIGNED FOR AERODYNAMIC STABILITY
D. B. Steinman, M.E.I.C., Consulting Engineer, New York, N.Y.

CHAMPLAIN ROOM
200,000 KW REHEAT BOILER DESIGN FOR ONTARIO HYDRO COMMISSION
F. W. Cranston, Babcock-Wilcox & Goldie-McCulloch, Limited, Galt, Ont., and
M. G. Ireland, Assistant Contract Manager, Babcock & Wilcox Company, Barberton, Ohio

BRITTANY ROOM
MOVING-BED PROCESSES
E. H. Lebeis, Catalytic Construction Company, Philadelphia, Pa.

12:30 p.m. ASME LUNCHEON
SHERATON HALL —
$2.75 per person
Chairman: G. Ross Lord, Chairman, Ontario Section ASME.
Speaker: J. W. Barker, President, American Society of Mechanical Engineers.

2:00 p.m. BALL ROOM
LONG RANGE PLANNING IN AN ATOMIC AGE - MANAGEMENT PANEL DISCUSSION
Chairman: L. F. Urwick, C.I.Mech.E., Mem. ASME., Management Consultant, Urwick Currie Limited, Montreal

CHAMPLAIN ROOM
MASS TRANSPORTATION IN CITIES — A TRAFFIC PANEL DISCUSSION
Chairman: George S. Mooney, Director, St. Lawrence Municipal Bureau, Montreal.

3:30 p.m. CHAMPLAIN ROOM
Special Lecture
THE APPLICATION OF CENTRALIZED RESEARCH AND EDUCATIONAL SERVICES TO IMPROVE PRODUCTION ECONOMY
D. F. Galloway, M.I.Mech.E., Director, Production Engineering, Research Association, Melton-Mowbray, England.
Chairman: J. W. Barker, Mem.ASME., President, American Society of Mechanical Engineers

6:30 p.m. RECEPTION - CHAMPLAIN ROOM

7:15 p.m. THE ANNUAL BANQUET
$5.50 per person (including dance)
BALL ROOM
Chairman: Dr. R. E. Heartz, M.E.I.C., President of the Institute
Speaker: Dr. David L. Thomson, Vice-Principal and Dean of the Faculty of Graduate Studies, McGill University, Montreal
Presentation of Medals and Prizes and introduction of the new president, V. A. McKillop and new members of Council.

9:00 p.m. ANNUAL DANCE
CHAMPLAIN ROOM -
$2.50 per person (Dance only)
(Dress Optional)

9:00 p.m. RECEPTION
There will be an informal reception after the banquet when members and guests may meet the incoming and retiring presidents, distinguished guests, the Chairman of the Montreal Branch, and their wives.

PRINTED IN CANADA

Engineering Institute Brief to the Royal Commission on Canada's Economic Prospects

Institute Asks for a Complete Study of Needs for Engineering Education

Some time ago the president on Council's instruction appointed a small committee to prepare a brief for the Royal Commission on Canada's Economic Prospects. The committee consisted of E. B. Jubien, chief engineer of Dominion Textiles, R. F. Shaw, vice-president of the Foundation Company Limited and G. N. Martin of the Dominion Bridge Company, a councillor of the Institute and chairman of the Publication Committee.

The brief was presented to the Commission in Ottawa on March 8. It had been arranged that the presentation would be done by the president, accompanied by Mr. Martin and the general secretary. Unfortunately, the date selected corresponded with one of eastern Canada's worst blizzards, and the president was unable to get to the airport or the railway station in Montreal, hence the presentation was made by the general secretary.

The brief was introduced by some general observations and was backed up with four documents which amplified and emphasized the statements made in it.

The supporting documents were (1) a letter from Rt. Hon. C. D. Howe, HON.M.E.I.C., (2) an article by Dr. C. R. Young, HON.M.E.I.C., reprinted from the March 1944 *Engineering Journal* (which will be printed again in the *Journal* under instructions of Council) titled "The Desirability of Establishing Technical Institutes in Canada," (3) the article "The Tide and the Crisis" by Dr. G. E. Hall of the University of Western Ontario, which appeared in the December 1955 *Engineering Journal,* and (4) a paper by Rear Admiral Hyman G. Rickover of the U.S. Atomic Energy Commission titled "Engineering and Scientific Education", which appears in this issue of *The Engineering Journal.*

The brief and the introductory remarks follow.

Introduction

Mr. Chairman and Gentlemen:

Thank you for this opportunity to appear before your important body. The breadth of the field which you have been called upon to study is so great that one may well wonder just what he can do to help toward the accomplishment of your task.

Our story as told in our brief is a simple one, but we think it deals with the most important single element in the equation which you will have to find in order to solve the problems of "Canada's Economic Prospects". This element is manpower — trained manpower.

Our brief does not labour any point. We do not try to tell you how to solve the problem, but simply how to approach it. We have studied the problem too long to believe that the answer is an easy one, or that one person or group has the whole answer, but we do recommend that something sensible be started now so that we will not always be in our present confused state of mind. We feel that your Commission is the one to point the way with clarity and emphasis.

We have noticed that a great many briefs presented to you have emphasized the need of more engineers and scientists, and more well-trained technicians. Apparently most of those who have appeared before you are agreed on it. This has pleased us greatly and we hope it will give the Commission further encouragement to bring forward a far-reaching recommendation.

The Institute has been asked by some of the university authorities to undertake a study such as we are now recommending to the

The Introduction is continued on page 446. The Brief is on page 442.

The Royal Commission on Canada's Economic Prospects

Gentlemen:

1. The purpose of this presentation is to discuss with the Royal Commission, one of Canada's most serious shortages in resources. We refer to manpower, and in particular to one segment of it i.e. engineers, scientists and technicians.

2. The terms of reference of the Commission include more than one reference to a field in which engineers may be the most important element. It seems appropriate that in any study of "Canada's economic prospects," the supply of engineers and scientists should be considered. No other human element will be effective as the engineers in "the supply of raw material and energy resources," in extension "of productivity", and in meeting "the prospective requirements for industry".

3. It is not necessary for us to submit proof of the shortage of engineers, scientists and technicians. That is now a self evident fact, that can be denied by no one who is informed and who regards the situation objectively. However, the present and potential seriousness of the shortage, in terms of "Canada's economic prospects" does merit the presentation of some facts and some recommendations.

National Defence

4. The most important consideration is that of national defence. We do not wish to appear to be hysterical, but we are concerned about prospects for the future. Russia continues to be a threat, and the fear of that threat increases daily, with the rapidly increasing number of engineers and scientists being educated and trained there.

5. British scientists who visited Russia last summer turned in a startling report—by 1960 Russia would have between 2 and 3 million engineers and scientists, the quality of the training was high, and the top men were at least as good as the top men in the United Kingdom and the United States. In a single generation this nation has risen from the most lowly to the highest in these fields.

6. Why has Russia done all this? In order to excel! Just to what extent she wants to excel, it is hard to tell, but we can be sure she wants to excel in trade at least. Many people believe that she wishes to dominate the world. To do this she is building up the greatest army of technically trained persons that the world has ever known. She believes that such personnel are the means of reaching her objectives.

7. These tactics should both disturb and inspire us. If we are to realize our own destinies, we must not sit by quietly, while these developments take place before our eyes. We must join with others in preparation for the future. As far as we are concerned this means more engineers, more scientists and more technicians.

Natural Resources

8. Canada is blessed with the greatest gift of undeveloped natural resources of any nation in the world. The two things most essential to their development are money and men — technically trained men. Without these men the resources are without value. If the present shortage is allowed to continue, the full use of the resources is denied us. To develop Canada we must have more technically trained people.

Industry

9. It is hard to tell which section of Canada's activities is hardest hit by the shortage in technical manpower, but there can be no doubt that industry is indeed suffering. The Engineering Institute operates an employment service for its members and employers. This is an excellent medium through which to follow the nation's industrial development. We have more job vacancies and fewer applicants than ever before in our history. Even positions offering up to $25,000 a year are hard to fill. Right now we have one opening of $40,000 and we have not yet found the man for it.

10. The design and building of new plants and the extension of existing ones, is being delayed in many instances because of the shortage of design engineers. Consulting engineers have told us that they have had to decline invitations to design plants and industrial buildings, highways and bridges because they could not find additional engineers to enlarge their design staff. Most definitely, Canada's industrial development is being retarded by such shortages.

11. No one can tell exactly how many should be trained, but according to the now famous Sheffield report, in ten years' time the university population will have doubled. Assuming that the same proportion continue to enter the sciences, it is evident that the present facilities will be completely inadequate. The likelihood is that a greater proportion

will go in for science. What are we going to do about it?

Facilities of Education

12. More facilities and more staff will have to be provided. This includes universities, technical institutes and high schools. The staff problem will be the more difficult one to solve, but it must be solved. More people must be trained for teaching and all must be given a remuneration commensurate with their importance, and more nearly in line with that offered by industry for such services. Canada appears to be the only nation that pays its university teachers substantially less than they could obtain from other employers (see—Survey of National Research Council). Any further extension of such a policy will be ruinous to our future.

13. Up until a year or so ago, it was possible to get some real help in our difficulties, by employing European engineers, but this source is now dried up. We now face a situation where we will have to "grow our own". It becomes increasingly evident that a great effort has to be made in Canada by Canadians.

Finances

14. It is plain that more money must be made available for education in addition to the natural increase in the volume of fees. For engineering, fees pay only forty per cent of the cost. It is evident that the money must come from outside the university. It seems equally evident that a substantial portion of it must come from government. We believe the federal government has a real responsibility here.

The Cost

15. It is always interesting to know what a proposal adds up to in dollars and cents, but there is no way of which we are aware, whereby even approximate figures can be obtained for all of Canada that would include extensions to existing universities, the building of new institutions, additional equipment and new staff. However, it is not necessary now to have such figures. They can be developed when they are needed.

16. Plans should be made at least to double the present number of graduates. No matter what this costs it will be modest in terms of benefits derived. Today's expenditure for university education is lamentably small. We spend more on recreation than we do on education. We spend more than twice as much to keep a criminal in custody as we do to educate a free man at a university. Without a murmur we hand out more to take care of a mentally deficient person than we do to educate a mentally efficient one. We spend more than twice as much on carbonated beverages and about three times as much for alcoholic beverages as we do for a university student. Truly our sense of values is badly distorted. Isn't it time we did something about it?

17. It would be futile for the Institute to attempt to state before the Commission just how the situation should be met. To find the full sensible solution will require an exhaustive study by persons concerned with the answer, and competent to locate and evaluate evidence. There is much urgency about this matter, but enough time should be given to it to find the one best answer. This is no time for half measures or mistakes.

18. The Engineering Institute of Canada has considered the problem for several years. Discussions with university presidents, deans of engineering, faculty members and employers right across Canada, and in the United Kingdom and the United States as well, have given us an insight into the situation and have left us with a sense of urgency. This brief is not the place to go into details, but if at any time our knowledge of conditions and our opinions may be helpful to your Commission or to departments of the government, we shall be happy to collaborate.

Further Proof

19. Rather than lengthen this brief with arguments and proof, we are attaching some documents which give emphatic and colourful support to the things we have said. We are confident you will find them interesting and helpful. They are (a) a letter from the Right Hon. C. D. Howe, HON.M.E.I.C., Minister of Trade and Commerce and of Defence Production, (b) a paper by Dr. C. R. Young, HON.M.E.I.C., Dean Emeritus of the Faculty of Applied Science and Engineering, University of Toronto, and a past president of The Engineering Institute of Canada, (c) a paper by Dr. G. E. Hall, President and Vice-chancellor, the University of Western Ontario, (d) an address by Rear Admiral H. G. Rickover of the United States Atomic Energy Commission.

20. The problem of technical education is a complex one, the solution of which will require more money and more collaboration between government, educators and employers. As we have said we are not now attempting to present details although they are known to us. We feel that our proposal to the Commission should be clear and simple, and that details should be reviewed later.

21. Believing that a great share of the responsibility of meeting the problem belongs to the federal government, *we recommend with a sense of urgency that your Commission propose to the federal government, the creation of a body to study the problem immediately so that a realistic program may be developed with a minimum loss of time.*

R. E. Heartz, M.E.I.C.,
PRESIDENT

L. Austin Wright, M.E.I.C.,
GENERAL SECRETARY

The Engineering Institute of Canada

March, 1956

The Desirability of Establishing Technical Institutes in Canada

by

C. R. Young, M.E.I.C.

Dean of the Faculty of Applied Science and Engineering, University of Toronto

Past-President of the Engineering Institute of Canada

A memorandum submitted to the Council of The Engineering Institute of Canada on February 9th, 1944. Council approved the proposal and has since taken steps to initiate action through the provincial departments of education.

The Need for Technical Institutes

One of the present obligations of the educational authorities and institutions in this country is to direct their resources towards a speedy and sound re-establishment of men discharged from the forces or released from war industry. A forward-looking and realistic technical educational program ought to form an important part of the general scheme of rehabilitation. The faculties of engineering of the universities will, no doubt, do their share, but they are properly restricted to the professional field. It is therefore necessary that steps be taken under provincial auspices, but perhaps with federal support, to provide essential training to many men with technical aptitudes who either could not qualify for admission to a university or could not spend four more years of their lives in obtaining an education for a livelihood. Some plan should be devised whereby men without professional ambitions could have their needs satisfied in institutions giving a training above the ordinary vocational level but less advanced than that offered by the engineering colleges. Minimum qualifications for admission would naturally have to be less than complete university matriculation and might in some instances have to rest chiefly on personal capacity and interest, supplemented perhaps by assurances of future employability in technical pursuits.

Consideration of technical education in Canada clearly indicates a serious gap in it above the secondary school level and below that of the degree-granting engineering faculties and colleges. The universities, as the sole type of institution above the ordinary or vocational high school, cannot possibly serve adequately all of the needs of the country in the matter of advanced training of technical personnel and any attempt at doing so is bound to be unsatisfactory both to those seeking training and to the universities themselves. Experience in the United States, in Great Britain, and on the continent, has shown that the whole fabric of technical education is strengthened and marked public benefits realized from the establishment of an intermediate type of institution commonly designated as the "technical institute".

Employment of Technical Institute Graduates

It is of importance to note that in the United States renewed emphasis is now being placed on the work of the technical institutes. Much of the technical training to be made available for men discharged from the forces and released from war industry will be given by them. As an evidence of the growing activity expected in this field, eight technical institutes are projected for New York State, to be built as part of the post-war construction plan and turned over to the State for operation.

While the graduates of engineering colleges look to professional employment involving investigation of the scientific and economic features of undertakings and are concerned with devising what are often original methods of analysis, design, construction, manufacture, or operation, the graduates of technical institutes are for the most part concerned with repetitive activities associated with production, operating or maintenance procedures. Graduates from the latter type of institution constitute the "line" side of an organization, as contrasted with the "staff" side, which is generally recruited from the graduates of professional schools.

Technical institute graduates very often limit their interests to, and are trained for, particular industries. Their duties are normally of a supervisory character, but may include minor technical functions such as drafting, design of details, laboratory testing, inspection, construction in the field, or the technical aspects of sales work.

Careful studies made in the United States indicate that the technical institute graduates required by industry represent from 2.2 to 3.0 times the number of graduates required from the professional schools. These two groups are related in much the same way as are non-commissioned officers and commissioned officers in the army.

Types of Technical Institute Students

Technical institutes serve more effectively than the engineering colleges the following types of young men:

(1) Those who have had industrial experience and have already chosen a vocation upon which they wish to embark with the least possible loss of time.

Dr. C. R. Young, HON.M.E.I.C., is now Dean Emeritus of the Faculty of Applied Science and Engineering of the University of Toronto.

(2) Those who have passed the state of "book-mindedness" and whose mental learning processes centre on actual doing rather than on formal study.

(3) Those who, for financial or other reasons, cannot devote four years to preparation for remunerative employment.

(4) Those who, having practical rather than intellectual interest, have had to leave college before progressing very far.

(5) Those whose educational qualifications would not admit them to a university.

General Characteristics of Technical Institutes

While great diversity exists in the character and practices of the presently-operating technical institutes, they nevertheless exhibit certain well defined general characteristics. The courses offered are shorter and more practical than those available in the professional schools. While courses in the latter develop the specialized functions of research, analysis, design, and new production or operating procedures, the work of a technical institute is centered upon and seeks to rationalize the higher practical pursuits of industry. Students of the latter learn by doing rather than by studying and there is much less emphasis on independent study than in the universities. The mathematical and physical sciences are not taught as independent disciplines, but in intimate and very direct and practical connection with their technical applications.

The length of technical institute courses varies from one to four years, the most common being two years. Under favourable aspects, two years of intensive practical work with a sound grounding in the underlying sciences will result in a high employability of the graduate.

Three broad types of training are offered in technical institutes: — (1) generalized engineering courses, (2) technology of particular industries, (3) functional courses.

Experience has shown that there are innumerable positions in industry for the efficient occupancy of which a wide range of scientific or technical knowledge is not necessary. Many of these are conventionally classed as belonging to engineering and many open paths to posts of high responsibility in producing and operating organizations. The technical requirements of such positions can be adequately met by an intensive type of engineering training from which the more advanced scientific features are omitted. To meet this situation, so-called generalized engineering courses have been established in some of the technical institutes.

In the generalized engineering courses a strong effort is made to present basic science and technology that would be useful in any one of a variety of industries. Some of the subjects taught are mathematics, physics, chemistry, mechanics, engineering drawing, descriptive geometry, electricity, and materials of construction. To these there may appropriately be added industrial relations, sociology, industrial safety, and industrial law. The generalized engineering course in a technical institute parallels the engineering courses in the universities but represents an abridgment of them. The material is presented in a more practical form and in a manner not demanding of the student any marked attainments in mathematics or in theoretical science.

Many technical institutes offer courses in the technology of particular industries, often with a definitely local application. Some of the most successful of these institutions have grown out of the idea of service to one or more important local industries. An application of this principle in Canada might well be advantageous.

Some technical institutes offer what are called functional courses. These pertain to such activities as quantity surveying, textile designing, power plant management and operation, management, and general supervision.

The co-operative plan has been found particularly helpful in extending the usefulness of technical institute work. Under this, the student alternates between study in the institute and employment in industry. His experience and practical qualifications increase in parallel with his theoretical knowledge.

Although degrees cannot be granted on the completion of the typical short, practical courses offered by the technical institutes, it is highly essential that some form of certification should be adopted through which the graduate would be able to establish his qualifications. This has been admirably worked out in Great Britain. A scheme of examinations and credentials has been developed under the joint auspices of the English and Scottish Boards of Education and a group of professional institutions. *National Diplomas* are given for successful examinations following full-time day courses, and *National Certificates* for examinations following evening and part-time courses.

In order to guard against an effort by anyone to attain professional recognition without the prerequisite training, a clear understanding should be reached by those sponsoring technical institutes with the Provincial Associations of Professional Engineers respecting the attitude of the latter to applications for admission from technical institute graduates. Credentials obtained from a technical institute might be acceptable in lieu of part at least of the examinations required of non-graduates of professional schools for admission to the associations. The difference in required practical experience for the two types of graduates should be determined at the outset.

Relation of Technical Institutes to the Universities

Experience has shown that it is not practicable for a degree-granting engineering college itself to attempt parallel technical institute activities on the same campus, under the same administrative and teaching direction, and during the same operating hours. No experiment of this kind has so far succeeded. Under such circumstances, the technical institute is soon regarded as a salvage mechanism for failures, culls and misfits. Students in the short courses are not accorded the full privileges of regular students in campus activities and organizations. Unconsciously, but nevertheless almost inevitably, the staff comes to favour the longer course, to the very great prejudice of the technical institute work and to the detriment of the morale of the institution as a whole. No such undesirable situation exists if the technical institute has its own administration, its own instructors, its own quarters, and its own particular policies and ideals, freed of any invidious comparison with institutions giving professional courses.

From the point of view of the engineering faculty or college the superposition of aims and objectives is undesirable. The colleges must protect their standing with the professional societies and accrediting agencies. They must insure that industry places definite value on their credentials. One standard of admission, one general level of work, and one grade of credentials are essential. It is not practicable to arrange the curriculum of an engineering college in such a manner that attendance of one, two, or three years would constitute adequate and final educational preparation for different types of technical employment. Many years ago, the German technical universities attempted this plan and had to abandon it in favour of different types of schools for different callings.

Credits toward a University Course

Experience has shown that it is difficult to arrange automatic credits for students who complete technical institute courses and desire to enter engineering colleges with a view to obtaining professional training. The two types of programs are widely different. To obtain the greatest success, the methods of teaching should correspondingly differ.

A dominating principle in the technical institute work has been that the courses are of a "terminal" character. It consequently appears impracticable to admit graduates of technical institutes at any higher level than the first year, except in special cases. The difficulty arises in the fact that the so-called theoretical courses have by intention been made very different in content in the two institutions. In most cases, technical institute men have had neither the amount nor the type of mathematics that would serve as a prerequisite for the more advanced engineering subjects and for which the colleges will allow any considerable credit, however purposeful or useful the content or giving of the instruction has been. Graduates of the technical institutes would, on their part, often experience disappointment in being asked to start over again far down the line. They could scarcely escape a feeling of repetition, waste of time, discouragement, or even embarrassment.

While any regular plan of admission of technical institute graduates to advanced standing in the engineering courses appears to be impracticable, exceptional men, having higher educational qualifications than most technical institute students have, might be admitted to the professional schools above the first year. The possibility of this would prove highly attractive to young men thinking of entering a technical institute. Undoubtedly, it would be in the public interest for the universities, possibly in co-operation with the Department of Education for the province concerned, to arrange suitable "bridging" courses for facilitating such transfers.

Advantages of the Technical Institute Plan to the Universities

Due to the comparative absence of technical institutes in Canada the engineering colleges have, in effect, been forced to conduct two over-lapping types of training. Primarily, the courses offered are designed for men seeking professional qualifications and capable of acquiring them. At the same time, however, there are, in every engineering college, appreciable numbers of students who can hope to attain only a general education or a sub-professional status. Their capacity, or interest, does not enable them to keep pace with the majority of their classmates. As a result, they waste their time and in some measure, hamper the training of the better students. Actually, their own interests are ill-served and industry is by no means a gainer in the process. It must be admitted, too, that a very substantial part of the demand for technical personnel could be filled by technical institute graduates with a greater continuity of service and often with greater immediate satisfaction to the employer.

The concensus of opinion amongst persons long experienced in educational matters is that strictly professional education would be advanced, the engineering colleges would be greatly relieved, and their primary objectives brought nearer, if those students whose interests are practical and vocational rather than professional were to seek their training in an institution of the type of the technical institute.

Suggested Action

It is my belief that both education and industry would be notably served if, with the sponsorship of the provinces, a number of technical institutes were immediately established so as to be available for qualified demobilized men and displaced war workers as soon as they are free in substantial numbers.

Introduction to Brief to The Royal Commission

(Continued from page 441)

Commission. Some preliminary study had been done before the announcement was made of the appointment of this Commission. It was decided to withhold further action in the hope that the Commission would find that an adequate supply of engineers and scientists was inextricably and basically involved in any attempt to evaluate "Canada's Economic Prospects".

At the latest meeting of the Council of the Institute funds were voted to finance an engineering education conference, to which would be invited the deans of engineering and members of their staff. The preliminary arrangements are already under way and it is proposed to continue, inasmuch as the details of education itself are not likely to come within the terms of reference of the Commission, but the availability of funds to supply buildings, equipment and personnel would seem to be appropriate to your field of interest.

In this way the Institute hopes to have a part in planning the future of Canada. We feel it will be most advantageous to have the studies on engineering education completed in time to be integrated into this expansion program which should follow the report of the Commission.

The Institute's study of the subject and our facilities from coast to coast are at the service of your Commission, or any body that succeeds to your responsibilities. We are a national body with a strong sense of national responsibility in this matter. We have no personal "axe to grind". We just happen to believe that more properly trained people are going to be needed as time goes on, and that the only way to meet today's desperate situation and to attack tomorrow's, which will be even worse, is to do something about it now. We believe your Commission is the body to start it. We hope you will agree with us.

Engineering and Scientific Education

by

Rear Admiral Hyman G. Rickover, USN

Chief, Naval Reactors Branch, U.S. Atomic Energy Commission

and

Assistant Chief of the Bureau of Ships for Nuclear Propulsion

Head of the atomic-powered submarine projects, the Nautilus *and the* Seawolf

Address given to the Sixth Thomas Alva Edison Foundation Institute on "The Growing Shortage of Scientists and Engineers", November 21-22, 1955

For the last eight years my work has been in the field of nuclear power. In dealing with the problems involved in developing this new source of energy, I have found them to be but one facet of a much larger problem — how to provide the trained men and women to maintain the momentum of our rapidly expanding technical civilization. You are all aware that our explosive population growth has placed a tremendous strain on the resources — human and material — of our educational institutions. There are just not enough good teachers and schoolrooms to give each child the opportunity to develop his capabilities to the fullest.

I consider the present crisis in education as grave a problem as any that faces our country today. Unless it is dealt with promptly and effectively the machinery which sustains our level of material prosperity and political power will begin to slow down and we will be in danger of losing the cold war by default. Let me illustrate this with a few figures:

First, the United States has doubled its population in the past fifty years and is expected to double it again by the end of the century.

Second, with only seven per cent of the world's population and eight per cent of the land area, the United States is today responsible for more than half the world's production.

Third, to maintain our relative position in the world economy and to preserve our high standard of living, American industry must — ten years from now — produce forty per cent more than it does today.

The use of electric power, for example, is expected to quadruple in the next twenty-five years. Or take minerals and most mineral fuels: the United States has used up more of these in the last thirty years than the entire world did in all of history before 1914. A similar growth in consumption in the next thirty years cannot occur unless we make profound changes in technology.

Experiment or Perish

Our accelerated increase in production over the past century has been due to the efforts of but a small number of companies. Only one per cent of all the businesses in existence a hundred years ago are still alive today. And in a recent study by the Brookings Institution it was shown that only thirty-eight of the one hundred largest industrial companies existing in 1909 are still in business today. The companies which survived are those which have been willing to experiment, to take risks, to innovate, to break precedent. Their managements have anticipated and helped to bring about the very changes which caused their less astute or less courageous competitors to slip back. These companies hold their place in a world of change. The top is a slippery place.

The same holds true for nations; like industrial organizations, they will decline if they are not continually alert to the needs of the future. The law of life for industrial organizations and for nations is the same: "adapt or perish." The industrial, and hence the political power of nations is dependent in large part on their scientific and engineering professions, and these in turn depend on a continuous inflow of capable and well-trained individuals. In other words, a nation progresses or falls back in the race for survival to the degree that it succeeds or fails to afford each individual citizen the maximum opportunity for education and training.

An essential function of leadership, in the government of nations as in the management of industries, is to plan for the future. What we do today was largely determined for us by the vision and action of those who preceded us. Likewise, tomorrow's events will depend on what we plan and do today — on the wisdom we use in planning for the future. Perhaps the most insidious weakness a nation can have is the belief, fostered by propaganda of one kind or another, that it can do everything better than other people. We in this country are subjected to this kind of propaganda in various media — such as the slick advertisements of magazines — week upon week, month upon month. We overlook what we do not hear much about, especially if it is unpleasant.

Unpleasant Facts

One of the unpleasant facts which has but recently been mentioned is that in the field of scientific and engineering education our main competitor — Russia — is speedily passing us. According to the best estimates, the United States now has about 800,000 engineers and scientists — Russia 650,000. Disturbing as this is, it is insignificant as against the rate with which she is increasing her engineering and scientific talent compared with us. In 1954 she graduated more than 50,000 engineers and scientists; we graduated 23,000. Mr. Allen Dulles, the Director of our Central Intelligency Agency, has stated that between 1950 and 1960 Soviet Russia will have graduated 1,200,000 scientists and engineers, compared with 900,000 in the United States in our present program. Thus by 1960 it is estimated she will have more engineers and scientists than we; moreover, the rate of attrition in Russia is lower than ours because of lower age.

Some may argue that Russian engineers are not technically as well trained as ours. This is not the case. It is true that they are trained in engineering exclusively and at the cost of their general education. Further, their engineering training is confined to narrow specializations. This is so because the Soviet educational philosophy is based on the premise that the purpose of education is to train the individual for the particular purpose the state requires.

You know what kind of a job the Russians have done on jet engines, radar, long-range bombers, and atomic weapons. Their industrial production has quadrupled in the last fifteen years.

The Clear Trends

The Russian approach to education is a total approach. They are educating as many women as men, and women constitute one-half of the total in the professions. In contrast, in the United States this is but a fraction of one per cent. Can we continue to neglect so large a potential of trained personnel ?

While our mass production system will permit us, for the time being, to build more things faster than Russia, their engineers may soon, by their very numbers, invent better machines. In rate of progress they are, in fact, already ahead of us. We must not take for granted our present technological leadership.

There are some who believe that the United States is not even graduating enough trained people merely to sustain our present rate of technical expansion beyond the year 1970. What is certain is that unless the number of our scientists and engineers increases at an accelerated rate our economy will be in serious trouble for lack of technological nourishment, because our pool of graduate engineers is the source from which arise nearly all our technological advances from jet engines and nylon, to earth satellites, atomic power, and intercontinental missiles.

In light of these facts, the present Soviet peace offensive makes a great deal of sense to the Russians. Recently Mr. Khrushchev said: "We don't have to fight. Let us have peaceful competition and we will show you where the truth lies. . . . Victory is ours."

Can we in the United States permit this challenge to stand ?

Quality Imperative

America's present educational crisis is not only one of quantity — *i.e.*, not enough engineers and scientists being graduated each year — but also one of quality. And this is a serious matter, for in the contest with Russia we must depend on greater human quality, since we cannot match her manpower in numbers.

Our primary and secondary schools have recently come in for much criticism for not doing a good job. Actually, the average high school graduate of today is better trained than the one of seventy-five years ago — which should not surprise us since today's school year is twice as long as that of 1870; the proportion of teachers to pupils is greater; and — even taking into account the changed value of the dollar — we spend nine times as much per pupil today as we did in 1870. We have thus a situation where the child goes to school twice as long, costs us nine times as much to educate, but gets only a little better education than he was getting eighty-five years ago.

Unsatisfactory as this may be, the real issue is not whether the present-day pupil compares favorably with the pupil of 1870, but whether he is adequately trained for the demands of today's society. I submit that he is not.

I say this on the basis of study, intuition, and the experience I have gained from interviewing more than one thousand college graduates over the past ten years.

My experience in selecting people may have some relevance for other engineers because the design and development of nuclear power plants is extremely difficult. It encompasses the most advanced scientific and engineering concepts in physics, mathematics, chemistry, metallurgy, electrical engineering, electronics, and mechanical engineering. The problems we face in nuclear power plants are indicative of what all branches of engineering will soon have to face.

The single most important thing I have learned from these interviews is that all but a small number of the young college graduates lack proper motivation. Some of them consider their degree merely as a ticket to a job, and a pass for security. They use the college as a "service station".

This desire for security in terms of money, rather than in opportunity for self-improvement, is hard to understand in a society where security is so readily available.

Another important point that has been made clear to me in interviewing young graduates is that they know many facts — but they have not learned many principles. Principles are more important than facts and far more difficult to master. But once a principle is learned, it becomes a part of one, and is never lost. The facts we learn are soon forgotten and their meaning changes with time. A trained man knows how to answer questions. An educated man knows what questions are worth asking.

My concept of a good engineering course is one in which the student learns the principles of mathematics, of physics, of mechanics, of electricity, of metallurgy, and of chemistry. A thorough understanding of these leads easily to handling the facts associated with them.

I do not believe that "practical stuff" should be or can be properly taught in a university. The reason is easy to see. Nearly all college textbooks are several years behind current industrial practice. Furthermore, they are written by men who do not have the latest "practical" information, so that the texts are obsolete even while they are being written.

The employer who wants a "practical" engineering graduate is simply hiring a man who knows how to make the same mistakes that have been made in his plant for the past ten to fifteen years.

Whose Responsibility?

The failure in education is not the fault of the educators alone. It is the fault of all of us in not recognizing the impact of the Twentieth Century scientific revolution and taking the necessary measures in time.

I have tried to give you my view of the problems that face us in engineering education. What can we do about them ?

First, we must see to it that every young man and woman who is qualified obtains a college education. Today less than half of those capable of acquiring a college degree enter college. Sixty per cent of the best students graduating from high school do not go to college. This is a tremendous loss of talent amounting to 250,000 students each year. And nearly half of all those who do start college do not graduate. For every high school graduate who eventually earns a doctoral degree there are twenty-five others who have the intellectual ability to achieve that degree, but do not. We simply cannot afford a waste such as this.

Second, we must increase the funds for education. The United States is spending about two and a half per cent of the national income on education. In contrast we spend more than four per cent on recreation. We spend more money for comic books than for all textbooks used in our elementary and high schools. In 1951 the amount spent for advertising was $199 for every family in the United States, but the amount spent for primary and secondary education was $152 per household. This means that our national outlay for the education of citizens was substantially less than our expenditures for the education of consumers.

It may amuse you to know that in a recent year the United States home permanent wave industry budgeted for research into ways of improving the looks of human hair a sum amounting to two cents per United States (female) capita. The whole nation meanwhile was spending only three cents per capita for research into the distressing things that go on inside the human head.

How Much Are Teachers Worth?

Third, from what I read in the papers we seem to be more concerned with expenditures for school buildings than for spending money to obtain better teachers. Schools can be constructed in two years or less, but it takes four years to train an elementary or high school teacher, and seven to eight years to train a college professor. Our school buildings may be the best in the world, but can we say the same of our teachers ? I do not mean to imply that we should not have the best school buildings, but perhaps our children would be better off with fewer buildings but with the best teachers it is possible to obtain. We plan to spend twenty-five billion dollars in the next ten years on school buildings. What amount are we prepared to spend for assuring better teachers for these schools ?

The real question is, "Can we afford not to spend enough for such assurance ?"

This leads me to the question of the salaries we pay teachers. Compared to other professions there has been a considerable drop in their purchasing power, particularly for those at the highest professional levels. The deterioration at the top is so great that it has affected the attractiveness of the academic career as compared to other professions.

In any profession, and particularly in the teaching profession, there are dedicated people who will work under adverse conditions and at low pay. But we must not delude ourselves that the answer to our dilemma lies solely in dedicated people. There will never be enough of these. We are not entitled to educate our children on the philanthropy of our teachers. Whether we like it or not, in the culture which exists in the United States today the desirability of a given occupation is measured largely in terms of salary. As a rule the better people are attracted to the higher paying professions. This explains why the ablest young men and women are turning away from teaching even though numerous scholarships and fellowships are available. No such recruitment problem exists, for example, in medicine or in law. These have no lack of applicants; in fact many are turned away.

When the income of teachers rises to the point where it competes with other professions, it will attract the right kind of people.

Therefore, I submit that an immediate step in solving our educational problem is to increase salaries drastically. It little matters that some teachers will be overpaid. The low salaries paid for the past fifty years have served to attract to the teaching profession many who are not really qualified. It will profit us very little to spend millions of dollars on scholarships and then place the students under incompetent teachers. Increasing salaries is the surest way to attract more competent men and women over the long run. Further, when salaries are increased it will be possible to base advancement on performance, and not on the basis of time served.

Current Alternatives

Unless we quickly remedy the present treatment of our teaching and scholarly resources we will inevitably have morally and intellectually incompetent teaching staffs. Eventually the bright young man will sacrifice his desire to teach in favor of an adequate standard of comfort, decency, and security for his family. The movement away from teaching has actually begun and it looks as though it will continue at an increasingly rapid rate.

We all know of the nationwide shortage of elementary and high school teachers. What is not evident is the real meaning of this shortage, because very few classrooms are ever closed because a teacher is lost. What happens is that teaching standards are lowered or the class size is raised. Both of these accommodations are already taking place at a growing rate. When a teacher with the desired qualifications is not available, someone with lesser qualifications is hired. The teacher then becomes, in effect, a "baby sitter."

The result of this niggardly payment of our teachers — of those upon whom we depend to transmit our culture and our civilization — is to commit a fraud on our children. If the children were as astute as their elders supposedly are they would say: "I'm sorry, but I'm not ever going to be ten years old again. Can't you afford to give me good teachers now ?"

Lengthen School Year

Another thing we can do is to increase the length of the school year. The present school year is based on the requirements of an agricultural economy where the children had to help on the farm. True, the actual number of days at school now averages about 180 as compared with 90 days about 80 years ago. But, as you well know from your own experience, and from what your children tell you, many of these 180 days are wasted. With the great and geometric advance in knowledge since the turn of the century, can we afford to have our children devote less than half their available days to elementary schooling ? Students in Europe, including Russia, attend school six days a week instead of five, and their vacation period is about two-thirds of ours.

There is no longer a sufficient number of years left during youth to develop properly educated men and women. And we cannot keep them in school too long after they reach the age of twenty-two or twenty-three because it is then time for them to face the problems of the world. So it is to the earlier years that we must look for added learning. This problem has become particularly acute due to universal military training.

Many of you occupy responsible positions in industry, and you know that the great increase in our productive capacity comes from the optimum use of people and facilities. Some of the problems of education, particularly those concerned with administration, are susceptible of solution by the same methods we use in industry. Industry cannot operate effectively on a 180-day year. Why should we think our schools can ?

Increasing the length of the school year, say to 210 days, would be the equivalent of making two additional years available before college.

If to these two years we added better teaching, better school administration, and better use of school facilities, it is quite possible that by the time a young man reached the age of eighteen he could have completed the equivalent of the present day college course. This is not as farfetched as it may sound. Something close to this has been achieved in Europe.

Permit Rapid Individual Advance

Another important thing to be done is to make it possible for every gifted student to advance as rapidly as he is able to. It may be impossible for us to compete with Russia in the number of trained people but we must excel in the quality of our trained people. To accomplish this requires a drastic change in our attitude towards our primary and secondary schools — particularly our high schools. Up to World War I the high school was intended as a preparatory school for those who desired to continue on to college or university. The courses were organized on this basis and they did a pretty good job, considering the cultural and scientific climate of the time.

But the high school of today is no longer a place whose primary purpose is to prepare students for college. Instead, its purpose has proliferated into providing educational, occupational, civic, and cultural training for every child.

In this time of acute teacher shortage in our schools we might well consider relieving them of the problems which could just as well be taken care of in the home or by other activities. Under pressure from various groups, courses are being given whose educational value is questionable. Nearly half of our high schools offer little or no instruction in physics, chemistry, or in mathematics beyond introductory algebra. The percentage of high school pupils who today study scientific subjects is indicative of this:

	1900	*1950*
Physics	23	4
Chemistry	10	7
Algebra	52	27
Geometry	27	13

The high schools have been required to arrange the necessary curriculum to take care of the average boy or girl. For many children the school makes up for what they cannot obtain at home; and, in some cases, it takes the place of the home. The ones who suffer are the gifted children. Some parents, those who can afford to, send their children to private schools. Whether or not these are really better than our public schools is a moot question. Certainly it is not altogether desirable to have children, during their impressionable years, associate only with those who have the same economic background.

Two Kinds of Schools

A partial solution to the high school problem lies in setting up two different kinds of schools, one having higher standards than the other. There can be no valid objection to this because boys and girls with the necessary ability could go to the more difficult school. True democracy does not require of us that we hold back the qualified; it does require that we give each individual the opportunity to develop his talents to the fullest.

There is, however, a current of educational thought which is opposed to special treatment of gifted children. It is claimed that there are too many difficulties and injustices involved in recognizing ability at an early age, so that children of all abilities must be educated in a common manner. It is also claimed that educational grouping of this sort leads to or accentuates social stratification, and is, therefore, undemocratic.

Neither of these arguments will bear critical examination. If it is considered democratic to give special care to our retarded children, as we should and must, why should it not likewise be considered democratic to help our brightest children. There are many things which are pure gifts and which we cannot acquire even by the greatest application: they are endowments granted to us by God. Among these gifts are creative artistic talents, profound sensitivity to art, music or literature, philosophical power, and scientific or engineering intuition.

Every outstanding scientist or engineer is in his own way an artist. That is why he is able to reach out into the unknown and grasp a new truth which remains invisible to others.

This is the reason we must seek out and cultivate our gifted children, for it is from their ranks that creative ideas will come.

I have spoken of these major methods by which our educational potential can be improved: increasing the length of the school year together with better school administration; making sure that gifted children are afforded every opportunity; and obtaining enough good teachers.

Scale of Demands

Here are the unprecedented educational problems we now face: Elementary school enrollment has risen from 20 million in the 1940's to 29 million today, and is expected to reach 34 million in 1960. High school enrollment will increase from 7 million today to about 12 million in fifteen years. But the severest impact will be felt by the colleges and universities where the attendance will increase from about 2½ million today to between 5 and 7 million within the next ten to fifteen years.

To maintain the present pupil-teacher ratio the elementary and high schools will have to enlarge their teaching staffs by 500,000 in the next ten years; this is a greater increase than took place in the previous thirty-five years. But to achieve a net increase of 500,000, three times that many will have to be recruited to take care of those who leave to get married, to take other jobs, or to retire. And the colleges and universities will have to add more teachers in the next fifteen years than they have in all their previous history.

But faced with this formidable and unprecedented situation, we start with a present shortage of 140,000 qualified teachers. If the nation's schools are to be adequately staffed during the next ten years, more than half of the college graduates during that period will have to enter the teaching profession. But at present only one-fifth of the college graduates become teachers.

Public and Private Efforts

Our difficulty arises from the fact that we are not living in a static society, nor do we have a static population. We are faced with a national problem of the first magnitude and a major and over-riding effort by all of us is necessary — the federal government, the state and city governments, the schools, industry, and other private organizations. Because we have not been mindful of this situation does not mean that others have been equally unmindful. The meaning of what the Russians have been doing in education now becomes plain.

A partial solution and one which could be immediately effective is to enlist the aid of industry. Why cannot the scientists and the engineers from industry be given sabbatical leave to teach in our schools? The very shortage of college graduates and many of our educational problems have been created by the vastly increased requirements of industry. In 1900 the ratio of engineers to other workers was one in three hundred; today it is one in sixty — and in highly advanced industries it has already reached the figure of one for about every twenty workers.

Industry is today short more than 40,000 engineers and will require a minimum input of 30,000 for many years to come. The only serious attempt made by industry to solve this problem has been to offer considerably higher salaries to young college graduates. This has resulted in an unhealthy situation where the small number of graduates are being sought after by many organizations. Recently, at one college, the same 200 members of the graduating class were interviewed by representatives of nearly 500 companies. This is not recruitment; it is inflation. We have learned in the case of goods that inflation can only be solved by greater production; this is true of college graduates as well. There is danger to the young graduates in being sought after so avidly. Success is too easily achieved, and he gains it so quickly and so easily that he has had no time to learn the humility to handle success, or even to realize that he will need humility.

It is not farfetched to expect industry to help carry this social obligation. In present day America the business corporation is not a business device alone — it has become a social institution and has acquired the obligations inherent in this concept.

We have always recognized a duality in our schools: federal and local support; public and private support. Industrial support of schools fits into this duality.

It has also been characteristic of our people that when a social need arose which government was not able to take care of, groups of citizens have joined together to help.

Specific Recommendations

Specifically, I suggest that, at their own expense, industrial organizations make available their scientists and engineers for one-year periods to teach in our high schools, colleges, and universities. The cost of this will be more than repaid by the larger number and better trained students who will soon be available.

Another thing industry can do is to help finance education. This has already been started by some corporations in providing scholarships and other aid. I suggest that financial contributions to education rather than scholarships be made, but on a considerably larger scale than is presently the case, perhaps as a percentage of gross sales. These funds might be assigned for distribution to central groups of men not associated directly with industry or with the schools. This will eliminate any possibility of industry being accused of influencing education or the schools of being self-seeking.

The use of manpower and funds by industry in this manner could be considered as a legitimate operating expense required for the future good of the business.

Similar contributions by labor unions would also be appropriate.

There are a number of aspects connected with this proposal which I would like to discuss at greater length, but which time does not permit. There is the possibility of using the funds so contributed for the establishing, staffing, and operating of new schools. There is also the possibility that scientists and engineers of each community, as part of a definite company plan, could act as counselors for one or more high school students, devoting a part of their time to helping them to become interested and proficient in scientific and engineering subjects. They could also take over the leadership of the various after-school clubs in science, radio, mathematics, etc., thus relieving the teachers of this duty.

The United States, if it is to succeed in its role of world leadership, must produce citizens who have the wisdom, the vision, and the knowledge to grapple successfully with world problems; citizens who can see critically through conventional values and who are able to subject to principle and to reason all claims to power.

In the conditions of modern life the rule is absolute, the race which does not value trained intelligence is lost. It will matter little what other excellences our educational institutions possess if they neglect to recognize and to foster high ability wherever it is found.

The Choice Now

The task of ensuring that every youth in our land is helped to his highest intellectual growth is a formidable one. This task arises not alone from the military situation posed by Russia, but also from the realities of the rapidly spiralling scientific revolution. We are faced with a fateful challenge. The way we, today, meet it, will determine the future of our Country. We must not let it be said by future generations that we used our intellectual and moral capital without replacing it.

Only by an educational system strengthened, not only in its members and its organization, but in its sense of purpose can we hope to meet the obligations which today's events place upon us. And only if we meet them can we create in our society the kind of leadership without which we cannot hope to meet the responsibilities and the possibilities that our time has opened before us.

Month To Month

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

Increased Technical Activities

Report to be made at the Annual Meeting

For some time Council has been giving consideration to a proposal whereby the Institute's interest in technical papers and other activities will be increased materially. Over a long period of time F. L. Lawton, a councillor of the Institute, has been advocating this increased activity. He has presented a series of reports to Council the outcome of which it is expected will be a revised program.

For many years the Institute has made no special effort to develop highly technical activities within the branches or within the membership. This has been due to a number of causes principal among which was the fact that as the Institute was catering with equal emphasis to all branches of the profession it became more difficult to specialize in highly technical papers which would be related to one particular branch of the profession.

The second reason is that there have been fewer technical developments within the profession in Canada as compared to the United States or the United Kingdom. In Canada a great many of the industrial organizations are subsidiaries of organizations mostly in the United States but not infrequently in the United Kingdom. Naturally enough these organizations have done their research and development work in their parent plants rather than in their branch plants. In this way the technical aspects of the Canadian companies' activities have been greatly reduced and the opportunity for technical activities within the Institute have thereby been reduced.

Technical Development

Today, however, there are many changes coming over the profession. There are so many new divisions of it such as nucleonics, electronics, aeronautics, to mention only a few that even in Canada there is a great development in technical thinking. As a consequence of this there is an increasing interest in research and the theoretical aspects of engineering.

One must not overlook the excellent work done over the years by the technical divisions of the branches at Montreal and Winnipeg and later Toronto. It is the broad expansion of such activities in many branches and on a national basis that is now needed.

Mr. Lawton expects to present his final report at the annual meeting of Council in Montreal on May 22. It is expected that as an outcome of his recommendations the Institute will set up a new division whose purpose will be to promote activities within the technical field, on the part of our members. It is expected that the organization will finally find its way down to the branch level and that through the new arrangements, not only will branches have more technical papers on their program, but the annual meeting of the Institute itself will have access to a greater number of really technical manuscripts.

Members Will Participate

When the time comes to set up the new organization it is evident a great many members will need to be recruited to carry on the work. As soon as all arrangements are agreed to by Council the membership will be informed. This note is simply by way of indicating that something is underway and that shortly it is planned to present a detailed report of a far reaching nature.

Cover Picture

Site of the 1956 annual meeting of the Institute, Montreal. This view shows the city from the harbour.

Canadian Pacific photograph

Seventieth Annual General Meeting

Notice is hereby given, in accordance with the by-laws, that the annual general meeting of The Engineering Institute of Canada for 1956 will be convened at the Sheraton-Mount Royal Hotel, Montreal, at ten o'clock a.m., on Wednesday, May 23rd, 1956.

Competitive Bidding and Professional Conduct

Recently the American Society of Civil Engineers conducted a ballot which proposed a revision in their Code of Ethics. It is significant that the proposal was carried with a favourable ballot of 12,443 against an unfavourable ballot of 1,554.

The article in its former form read as follows: "It shall be considered unprofessional and inconsistent with honourable and dignified bearing for any member of the American Society of Civil Engineers:

> "4. To participate in competitive bidding on a price basis to secure a professional engagement".

The amendment which was approved by an overwhelming vote has changed the wording to read this way: "It shall be considered unprofessional and inconsistent with honourable and dignified bearing for any member of the American Society of Civil Engineers:

> "4. To invite proposals for the performance of engineering services or to state a price for such services in response to any such invitation, when there are reasonable grounds for belief that price will be the prime consideration in the selection of the engineer".

This is a subject which has been discussed many times by many engineers in different parts of Canada. This recent action of the members of the American Society of Civil Engineers doubtless will be found interesting to many Canadians.

Journal Changes Printer

Readers should be informed that effective with the July issue *The Engineering Journal* will be handled by a different printer. In addition to definite financial advantages resulting from a better price schedule, it is confidently expected that the date of publication, and mailing, will also be improved appreciably.

It would be more satisfactory to all concerned we are sure if the *Journal* came out by the 15th of each month instead of at the end of the calendar month as has been the case too often. Improved service, and lower cost, are the objectives of the change.

Work Outside of Canada

As has been reported before in *The Engineering Journal*, the Institute has been interested in securing information about engineering and construction projects which are taking place outside of Canada but which might be of interest to Canadians.

In the July 1955 issue of the *Journal* a report was made about a meeting held in Montreal at the time of the annual meeting of the Canadian Manufacturers Association. Since that time a certain amount of information has come to the joint committee and has been circulated to a group of individuals and firms who have expressed an interest.

Information about such projects continues to arrive and as far as the Institute is concerned the question now is to know which consulting engineering firms and which contracting firms are interested in knowing about this work to be done under the Colombo plan or in the Middle East. It is intended now to prepare a list of interested persons and to see that copies of the information go to them promptly.

As was reported before, a joint committee has been set up to distribute the information. The committee is made up of a representative of The Canadian Construction Association, The Canadian Manufacturers Association, and The Engineering Institute of Canada. There are many organizations that are interested in all three of these agencies. Therefore it becomes necessary when preparing a mailing list, to make certain that duplications are eliminated but that in one way or another everyone gets the information in which he is interested.

The purpose of publishing this notice is to bring to the attention of consulting engineers, and general contractors, the existence of information dealing with this type of project. If they are interested in seeing the details we would recommend that they send to the Headquarters of the Institute the name of the individual within their organization to whom such reports should be transmitted.

Where are Your Button and Certificate?

If you have had occasion to visit a medical doctor lately you could hardly have missed noticing several details of his surroundings. A well displayed sign near his entrance carried the title "Doctor", and in a place of importance inside you saw the framed certificate setting forth his professional status. Maybe there were several. He, and his colleagues, are proud of these insignia, and take for granted the prominent display of them. Why are so many engineers so different in this respect? And is it a good thing for us to thrust these tokens of professional achievement into a bottom drawer? We think not.

At many points on the President's tour this was a subject of discussion with members of the branch executives. These men were practically unanimous in their approval of the idea, at least in principle, that much can be done to stimulate interest in displaying E.I.C. certificates in engineering offices, and in wearing lapel buttons. But let's DO something about it! Where are yours?

We have found that quite a few members are actually unaware that certificates of membership and E.I.C. lapel buttons are available. Simply write to headquarters, 2050 Mansfield Street, Montreal 2. And look for the display of these items at the Annual Meeting in May. The cost is moderate —$1.25 for a certificate, and $2.00 to $7.00 for a button, depending on your grade of membership.

GZOWSKI and the Construction of The International Bridge between Fort Erie, Ont., and Buffalo, N.Y.

by W. E. Greening and Dr. Ludwik Zubkowski
Montreal, Que.

> **Canada is now old enough to have some engineering history, but much must have been lost for lack of a recorder and much is buried in official reports in inaccessible files and in books seldom seen. The authors of this paper have rescued some important incidents of Sir Casimir Gzowski's career from oblivion - Sir Casimir for whom our medal is named and who was a founder of the old Canadian Society of Civil Engineers and its president in 1889 and 1890.**
>
> **They read this paper at a meeting of the Institute of Slavic Studies.**

One of the most important engineering figures in Canada during the nineteenth century was the romantic Pole, Sir Casimir Gzowski. Of aristocratic origin he was exiled (in 1813) from his native land because of his participation in the revolt of the Polish patriots against Russian Czarist despotism and tyranny in 1831 and 1832. He landed in America as a penniless refugee, not knowing a single word of English, but eventually made his way to Canada, where he quickly rose to prominence in the engineering profession.

As Chief Engineer of Public Works in Upper Canada in the early eighteen forties, he was responsible for the construction of many highways, bridges, lighthouses and harbour works. Later, he entered the field of railway engineering and supervised the construction of part of the St. Lawrence & Atlantic Railway between Montreal and Portland, Me., the first line between Montreal and the Atlantic Coast. Later, he formed a construction firm, Gzowski, Macpherson & Co., which built the line of the Grand Trunk from Toronto, through Guelph and Sarnia to Detroit, Mich. He was also employed on several surveys by the Canadian Government which led to the improvement of the navigation channels and the canals on the St. Lawrence River between Lake Ontario and Quebec City.

He was one of the founders of the old Canadian Society of Civil Engineers, now The Engineering Institute of Canada, in 1887, served as its president in 1889 and 1890 and had a great deal to do with its early development and progress. The Gzowski medal, which is still given by the Institute annually for the best paper by a Canadian, on an engineering topic, commemorates his name.

One of Sir Casimir's most distinguished engineering exploits was the construction of the International Bridge across the Niagara River between Fort Erie, Ont., and Buffalo, N.Y., in the early eighteen seventies.

Ever since the beginning of the railway era, there had been discussion both in Canada and in the United States of the project of building a railway bridge across the Niagara River at this point, near the eastern end of Lake Erie. Several bridges had already been constructed across the river in the vicinity of Niagara Falls. The most celebrated of these was that erected by the well known German-American engineer, Augustus John Roebling, in the eighteen fifties. It was the object of great wonderment at the time because it was one of the first important bridges in North America to be suspended on wire cables. It afforded rail connection close to the Falls between Canada and the United States by linking the system of the Great Western Railway in Ontario with that of the New York Central in New York State. During the same period, another bridge had been constructed for road traffic further down the Niagara River at Lewiston, but it had been wrecked by a violent gale in 1861.

By the middle of the eighteen sixties, it was apparent that there was need for a more direct rail connection than that afforded by the suspension bridge at Niagara Falls, between the fast growing City of Buffalo and the section of the Ontario peninsula directly to the west, on the other side of the Niagara River. The construction of the Great Western Railroad between Detroit and Niagara Falls, through London and Hamilton, had already shown the convenience of the rail route across Ontario between Michigan and New York. Other railway companies became interested in giving the Great Western some competition in this area.

As early as 1858 a line was projected from Buffalo across the Niagara River to Lake Huron. This was the Buffalo, Brantford & Goderich. It was promoted by a group of capitalists in Brantford and some of the adjacent Ontario communities. It was planned to cross the Niagara River by bridge and then run westward through Brantford and Stratford, where it would make connections with the Grand Trunk, having its terminus at the Port of Goderich on Lake Huron. The men behind this scheme hoped that freight brought by steamer from the upper lakes would be transported by this line as a fast route from Goderich to Buffalo, where a connection would be made with American rail lines and with the Erie Canal.

Like so many other Canadian

railway ventures of this era, the Buffalo, Brantford & Goderich soon fell on evil days, became insolvent and was acquired by an English group, who changed its name to the Buffalo & Lake Huron. This company was able to complete the line between Fort Erie and Goderich, but lacked the large amount of capital necessary for spanning the Niagara River at this point. Eventually the Buffalo & Lake Huron was absorbed by the Grand Trunk, which possessed both the money and the initiative to make a start on the bridge.

The aim of the directors of the Grand Trunk in giving their support to the bridge project was an obvious one. By linking their own lines from Detroit and Sarnia with the Stratford, Fort Erie and International Bridge route, they would create a new fast route across southern Ontario from Detroit to Buffalo, which would rival the Great Western one from Detroit to Niagara Falls.

The Grand Trunk acquired control of the International Bridge Company, which had been chartered under the laws of the Province of Ontario and of the State of New York, and capital was raised in England for the enterprise. Since the undertaking was an international one, permission had to be obtained from the British Imperial authorities in London and an act of Congress had to be passed in Washington before work could be begun.

It was natural that the Grand Trunk should choose the engineering firm of Gzowski, Macpherson & Co., of Toronto, for the construction of this bridge. Casimir Gzowski was thoroughly familiar with the latest methods of bridge construction in Europe and North America. The structures which he had built on the Grand Trunk line between Toronto and Sarnia had received much praise because of the excellence of their design.

The plan for the project, as originally outlined by Gzowski in 1870 with expert advice, called for the construction of a simple truss, iron bridge on stone piers across the main channel of the Niagara River between Fort Erie and Squaw Island on the American side of the international boundary. A shorter span would take the rail line across Black Rock Harbour, which forms part of the Erie Canal, to Black Rock on the mainland of New York State. From there, a spur line would connect the bridge with the main line of the New York Central in Buffalo, a short distance to the south. Swing spans would be placed in the centre of the section across the Niagara River and in the section across Black Rock Harbour to allow the passage of boats. When completed, the bridge would thus give the Grand Trunk direct access into the centre of Buffalo and links there with the New York Central and with the other American lines converging at that point. It would be the first bridge built on piers across the Niagara River since the previous ones near Niagara Falls had been of the suspension type.

In undertaking this project, Gzowski was almost immediately confronted with some tough problems. The prospects were not very encouraging. People familiar with conditions in the Niagara River in the vicinity of Fort Erie and Black Rock declared that such an enterprise was impossible of achievement. Gzowski, in his own account of the construction of the bridge which was published in Toronto in 1873, recounts some of these obstacles and they were certainly enough to discourage the most stout hearted and determined individual.

The Niagara River was fifty feet deep in the centre at this point and the bottom was a treacherous one. The current was very swift and the depth of water was subject to sudden and completely unforeseeable fluctuations. A strong northeast wind from the New York shore could cause the level of the water to sink by nearly two feet in less than half a day. On the other hand, a strong southwest wind blowing up Lake Erie would raise the surface near Black Rock as much as five feet in as many hours. All these factors meant that the construction of the stone piers upon which the superstructure of the bridge would rest, in the centre of the river, would be a tricky and hazardous undertaking at the best.

Further difficulties were created by the ice conditions in the river, which made all construction activity impossible there during the winter months. At the end of the navigation season in the Great Lakes in early December, the centre of the river did not freeze over because of the swift current, but cakes of ice, sometimes twenty feet across, would float down the river from the ice fields opposite Buffalo at the end of Lake Erie. Later on, toward spring, there was the danger of large ice floes from other parts of the lake. Pessimists claimed that the pressure from these great masses of ice would destroy any stone piers in the centre of the river, no matter how strongly they might be based and built.

During the summer months huge rafts of logs passing down the river from Lake Erie to Tonawanda, N.Y., created an added hazard to the construction operations.

These alarming stories eventually reached the ears of the directors of the International Bridge Company and of the Grank Trunk in London. The latter sent an eminent engineer, a Captain Tyler, to Canada for the purpose of inquiring into the truth of these rumours. After examining Gzowski's plan for the bridge and making extensive investigations on the spot, he returned to London with the report that there was no cause for undue anxiety, and that the stone piers designed for the bridge would be strong enough to resist the force of the largest ice floes coming down from Lake Erie.

Work was begun on the bridge from the Canadian side of the river at Fort Erie in the early spring of 1870. Gzowski, of course, spent much time on the spot, personally supervising construction operations and working out engineering problems as they arose. But it is indicative of his great energy and capacity for work that, during some of this same period, he was also serving on an important commission the activities of which required much travel, and which had been appointed by the Federal Government to investigate the entire canal and waterway system of the new Dominion with a view toward its extension and improvement.

The superstructure of the bridge was of iron and was manufactured at the Phoenix Works in Pennsylvania. Iron was used for the fabri-

The authors of this article are preparing a complete biography of Sir Casimir Gzowski, which is to be published this year in book form.

cation of bridges during this period, as steel did not come into general use for this purpose until the end of the eighteen seventies, some years later. A Pratt truss design was selected because it had the advantages of being strong and at the same time comparatively light in weight. This latter was an important factor, since it cut down construction costs and Gzowski's budget, a million dollars, was a low one for an enterprise of this size and difficulty.

The stone piers on which the superstructure of the bridge was to rest in the section across the main channel of the Niagara River, were erected on caissons which were floated into position and sunk with the aid of cables and anchors. No very great difficulty was met in placing the first three piers in the section of the river which was closest to Fort Erie, since the bottom there was solid rock. By the spring of 1871 these structures and the stone abutments which were to carry the rail line out into the river from Fort Erie were completed.

The first real engineering headaches were met in sinking the foundation for Pier No. 4, which was near the centre of the river where the bottom was deepest and the current strongest and where fluctuations in the level of water were the most frequent. Early in May, 1871, when the caisson which was to be the foundation for this pier was lowered, one of the cables holding it parted. This threw such a strain on the remaining cables that the anchors began to draw and the caisson to sway violently from side to side. Finally it sank at a point below the line of the bridge. Before arrangements could be made to raise it, a violent wind storm carried part of it still farther down the river.

Gzowski then decided that no further effort should be made to obtain a base for this pier during 1871. Soundings in the area, made with the aid of divers, revealed the very unwelcome fact that the bottom of the river at this point consisted of layers of gravel interspersed with boulders and shale, which would have to be removed before the solid rock beneath could be reached. It was obvious that extensive dredging operations were necessary there. Gzowski finally decided to sink at this spot a large bottomless caisson inside of which excavation and dredging operations could be carried on in calm water. Divers worked at the bottom dislodging material which was brought to the surface with dredges. This was a difficult task, since the divers had to work in complete darkness with only their sense of touch to guide them. After much effort, the over-burden was completely removed and the inner watertight caisson on which the pier was to rest was lowered and secured.

In the summer of 1871 preparations were made for the sinking of the caisson for Pier No. 5. Here an even more serious mishap occurred. As we have said, at this period of the year large log rafts were floated down the river past the site of the bridge. An unusually big one came down the current from Lake Erie. It was about 3,000 feet long and most of the logs of which it was composed were more than 60 feet long. Through the carelessness of the crew operating the tug to which it was attached, this raft struck the caisson and there was an ear-splitting crash. The logs in the raft were twisted into all kinds of irregular positions. The stern of the raft swung into the main current of the river against the cables holding the caisson, which were thus exposed to a tremendous strain from the immense log structure. For a few moments the whole confused mass of caisson and raft remained stationary and then it began to move down river, dragging the anchors with it. The wreckage finally came ashore near the lower end of Squaw Island.

This accident was a grave one and involved much loss of time and additional expenditure of thousands of dollars. The caisson had to be towed back to Fort Erie and prepared for sinking a second time. When it was being placed in the centre of the river again, it swung around in the current and became completely unmanageable.

When fresh soundings were made, it was found that the bottom here was of the same treacherous type as that underlying the site of Pier No. 4, and the same type of excavation and caisson work was used again with similar success. Little difficulty was encountered in building the remainder of the piers in the Niagara River and in Black Rock Harbour which were erected on foundations of piles. In the meantime, work had begun on the installation of the iron superstructure, which was raised with the aid of pontoons.

First Locomotive Crosses Bridge

By the end of the summer of 1873 the sections of the bridge over the river and across Squaw Island and Black Rock Harbour were practically complete. The first locomotive went across the new bridge from Fort Erie to Black Rock on October 27, 1873, and the structure was officially opened to rail traffic at a ceremony which took place about a week later and at which high officials of the Grand Trunk were present. Mr. Bridges, the president of the company at this time, paid high tribute to the builder of the bridge, saying: "There is no other man in this country who could have carried on the work of this bridge or gone through the daily and hourly anxiety which it has entailed during the past four years, save Colonel Gzowski."

Indeed, it was a triumph of perseverance, skill and resourcefulness in the face of obstacles which would have completely defeated a man of lesser calibre. One notable fact was that the gloomy prophecies which had been made concerning the menace of the ice floes in the Niagara River to the foundations of the bridge proved to be utterly unfounded. The piers were so solidly constructed, out of such good quality stone, that they were in no way affected by the severe ice conditions during some of the winters which immediately followed the completion of the structure. Although the iron superstructure was replaced by a steel one at the beginning of the present century, the stone piers still remain as Gzowski built them more than eighty years ago.

The construction of this bridge was the subject of general acclaim in engineering circles both in North America and in Europe and its completion was recognized to be an outstanding feat even in this era of such epoch making accomplishments in the engineering field as the building of the Brooklyn Bridge and the Eads Bridge.

In addition to its importance as a feat of engineering, this bridge also had a good deal of significance in connection with the linking of the rail networks of Canada and the United States. It gave the Grand Trunk an entrance to Buffalo from which lines radiated south and east to New York, Philadelphia, Pittsburgh and other points. Shortly after the completion of the bridge, the Great Western, in order to compete with the Grand Trunk, built a short line from Glencoe, between Windsor and London, and across Ontario to the bridge. But what was more important still was the construction of another railroad across this region, the Canada Southern. Although the promoters of this road had no direct connection with the International Bridge Company, there is no doubt that their plans were powerfully affected by its completion. The route of the Canada Southern ran from Amherstburg on the Detroit River eastward through St. Thomas to Fort Erie and the bridge, with a side line to Niagara Falls. It provided a considerably shorter route between the Detroit River and Buffalo and the Niagara frontier than those of the Great Western or the Grand Trunk. At Amherstburg, it was connected by ferry across Lake Erie to Toledo, Ohio, where it had links with the Wabash system which ran southwestward to St. Louis and Kansas City. It thus provided the nucleus of a new east-west rail route.

These developments in Canada aroused the keen interest of the American railway king, Commodore Vanderbilt. He wanted to create for the New York Central a new route between Chicago and the Atlantic Seaboard. Within the next few years, he bought control of the Canada Southern and linked it at the western end with the Michigan Central, which ran between Chicago and Detroit, and at the International Bridge with his New York Central which ran eastward from Buffalo to New York. He now had a new fast line between Chicago and Buffalo, through Canada, around the north end of Lake Erie and across the International Bridge. The completion of the bridge therefore gave Buffalo important new rail links with the Province of Ontario and the State of Michigan to the west; with no fewer than three lines running westward from Buffalo to Sarnia and Detroit—the Canada Southern, the Great Western and the Grand Trunk. Other railways entering Buffalo from the south and the east, such as the Pennsylvania, the Erie and the Delaware, Lackawanna and Western also built lines to connect with the bridge. It still forms the most important rail link between Canada and the United States across the Niagara frontier.

The Good Things of Life and Engineering

There are many examples of persons complaining that the advance in engineering and science is retarding the development of the arts. Many engineers and scientists have sprung to the defence of the profession and have refuted such charges. Here is another excellent example, not only of a defence, but of an attack as well.

The European and United States Engineers' Conference (EUSEC) held its annual meeting at Copenhagen in September, 1955. On reading over the verbatim of this conference your editor's attention was called to a discussion in which some very cogent observations were made by Mr. J. Eccles who at that time was president of The Institution of Electrical Engineers. Believing that members of the Institute everywhere will support Mr. Eccles in his observations the *Journal* is herewith presenting two paragraphs from the verbatim.

"Mr. Eccles called attention to the importance of encouraging more young people to take up the engineering profession, saying that we are accused as scientists and as applied scientists of having no philosophy of life to offer in our work. Mr. Eccles continued, 'I think that this thing is being played up by the classical people who have themselves a classical education, and who are asking what kind of existence we are creating for the people of the world by mechanizing and creating robots and simply improving in some way the general standard of life and giving people no philosophy as to what life is all about. They feel that is the truth and they believe it, and think the best we can is to produce instruments of destruction.'

"Mr. Eccles continued, 'I myself feel that there may be truth in it, but I think that it is greatly exaggerated and considerably overstated and I should hope that we who are the representatives of the senior people in our respective professions who are old enough and mature enough to have ourselves formed some philosophy of life and the implications of the things we do, should be bold enough to state, if we believe it, that science and the applications of science provide probably the only way in which you can get a satisfying existence for the great majority of the people on this earth. In the past there has been a good life for a few people, and those people who study classics and developed philosophy are inclined to forget that the people they read of in ancient times were only one per cent of all the population, and that the others were slaves and helots; the philosophy that we bring to mankind is that we are extending the good things of this life to the great majority of the people, and that the average standard of living and the possibility of thought and expression for the ordinary man and woman is far more realized today through the invention of science and the application of science, than has ever been possible in this world up till now'."

Consulting Engineers Elect Officers

J. Georges Chenevert, M.E.I.C., of Montreal, was elected president of the Association of Consulting Engineers of Canada Inc., recently. Other officers elected were: vice-president, James MacLaren, M.E.I.C., Toronto; honorary secretary-treasurer, F. J. Friedman, M.E.I.C., Montreal. Other directors are: H. W. Lea, M.E.I.C., and J. G. Frost, M.E.I.C., of Montreal, Georges Demers, M.E.I.C., of Quebec City; C. D. Carruthers, M.E.I.C., of Toronto; past-presidents, E. A. Cross, M.E.I.C., Harry H. Angus, M.E.I.C., Toronto, and A. T. Hurter, M.E.I.C., of Montreal. Associate directors are Col. W. G. Swan, M.E.I.C., Vancouver, K. E. Whitman, M.E.I.C., of Halifax, and Roy A. McLellan, M.E.I.C., of Saskatoon.

Mr. Cross, the retiring president, reviewed the year's work, particularly the program planned in the field of public relations and publicity. The final phase of the annual meeting will be held in Montreal on Thursday, May 24, coincidental with the annual general meeting of the Engineering Institute of Canada. The annual meeting in 1957 will be held in Banff.

Great expansion was reported in the engineering field throughout Canada; natural resources were under a broad program of development in every province and the outlook for the coming year the brightest in history.

St. Lawrence power-house, Barnhart Island. Looking downstream at construction plant and power-house excavation, from U.S. side.

St. Lawrence Seaway and Power Project

The *Engineering Journal* reviews the progress of the St. Lawrence project.

Progress by Ontario Hydro

First concrete was placed on the main dam and power-house in February. Much preliminary work had preceded the concrete placing in the U-abutment section of the north end of the powerhouse excavation. Forms for the base pours were prepared and installed. Erection of the three gantry cranes for handling concrete placing proceeded on schedule.

Work of building the extensive conveyor system to take aggregates to the site of the concrete batching and mixing plant was completed. Assembly of the concrete plant was finished by mid-February, also the pipe system to convey cement under the present Cornwall canal and the diversion canal to the mixing plant silos were completed.

The trial run was made of all this equipment before concrete placing commenced. Several adjustments were made as the batching and mixing plant operations started. Output from the plant was limited at first because of these adjustments and the restricted area for placing the concrete. By the end of February, after ten days of curtailed plant operation, some 5,000 cubic yards of concrete had been placed on the power-house site.

As facilities for handling concrete increase, and the area for placing is enlarged, it is expected that about 2,000 cubic yards of concrete will be placed daily. Meanwhile, excavation was continued at an accelerated pace on the power-house site. The estimated total earth and rock removal by the end of the month amounted to 1,350,000 cubic yards.

In other areas of the project, significant progress was made. Almost 95 per cent of the excavation at the dike closure structure area of Cornwall canal diversion was completed. Installation of the concrete mixing plant for this sector was well advanced.

During the month, excavation continued at the western end of the cut in the Galop Island channel improvement contract. Some difficulty was experienced in hauling because of soft foundation conditions. Pumping was continued in the first excavation bay and the total excavation to date was estimated at nearly 2,000,000 cubic yards. On the Chimney Island contract, building of cribs proceeded on schedule.

At the St. Lawrence transformer station, work was pressed forward towards completion of the 115-kv. area. It was estimated that approximately 90 per cent of the work has been completed by the end of the month.

Preparations for first house moving to townsite No. 2 received further impetus during February as work started on the access road from Mille Roches. Already several hundred feet of sanitary sewer and water main had been laid at the new townsite and work was well advanced on the water intake pipe. Meanwhile at townsite No. 1 sewer and water line were being laid. Some 700 feet of water line and 2,000 feet of sewer pipe had been laid.

At Iroquois, 102 houses had been moved to the new townsite. Work continued on the water pumping station intake and was well advanced. At Morrisburg, house surveys continued. Crews were also carrying out basement surveys, soil investigation and lot surveys. Work continued on the water pumping station site. Total personnel on the work was 2,880.

Mixing Plant for Hydro Power-house

Approximately one million cubic yards of concrete will go into the Canadian power-house, with about the same into the U.S. structure. In terms of railway carloads, the combined concrete total for the two power-houses would make up a train that would stretch for about 1,000 miles, the distance from Cornwall to Fort William.

Concrete for the Ontario Hydro power-house will be produced in the large batching and mixing plant which stands on the north shore of the river. Four thousand tons of concrete on the average will be discharged every workday for the next two and a half years. The plant is completely automatic. Now owned and operated by Iroquois Constructors, before being brought to Cornwall this 200-yard-per-hour plant served Ontario Hydro's new Sir Adam Beck-Nia-

View of the power-house area where first placing of concrete took place in February shows preparation of the site.

gara No. 2 project at Chippawa for the intakes and for sections of the lining of the twin power tunnels.

This central mixing plant has many unique features. It provides fast, accurate, automatic weight batching; compensation for variations in sand and gravel moisture content; instantaneous mix changes with a mix selector; interlocking operations to prevent errors; centering of all controls on one control board, and complete, detailed records of every batch poured.

A rock quarry three miles north of the power-house site will supply three sizes of coarse aggregate and manufactured sand. Trucks will transport the material to hoppers at the north end of the tunnels under Cornwall canal, from where belts will convey them through the tunnels to stockpiles near the mixing plant. From there, conveyors will take the material to hoppers at the top of the batching and mixing plant as required.

Cement will be brought in by railway cars to a siding near No. 2 highway and unloaded into a surge silo. From there it will be blown in a six-inch steel pipe extending through the tunnel and up into two storage silos at the mixing plant. As required the cement is brought into the mixing plant by bucket conveyor.

From the mixing plant concrete is dumped on to conveyor belts and taken to a large hopper, where it is loaded in trucks equipped with special buckets or into buckets on narrow gauge railway cars hauled by small diesel engines. Cranes will lift the buckets and discharge the contents. Pouring operations will continue around the clock, with crews working in three eight-hour shifts. Completion of the power-house is scheduled for late summer in 1958.

Progress by N.Y.S.P.A.

February progress was highlighted by excavation at the structure sites, together with erection of the various contractors' construction plants preparatory to full scale concrete operations. More than twelve million cubic yards of excavation had been removed for the entire project by the end of the month.

The quarrying, hauling and placement of rock fill for Cornwall canal revetment was practically completed. This embankment will serve as a haul road to the Canadian end of cofferdam "E", as well as support for the canal when the river rapids are unwatered. Excavation for cut "F" is more than half completed. At Long Sault dam, excavation was started for the north earth wing dike and for the left abutment.

Placing of concrete at Iroquois dam continued, as over 15,000 cubic yards had been placed to the end of February in the east section of the dam and in the spillway apron. Excavation from the upstream unwatered areas continued along with driving of piles for the cofferdam cells.

In the powerhouse area, excavation, drilling and grouting of the foundation progressed, as erection of the contractor's construction plant continued. All work in connection with the construction of baffles on the water side of cofferdam "C-1" was completed early in the month.

At Massena intake, excavation, drilling and grouting continued concurrently with the erection of the contractor's construction plant. Progress was retarded due to saturated condition of the foundation area. The wet condition is considerably improved as a result of grouting and improved sumps to allow full scale excavation.

Work at the south Galop channel continued, as excavation passed the one and a half million cubic yard mark. Preliminary work was started in the Sparrowhawk-Toussaints channel area as equipment started arriving. Field office and shop buildings were being constructed. Work on the Barnhart Island bridge consisted of construction of sidewalk and installation of lighting conduits. Clearing operations progressed upstream from the Long Sault dam.

The Long Sault canal construction power line was practically completed and relocation of the Barnhart Island construction power line was progressing.

Specifications were issued during February for the construction of water facilities at the Massena lake intake, for the load centre unit substations and for the rehabilitation of the Massena-Taylorville transmission line. The production of drawings continued on schedule.

Total personnel on the job was 2,380.

NYSPA Opposes Public Service Act

On February 22 the Public Service Commission released a statement in connection with an act to amend the public authorities law, with respect to power produced and sold by NYSPA, in which admission was made that the bill is designed to transfer from the

Power Authority to the Commission the job of determining the geographical area in which St. Lawrence power is to be sold.

This statement expressed concern that unless the Commission regulates the rates at which Authority's power is sold, its distribution will "have to be confined to limited areas immediately adjacent to the production sites".

In a memorandum in opposition released February 27, Chairman Robert Moses of NYSPA replied that "The Authority is engaged in making arrangements with power companies, whereby the benefits of seaway power can be made available to consumers who also will receive power from other sources. Interconnection arrangements have already been worked out with respect to the contracts the Authority has made with Vermont, the City of Plattsburg and the Plattsburg Air Base.

"The proposed bill is not only unnecessary but clearly unconstitutional, because it would violate the pledge of the State contained in Section 1011 of the Public Authorities Law, and would impair the obligations of the contracts which the Authority has entered into with its bondholders and with those who have already agreed to purchase its power."

Progress by Canada's Seaway Authority

The seaway's most important contract from the point of view of navigation, and the last of the dredging contracts for the Lachine Section, is valued at $10,636,000, and was awarded on March 9 to Marine Industries Limited, Montreal. Canadian Dredge and Dock Company Limited, Toronto, had submitted a bid of $10,903,000.

The work comprises dredging of an area one mile below the Jacques Cartier bridge for the approach between the St. Lawrence ship channel and the seaway canal, and of an area two miles downstream to provide a turning area for vessels. Dredging is to commence within 10 days of the opening of the 1956 navigation season on April 16, and all work must be completed by August 31, 1958.

The amount of overburden to be dredged is some 3,200,000 cubic yards and the amount of solid rock is some 100,000 yards. Rehandling and shore disposal of material and towing material to the north shore of the harbour area amounts in all to some 3,000,000 cubic yards.

Award of this contract brings to some $72,000,000 the value of contracts awarded by the Seaway Authority to date. Dredging to be performed by the Authority calls for the removal of some 16,000000 cubic yards from the seaway channel, of which 700,000 cubic yards will be rock and some 15,300,000 will be over-burden, sand, silt, clay and other common material. Of this, the five dredging contracts now awarded require the removal of some 200,000 cubic yards of solid rock and some 12,000,000 cubic yards of common materials.

Three contracts have also been awarded for concrete aggregates for the locks to be constructed at St. Lambert and at Cote Ste. Catherine in the Lachine Section, and for the two locks to be built between Lake St. Louis and the Beauharnois power canal.

The contract for aggregates at Beauharnois, valued at $2,131,000 has been awarded to Canit Construction Limited. Two firms, Mount Royal Paving and Supplies Limited and Miron & Freres Ltee., submitted identical bids based on unit prices, for the supply of coarse aggregates for the St. Lambert lock and the Cote Ste. Catherine lock. The contract awarded to Miron & Freres Ltee. is valued at $1,113,000 and that awarded to Mount Royal Paving is valued at $1,099,000.

Tenders were called on February 29 for the first stage of construction of lower and upper Beauharnois locks and approaches thereto in the Soulanges section. What requires to be done is to complete the junction between the canal and Lake St. Louis by means of two single locks. This contract will provide the preliminary work prior to the construction of the locks.

The location of the work is at the entrance to the Beauharnois power canal on Lake St. Louis and adjacent to the power development at Melocheville. The work includes clearing of the site, excavation, rock grouting, cofferdams and unwatering, service roads and relocation of a portion of the New York Central railroad line. Work involved includes excavation of some 170,000 cubic yards of common material, and some 1,115,000 cubic yards of rock. Tenders were received up to March 27. The work is to be completed by October 31, 1956.

Officials of SLSA met at Washington with SLSDC administrator Lewis G. Castle, March 1 to 5, 1956, regarding progress of the work in the International Rapids section. Among items discussed were the Polley's Gut bridge; the

St. Lawrence power project. General view of power plant looking west from the Canadian side.

relocation of the highway and railway facilities on both sides of the international boundary; the dismantling of the south channel bridge and dredging north and south of Cornwall Island.

President Lionel Chevrier, accompanied by Vice-President Charles Gavsie and engineers of the Authority, visited the Niagara Peninsula on March 14, to view Authority contracts to enlarge the Welland ship canal and to observe how much work has been completed this winter while the canal was dewatered. The Welland canal will be reopened for navigation April 2. Under these contracts some 549,000 cubic yards of material must be excavated. The work is to be completed by June 30, 1958.

Iron Ore Forced the Seaway

President Lionel Chevrier of The St. Lawrence Seaway Authority, addressing the Canadian Institute of Mining and Metallurgy at Montreal on February 22, stated that "the mining industry — at least one important branch of it, the iron ore industry — can take credit for swinging the balance in favour of an immediate start on this great project." Combination of development of the Quebec-Labrador iron ore fields and worsening of the ore supply position of the steel industry in the Great Lakes area "made the seaway the obvious and necessary solution," he declared.

"The course of events since the start of construction of the seaway has greatly reinforced the position of those who believed it a strategic necessity for the steel industries of both Canada and the United States," Mr. Chevrier pointed out. Steel production had expanded to its greatest peace time level and consumption of iron ore had preceded it in the same direction. Indeed, this future movement is already being anticipated by the canaller-type vessels on the present canals, Mr. Chevrier revealed.

"From the reshipping point at Contrecoeur below Montreal, some 300,000 tons of Labrador ore moved up the St. Lawrence canals in 1954 — the first year of production at Knob Lake. In 1955 this traffic grew to 1,750,000 tons. When the seaway is ready, this movement is expected to reach 10,000,000 tons annually without considering possible future expansion", he said.

"While traffic in other mine products on the seaway does not approach the scale expected in the case of iron ore there is every reason to look for a considerable use of the seaway in the movement of these commodities so well adapted for bulk carriage by water," he continued. "Let us remember that the seaway is to be a two-way street connecting the two major Canadian industrial areas and consumer markets—Southern Ontario and Southern Quebec."

"The future developers of new mineral deposits and the future planners of industry will be able to count on a 2,000-mile waterway—from the Gulf to Western tip of Lake Superior. The availability of this route will doubtless often serve to convert marginal or sub-marginal prospects into economically justifiable undertakings."

Electric Smelting Possible At Iron Mines

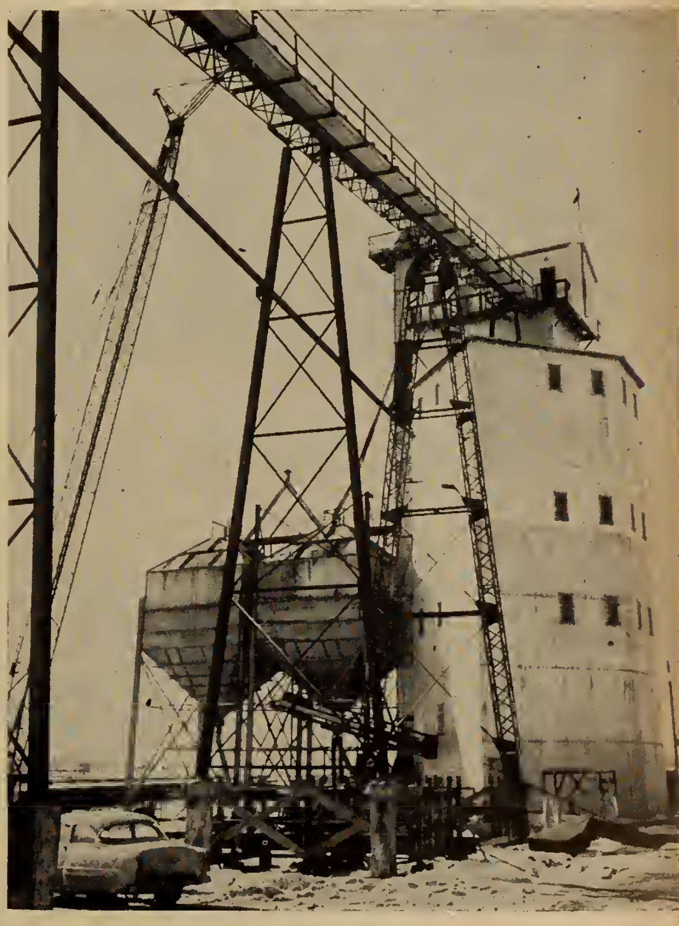
"Cheap hydro power may permit electric smelting at the site of the Ungava iron ore developments in the forseeable future, but the prospect for steel production along the St. Lawrence is remote." This was the opinion expressed by W. H. Durrell, executive vice-president, Hollinger Hanna Ltd., management company for Iron Ore Company of Canada, when giving evidence before the Royal Commission on Canada's Economic Prospects at Montreal, February 22.

While research on electric smelting may make the process practical for low grade ore at mine sites, economics of steel production made it plain that any increase in Canada's steel making capacity must come from extension of existing facilities, he said.

Any new mill must have a capacity of two million tons yearly for economical construction, which means Canada would have to enter the steel export trade in competition with Germany, Britain and United States. Lack of coal along the St. Lawrence was another handicap, he pointed out, though ore boats might bring coal from the Great Lakes area on return trips.

Some 12 million tons of ore would be shipped during the 1956 season, continued Mr. Durrell, two million to Britain and Europe, two million to Hamilton and Lower Great Lake ports and eight million to U.S. Atlantic ports. The volume of ore that would be shipped through the seaway when completed would depend upon whether tolls to be established would per-

(*Continued on page 599*)



Concrete mixing plant for the powerhouse stands on the Canadian shore of the north channel.

Professional Development Groups

The Toronto Branch has an active P.D. group (see above). At their January 10 meeting, this year, E. C. Luke of Headquarters, spoke on "The Impact of NATO on Europe". Committee members are E. M. Spencer, Jr.E.I.C., chairman; Lee Broderick, S.E.I.C., treasurer; E. J. Rice, Jr.E.I.C., and J. A. Gingrich, Jr.E.I.C.

Below: The Winnipeg P.D. Group photographed at their January 10 meeting.

Engineering students of the University of Saskatchewan study public speaking as a professional development course. Here, two fourth year mechanical engineering students participate: A. A. G. Swanson, speaking, and R. W. Gillanders.

Hamilton (below). Committee for the large Hamilton group, with registration totaling 147, consists of: G. T. Fenwick, secretary, W. H. Hohn, E. W. Hill, W. A. H. Filer, G. L. Schneider, R. de Young, J. A. Walsworth, K. Crean, K. W. Baker.


The Ottawa professional development meeting of January 11 in session. At right: H. E. Gladish; J. J. Deitrich, of the Association of Polish Engineers; Major J. Wendt, the speaker, chief of research and development for personnel selection in the Canadian Army; A. A. Swiderski, of the Polish Engineers; J. M. Pritchard.

The Belleville Branch has a P.D. course, with an enrolment of 40. On January 11, the speaker was Prof. J. L. McDougall, of Queen's University.

Saguenay Branch P.D. program includes a chemical refresher course. Six of the seven participants are shown here, at the meeting of January 11: D. Williamson, W. W. Robertson, sec.-treas., J. Jefferies, D. Monogan, M. Marhengi, H. Edwards.

The Saguenay course in public speaking has an enrolment of 11. In this group, photographed on January 10: G. B. Gilbert, chairman; J. K. Furlong, J. Kirkland, B. Benson. Other members are: R. V. Norman, H. J. Baker, T. Barwick, R. Langevin, E. Wiggans, B. Culton, and S. Wellein.

Other branches have professional development courses, photos of which were not available for this report.

Orchids from U.S.A.

The following letter from Harvey M. Kolesar, JR.E.I.C., came into Institute Headquarters some time ago but several months passed before we were able to get in touch with Mr. Kolesar to see if we had his permission to publish the letter in the *Journal*.

In this day and age when so many of us in Canada seem to think that all the best things come from countries outside of Canada it may be a bit of a surprise and relief to find that at least one Canadian engineer believes that on a comparative basis the Engineering Institute of Canada is not doing too badly in Canada. — Ed.

Dr. L. Austin Wright:

Your invitation to the reception at the Sheraton-Blackstone Hotel in Chicago, on Wednesday, November 16, is gratefully acknowledged, and I regret that I shall be unable to attend.

The Engineering Institute of Canada is rightfully included in the celebration, for their part in improving the standing of the engineering profession in Canada deserves considerable praise. It is unfortunate that there is not a similar organization in the United States to serve as a rallying point for all engineers, for it has been my observation that the prestige of engineering is certainly higher in Canada than it is in this part of the United States.

Harvey M. Kolesar, JR.E.I.C.,
Wheatridge, Colorado.

Thirty-five Years Ago

Comment on the *JOURNAL* of April 1921

The *Journal* for April, 1921, finally got around to announcing the results of a letter ballot on several proposals to amend the bylaws, including one that would have raised the fees. This one was defeated; as I wrote last month, the first report the *Journal* carried made it look as though it was defeated solely by the votes of those present at the Toronto meeting, but it seems that every corporate member had his chance to say "Yea" or "Nay". I couldn't imagine that it could have been otherwise, but I reported the matter just as the *Journal* did in March, 1921.

The principal technical paper in this April *Journal* was "Relay Protection Features of the Toronto Power Company's Transmission and Distribution System", by P. Ackerman. The schemes of protection described, some of which appear to have been novel for the times, were successful in reducing the outages in the company's system. As a general average, complete outage became very rare by 1920 and only six times during that year was more than 30 per cent of the load lost through line disturbance.

Mr. Ferdinand van Bruyssel, the organizer of the Belgo-Canadian Pulp & Paper Co., Ltd., in "The Pulp and Paper Industry of Canada" made some pretty caustic comments on Quebec's treatment of the companies. His major theses were that leases of timber lands ought to run for long periods, that they should require something in the way of reforestation and that each ought to carry with it the lease of a power site, all, it would seem, reasonable enough requests. He mollified the provincial government in advance, however, by saying that it was "recognized to be patriotic, progressive and wise, a combination of qualities one should not expect to find in a ministry elected under a system of universal suffrage, unattended as yet by any measure of proportional representation."

Under "Correspondence" there appeared an unusual letter from Lockwood, Greene & Co., of Boston, congratulating J. M. Oxley on his paper on the economics of building design, noted here last month. "(A) very excellent paper . . . one of the finest we have seen . . . We shall find this paper of very great value in checking our (own) results"; thus L.G. & Co., then perhaps the leading firm of industrial engineers and architects in the United States. This letter must have pleased Mr. Oxley.

Another correspondent quoted some of the propaganda of the Technical Alliance of New York. In effect, this organization claimed that all government and all industry ought to be run by engineers and technicians as they were the only people who really knew how. I believe this was the beginning of the cult of "Technocracy", which created quite a stir for a time. Where is it now? It is dead; it failed, largely, I think, because like most socialistic movements it did not recognize the most basic of human desires, the desire for personal advancement. This correspondent naively concludes his letter, "The foregoing . . . which I cannot quite follow in all its inferences, seems to me . . . provocative of thought . . ."

For some months the *Journal* had been running a column or two in each number of "Town Planning News and Comments". The contents of these columns can be succinctly summed up as composed of personals, accounts of numerous conferences and endless talk and little or no report of tangible results. Town planners have ever been good talkers.

In April, 1921, the *Journal* carried lists of engineering students at McGill and Queen's Universities who were looking for permanent or summer jobs. Most of the names mean little to us, but there is the occasional one of somebody who made a name for himself in the nation's affairs.

This *Journal* ran a brief biography of H. G. Acres, M.E.I.C., who had just been elected a vice-president on a special nomination against the candidate put up by the Institute's nominating committee. One gets the impression on reading this note that the writer was not too pleased with Mr. Acres' election. He served the Institute long and well and those who nominated him did us an excellent turn.

The Calgary Branch listened to a talk on the petroleum situation. The speaker estimated that United States production would cease about 1938. He thought that Alberta's chances of becoming a real producer were pretty slim and he gave its 1920 production as about 12,000 barrels. Geological exploration was too uncertain and cost too much, he said. Beside, geological exploration was quite unnecessary. Some years before one lucky Alberta oil man knew a squaw "quite intimately." She pointed out a place where oil was flowing in a great river under some land he owned. He sank a well, struck oil and there you are.

The Saint John Branch was interested in the paving of the streets of its city, about 70 per cent of which were then unsurfaced . . . "Granite blocks and asphalt are the best types of paving for use in Saint John." Where were the concrete people, to let such a statement pass without comment?

They had just finished the Toronto-Hamilton highway, which gave them something of which to be proud. Asphalt is still very much with us, but a street paved with granite block is a museum piece.

And so we may now put down this *Journal* in the hope that when we look into the one of May, 1921, we shall find something a little more exciting.

Elections and Transfers

At the meeting of Council held at the Chateau Laurier Hotel, Ottawa, Ontario, on Saturday, March 24th, 1956, a number of applications were presented for consideration and on the recommendation of the Admissions Committee the following elections and transfers were effected:

Members:

K. Bailes, *East Angus*
R. L. Booth, *Toronto*
L. G. Cazaly, *Toronto*
V. Davidovitch, *Montreal*
F. H. Davies, *Toronto*
T. J. Farrell, *Montreal*
G. Gelfreih, *Montreal*
J. F. Gniewosz, *Montreal*
M. G. G. Curr, *Toronto*
M. D. Head, *Copper Cliff*
A. Himsley, *Toronto*
S. C. Jones, *Owen Sound*
A. Kane-White, *Montreal*
J. Kates, *Toronto*
R. A. Krikorian, *Uplands*
A. N. Krouglicof, *Montreal*
O. Lloyd, *Toronto*
R. S. MacLennan, *Sudbury*
L. D. Mahoney, *Montreal*
R. E. Moore, *Ottawa*
A. J. Neil, *Sudbury*
J. Penzer, *London*
F. R. Pollard, *Toronto*
T. G. Quance, *Sarnia*
C. D. Quarterman, *Ottawa*
J. W. Setehell, *Toronto*
A. F. Tiesdell, *Quebec*
D. J. Turland, *Trail*
G. A. Watkins, *Montreal*
J. Williams, *Hamilton*
W. Wisniewski, *Montreal*

Juniors:

E. C. Amos, *Montreal*
G. K. Bowser, *Montreal*
N. B. Ede, *Pine Falls*
S. K. Fang, *Montreal*
W. J. Forsyth, *Arvida*
B. J. Goodal, *Urbana, Ill.*
J. Gow, *Montreal*
H. D. MacEwen, *Dartmouth*
R. L. Ormiston, *Hamilton*
W. A. Pieczonka, *Hamilton*
E. L. Piltz, *Mt. Apica, Que.*
G. S. Presser, *Montreal*
M. W. Smith, *Arvida*
B. A. Wilson, *Montreal*

Transferred from the class of Junior to that of Member:

J. G. Baillot, *Montreal*
P. L. Bournival, *Montreal*
P. N. Brown, *Walkerville*
W. E. Dempster, *Montreal*
G. W. Huggett, *Montreal*
W. D. McMurtry, *Toronto*
F. E. Thouret, *Riverbend*
G. R. Williams, *Toronto*

Transferred from the class of Student to that of Junior:

R. F. Critchley, *Montreal*
G. L. V. Springate, *Three Rivers*

The following Students were admitted:

Ecole Polytechnique

R. Auger	J. P. Milette
G. Beaudry	J. Monat
R. Bergeron	P. Monet
R. Bernier	A. Moquin
R. Bertrand	G. Moreau
C. Bibaud	G. Morneau
C. Boisvert	G. Papin
J. P. Boucher	A. Paquette
P. E. Brunelle	R. Parenteau
G. Cardin	G. Y. B. Perrault
H. Champagne	R. Perreault
R. E. J. Charland	J. M. Pineau
B. Coupal	J. G. G. G. Poitras
L. Courville	R. Portugais
J. G. Curzi	A. Potvin
G. Dansereau	D. Poulin
P. E. Dery	A. Poulson
L. G. J. Desmarais	J. P. Prefontaine
E. Desnoyers	J. J. R. Prevost
S. Dessureaux	J. L. Regimbald
J. J. R. Dubeau	A. H. J. Rinfret
M. Dubois	G. Rivest
J. P. Duchesne	R. J. G. J. Roberge
N. Gagnon	J. C. Rochon
J. Genest	A. Roy
P. Goulet	L. Roy
P. Goyette	M. St. Arnaud
J. Guilbeault	J. P. Saint-Dizier
J. Houde	J. E. R. St. Louis
Y. Lafontaine	R. Santerre
M. A. Lafrance	B. Sauvage
J. C. Lamoureux	L. P. Senechal
J. V. A. Lapointe	J. Simard
R. Lariviere	J. Sylesvtre
H. Latendresse	J. L. Thibault
J. G. Lauzon	L. N. Thibault
J. H. G. G. Lebeau	L. G. Tremblay
F. Leduc	P. R. Turgeson
J. Lefebvre	J. R. R. Vallee
P. Leger	S. J. M. Vauclair
J. P. Lepine	A. Veilleux
P. Manseau	J. A. H. M. Verreault
J. P. Mathieu	C. Villeneuve
W. R. Menard	

Laval University

J. G. R. Beaudoin	J. G. J. Heroux
M. Bolduc	P. Imbeau
J. G. Brousseau	J. G. Brosseau
J. L. M. Canuel	M. R. Lagace
G. Castonguay	J. C. M. Lagare
P. Cayer	J. G. J. M. Lambert
J. M. A. T. Cote	A. Lemieux
C. Dubuc	B. Mathieu
R. Francoeur	D. Miller
R. Gauthier	J. E. J. Pineau
P. Gendron	J. Plamondon
J. L. Giroux	R. Senechal
Y. M. Giroux	F. Santerre
G. Gregoire	J. A. P. A. Sauvageau
R. J. D. Guerin	J. C. Tardif
F. Heroux	

University of Toronto

J. Billings	J. C. Lefler
S. C. Eccles	J. R. Lines
R. R. Harding	E. A. McLennan
E. Karuks	J. W. G. Shortt

Queen's University

A. T. Ball	F. H. Holm
J. G. Colbourne	E. J. Korhonen
D. A. Ennis	R. D. Nairn
M. B. Fielding	N. J. Ruff

University of New Brunswick

D. J. McColm	M. E. Richardson
R. E. B. Moffatt	

University of Alberta

C. H. Grant Jr.	A. R. Rogers
W. A. Porter	

Dalhousie University

C. Johnson	P. G. Kennedy

Nova Scotia Tech. College

M. A. L. Harrigan

McGill University

S. U. Baltuch

Royal Military College

W. B. Lynn

R. G. Pinkney, Ottawa, B.A.Sc., Toronto, 1955.
A. G. Davenport, Toronto, B.A. Cambridge Univ. 1954.
J. Z. Tomaka, Montreal, B.Eng.(Mech.) McGill 1955.
M. J. Simmer, Montreal, Student C.P.E.Q.

Applications through Associations:

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections and transfers have become effective:

ALBERTA

Member:

J. A. Irvine

SASKATCHEWAN

Members:

R. J. Briggs	M. P. Kocur
C. R. Douglas	J. E. Laughlin
G. C. Docken	J. D. McMillan
H. A. Eley	S. L. Mingle
G. D. Hill	M. E. Stillwell
S. M. Illum	M. M. Tomilin
L. W. Johnston	E. J. Wendeborn

Students:

A. A. Condy	L. G. Morrison
W. B. Edwards	T. J. Moynihan
G. A. Gette	J. G. Stone
C. B. Lipsett	J. Thon
P. W. McAra	P. A. Weber
E. W. Mills	R. J. Woodward

Junior to Member:

W. Chow	K. A. Oakley
D. O. Coghlan	D. H. Pollock
R. D. Dunlop	E. K. Sauer
E. A. Fischer	I. B. Sveinbjornson
R. W. Gush	B. F. Sworder
A. L. Jones	W. G. Thompson
M. H. Nelson	S. J. Warder

Student to Junior:

A. P. Belyk	J. E. Moore

NOVA SCOTIA

Members:

J. E. Bright	W. McCabe

Junior to Member:

E. P. Smith

NEWS OF THE ASSOCIATIONS & CORPORATION

Information received through co-operation with the provincial organizations

Quebec

Leo Roy, New President

Leo Roy, of Montreal, was elected president of the Corporation of Professional Engineers of Quebec at the 37th annual meeting of the group, held in Montreal.

Leo Roy

A graduate of Ecole Polytechnique and McGill University, Mr. Roy is chief engineer of auxiliary services at the Hydro-Quebec. He had previously been connected with the Shawinigan Water and Power Company and the Quebec Power Company.

Mr. Roy is vice-president of the Montreal Section of the Engineering Institute of Canada, a vice-president of the Electrical Club of Montreal, and a member of the Illuminating Engineering Society, the Canadian Gas Association, the American Institute of Electrical Engineers. He has also been active on the Engineers' Council for Professional Development.

The new Council of the Corporation of Professional Engineers for 1956 is as follows: president, Leo Roy; vice-president, R. A. Phillips; honorary secretary-treasurer, Guillaume Piette. Quebec district representatives are Robert Painchaud and O. S. Gislason, and Montreal district representatives are Yvon De Guise and Leopold Nadeau.

Ontario

Initial Meeting of Council

The inaugural meeting of the 1956 Council of the Association took place on January 26 and 27, President M. W. Hotchkin being in the chair. In opening the meeting Mr. Hotchkin specially welcomed the new members of Council, J. H. Irvine, Ottawa; D. S. Simmons of Toronto, J. W. Holmes, Peterborough; and Dr. C. P. Jenney, Toronto.

Reports submitted by committees included that of the Board of Examiners, under the chairmanship of Professor V. G. Smith. This report contained the recommendation that graduates of the course in chemical engineering at the University of Ottawa be given the same recognition as given graduates of similar courses of other Canadian universities. The recommendation was unanimously approved by Council.

The chairman of the Professional Status Committee, Gordon W. Ames, reported that during the latter part of the year recommendations of Council that courses be started to train technicians in heating, ventilating and plumbing; refrigeration and air conditioning; and structural draughting and design detailing had been transmitted to the Ontario Department of Education. He further reported that a reply had been received to the effect that steps had been taken to implement the first two courses and that the last-named, structural draughting and design detailing, is already operating at the Provincial Institute of Trades in Toronto.

Approval was given by Council to the awarding, in 1956, of nine scholarships each at the University of Toronto, and Queen's University, to undergraduates in the first, second and third years. Another award authorized was the Admission Scholarship which this year will be given to the top Grade 13 student entering engineering at the University of Toronto. This alternates between Toronto and Queen's. In addition to the above there is also the Association's Gold Medal which is awarded to a member of the graduating class in engineering at these two Universities for academic attainment.

The secretary-treasurer reported that as of December 31, 1955 the number of members enrolled totalled 14,027, a net increase of 1,024 members during 1955. During the year 90 members were added through transfer to the Association as against 72 who left Ontario to join other Associations.

Committees

Committees appointed for the year are as follows:

Executive: M. W. Hotchkin (Chairman); J. R. Montague; J. H. Fox; C. T. Carson; T. N. Carter; J. H. Waghorne; D. S. Simmons; J. H. Ross; G. B. Langford.

Legislation: G. B. Langford (Chairman); W. D. Sheldon; J. R. Cavanagh; F. R. Duncan; J. W. Holmes; J. H. Irvine.

Finance: J. H. Fox (Chairman); C. T. Carson.

Professional Status: G. W. Ames (Chairman); J. H. Waghorne; N. Fodor; D. L. Angus; A. DeMaio; O. D. Johnston; D. R. Yeomans.

Public Relations: P. E. Cavanagh (Chairman); W. J. Gilson; J. N. Milne; J. W. Carrington; C. F. Morrison; R. W. Harris; R. C. Poulter; R. G. Tredgett.

Practice and Ethics: J. F. MacLaren (Chairman); G. R. Lord; A. E. MacRae; E. A. Cross; M. S. Fotheringham; O. D. Johnston; N. A. Eager; C. W. Knight.

Board of Examiners: V. G. Smith (Chairman); W. L. Sagar; S. E. Wolfe; R. C. Wiren; C. K. Fraser; N. Fodor.

Appeal Board: A. W. Murdock (Chairman); G. B. Langford; J. W. Bain; W. J. Gilson; J. H. Fox.

House: G. R. Lord (Chairman); J. H. Brace; J. R. Mens; B. A. Hole.

Consulting Practice: J. H. Ross (Chairman); E. A. Cross; D. L. Angus; W. H. Bonus; R. A. Crysler; A. D. Margison; L. C. A. Walford.

Insurance: A. W. Murdock (Chairman).

Interviewing: R. C. Wiren (Chairman); K. R. Rybka; J. W. Bain; O. W. Ellis; N. Fodor.

Professional Engineers Medal: J. C. Keith; W. P. Dobson; O. W. Ellis; M. J. Aykroyd; L. F. Grant; E. V. Buchanan; H. G. Conn; A. E. MacRae; G. L. Macpherson.

Honour Science Graduates: G. P. Jenney (Chairman); G. L. Macpherson; V. S. Murray; W. G. McIntosh; W. P. Dobson.

Scholarship: G. R. Lord (Chairman); A. M. Doyle; W. W. Loucks; G. M. McHenry; K. C. Siddall.

Company Groups: J. H. Waghorne (Chairman); J. H. Fox (Vice-Chairman); G. W. Ames; (alternates: J. W. Holmes; V. S. Murray).

Over 400 Write Qualifying Tests

Some 360 hopeful applicants were busy writing examinations in March in a central-Toronto church hall that could qualify them to practise professional engineering in Ontario. Another 45 to 50 persons were writing the same type of examinations in other Ontario centres as well as in certain parts of Canada, including one Canadian serviceman stationed in Germany. The examinations began March 19.

A total of 62 different papers on the various branches of engineering constitute the examinations held annually by the Association of Professional Engineers of Ontario. Applicants must write a maximum 15 separate papers at university level and a thesis on the particular branch of engineering chosen.

The examinees comprise a number of skilled technicians who have not received an engineering degree from a university, but who have the background and experience to try for admittance to Association membership.

"Approximately two or three per cent of those admitted to membership stem from the examination-writing group," says J. M. Muir, Association secretary-treasurer. He adds that about 60 per cent are successful, a figure comparable to university examinations. The majority of candidates are over 30 years of age, and there is a significant sprinkling of new Canadians among them. Many of these have taken engineering in their native lands, but must pass additional examinations in order to qualify under Canadian standards.

The examinations are set by university professors and noted professional engineers.

This year marks the first time that a uniform syllabus of examinations is being used by the ten provincial registering bodies of the engineering profession.

News of Members

James M. Reed, has been appointed to the Ontario district sales staff of Ferranti Electric Ltd., Mount Dennis, Toronto, as a sales engineer.

A graduate in electrical engineering of the University of British Columbia, Mr. Reid was engaged in traffic control and street lighting and engineering and communication sales from 1951 until he joined Ferranti Electric in 1955.

G. W. Mitchell, fomerly sales engineer at the Toronto office of Canadian Westinghouse Co. Ltd., has been appointed sales engineer of the apparatus division at the Windsor, Ont., office of the company.

Ian L. Colquhoun of English Electric Co. Ltd., St. Catharines, Ont., has been made manager of circuit breaker engineering of the company; **James A. Hibbert,** manager of switchgear engineering; and **J. R. M. Szogyen,** assistant manager of rotating equipment engineering.

Leslie A. Shaver, of Canadian Westinghouse Co. Ltd., Hamilton, Ont., has been appointed to the new position of headquarters approvals engineer of the company.

Mr. Shaver has been with the organization for over 40 years and before receiving his new appointment was section engineer of marine and transport control. His new responsibilities will include co-ordination of all Westinghouse activities associated with the Canadian Standards Association.

R. C. McMordie has recently resigned from the engineering staff of the Hydro-Electric Power Commission of Ontario to assume the appointment of chief engineer of the British Columbia Power Commission. This new responsibility has entailed his move from Toronto to Victoria, B.C. (See "Personals.").

Charles A. Wakeham is now associated with H. G. Acres & Co. Ltd., of Niagara Falls, Ont., and recently arrived in Masanjore, India, where he will be located for several months during the construction of the power house at the Canada Dam.

Mr. Wakeham graduated in electrical engineering from the University of New Brunswick in 1928 and has had a wide professional experience in the electrical and industrial fields.

John R. Caswell retired some months ago as Algoma district engineer of the Canadian Pacific Railway. Mr. Caswell has since been devoting part of his time in engineering work with the Caswell Construction Co. Ltd. of Kirkland Lake, of which his brother is senior executive. The undertaking in which Mr. J. R. Caswell is engaged is in the Sault Ste. Marie area.

George W. Beecroft, of Toronto, is president of Propane Containers of Canada Ltd., Mimico, Ont. **John H. Becker** is vice-president and general manager and **James W. Thompson** is works manager.

This company is manufacturing a complete line of bulk tanks for propane gas and anhydrous ammonia, and also equipping tank trucks for bulk deliveries.

W. K. Redsell has been appointed inspector of mines at the Sudbury district. A graduate in mining engineering from the University of Toronto, Mr. Redsell has latterly been with Kerr Addison Gold Mines Ltd., at Virginiatown, Ont.

N. J. Ypes has advised of the change in firm name to Jackson, Ypes and Associates with offices at 5453A Yonge St., Willowdale, Ont. The partnership of Mr. Ypes and D. K. Jackson, M.R.A.I.C., started three years ago and has operated under the name of Jackson and Ypes until the recent change. Jackson, Ypes and Associates engage in consulting practice as engineers and architects.

New staff announcements have been made by Johnson Temperature Regulating Co. of Canada Ltd., Toronto, as follows: **W. L. Rootham,** who has been manager of the Toronto branch, becomes assistant sales manager with headquarters at the company's main office in Toronto. **Bruce Overend,** formerly engineer in charge of the London, Ont., branch, succeeds Mr. Rootham as Toronto manager. **Arthur P. Johnson,** of the Toronto branch, becomes engineer in charge at London, Ont. **T. M. Patterson** will supervise the assembly and manufacturing operations at the company's Toronto headquarters.

Kenneth E. Hunter has accepted the position of manager of the geophysics department of Hycon Aerial Surveys, 1020-1030 South Arroyo Parkway, Pasadena 2, California.

Mr. Hunter is a graduate in engineering physics of the University of Toronto and prior to joining Hycon Aerial Surveys was chief geophysicist of Tsumeb Corporation Ltd., of Tsumeb, South West Africa.

R. B. Sweet has moved from Sault Ste. Marie, Ont., to Windsor Mills, Que., where he is employed by the Canadian Paper Company as assistant mechanical superintendent. Prior to this change in work Mr. Sweet was with Algoma Steel Corporation Ltd. as a sales representative.

J. R. Baird has resigned his position of chief engineer of Trailmobile Canada Ltd., to assume the duties of a director and chief engineer of York Transport Equipment Ltd.

Mr. Baird will be in the United Kingdom for a period in connection with the establishment of a subsidiary company owned by York Transport Equipment Ltd. and his address will be York Trailer Co. Ltd., Cherry Lane, Liverpool, England.

A. J. G. Campbell, formerly combustion engineer of Imperial Oil Ltd., has been made field engineer of the National Warm Air Heating and Air Conditioning Association of Canada, with headquarters at 4195 Dundas St. West, Toronto 8.

His initial undertaking will be a trip across Canada during which he is scheduled to deliver a number of lectures on the latest requirements and developments in the warm air heating industry.

Ivan M. Wallace has joined the firm of consulting engineers, C. C. Parker and Associates, of Hamilton, Ont., and will have general supervision of their Western Ontario operations. His address in London is 232 William St. Mr. Wallace, who obtained his engineering education at the University of Toronto, has been chief engineer of the London Steel Construction Co. Ltd. for a number of years.

H. F. McEntire, chief engineer of Atlas Steels Ltd., Welland, Ont., has announced the promotion of **Thomas J. Nolan** to the position of assistant chief engineer, and of **Harry L. Brien** to the post of electrical engineer.

Mr. Nolan is a Toronto graduate of 1938 and first joined Atlas Steels in 1943 in connection with the company's extension program. In 1946 he was employed by H. G. Acres and Company in connection with power developments on the Pacific Coast and in 1947 he returned to Atlas where he has functioned as plant electrical engineer until his recent promotion.

Mr. Brien obtained his engineering degree at Queen's University in 1952, in which year he joined the company. In 1954 he was appointed engineer of the hot planetary mill and in 1955 was made general foreman of the stainless strip and tube department.

J. N. Milne has recently been appointed assistant manager of the Market Research Department of MacLaren Advertising Company Ltd., Toronto.

Mr. Milne obtained his degree in electrical engineering at Queen's University in 1935 and in that year joined the Canadian General Electric Company's test course. Remaining with the company until moving to the MacLaren Advertising Company last fall, he was engaged in the engineering and marketing areas of the C.G.E. activities. Seven of his 20 years with the organization were spent with the export subsidiary and for the past three years he was manager of marketing research.

British Columbia

Granted Life Membership

The Association of Professional Engineers of British Columbia announced on February 16 that the following engineers have been granted life membership in the Association: Col. W. G. Swan, Charles Brakenridge, Charles Bentall, F. J. Bartholomew, H. P. Archibald, C. T. Hamilton, F. B. Hardin, T. H. D. Lundy, W. G. McElhanney, J. S. Wilson, M. Y. Williams, W. W. Urquhart, S. J. Crocker, A. Cummings, G. H. Burnett, E. F. Carter and F. Bagshaw, all of Vancouver.

B. C. Affleck, Nelson; F. J. Donkin, Francois Lake; D. J. McCugan, New Westminster; C. D. MacKintosh, Victoria; G. J. Jackson, Victoria; E. I. W. Jardine, Victoria; G. H. Shepherd, Burquitlam; E. N. Horsey, Victoria; H. D. Dawson, Royal Oak; F. P. Burden, Prince George; and E. F. Cooke, Sechelt.

Engineers in the News

A. G. Tanner has sent word that he is now with Angus Robertson Ltd., as assistant construction engineer on the Warsak hydro-electric development in Pakistan. This work is being carried out under the terms of the Colombo Plan and Mr. Tanner expects to remain on the project for two to three years.

J. B. Bush, formerly at Nickel Plate, B.C., is now employed as a geologist with Granby Consolidated Mining Smelting and Power Co. Ltd. at Copper Mountain, B.C.

W. E. Erlebach, who was studying in England at Cambridge, is now back in Canada with the Atomic Energy Commission, Deep River, Ont.

B. Colloby has accepted a position with H. A. Simons Ltd. as assistant project engineer. He was previously with Alaska Pine and Cellulose Co. Ltd.

W. C. Rueger, who had previously been with Industrial Mill Services, has taken a position with John Laing and Son (Canada) Ltd.

W. R. Cheriton recently accepted a position in Edmonton with Wirtanen Electrical Co. Ltd., on industrial installations, maintenance and repairs. He had been employed by Hume and Rumble Ltd. in Vancouver.

H. J. Page was recently appointed assistant chief engineer of the Public Utilities Commission. Mr. Page is a 1949 electrical graduate of the University of British Columbia and has been in Vancouver as toll plant extension engineer at the B.C. Telephone Company.

G. S. Ortner has been appointed to the position of assistant manager of the personnel division of the Consolidated Mining and Smelting Company of Trail, B.C. Mr. Ortner, who has been with the company since his graduation as a chemical engineer in 1928, had recently been supervisor of methods studies.

Wm. Thornber of the B.C. Lumber Manufacturers' Association left for the United Kingdom at the end of March with Professor Fred Lasserre, director of the School of Architecture at the University of British Columbia. Mr. Lasserre will give a series of talks to architectural groups in 12 major cities. He will feature Pacific Coast housing designs and building methods in this program, which is sponsored jointly by the Department of Trade and Commerce and the B.C. Lumber Manufacturers' Association.

E. H. Parr, who has been with the Northern Construction Company and J. W. Stewart Ltd., and recently engaged in work on the Distant Early Warning Line, has accepted a position as project engineer with the newly formed B.C. company, Route Surveys and Engineering Ltd.

W. H. R. Gibney of the Consolidated Mining and Smelting Company, has been transferred from the Bluebell Mine at Riondel to the Sullivan Mine at Kimberley as section engineer.

V. N. Jacobson is now living in San Francisco and has accepted a position as structural engineer-designer with Sverdrup and Parcel Inc. Mr. Jacobson has been employed by Swan, Wooster and Partners for the past several years.

R. C. Wannop, formerly with F. W. Urry, is now with A. B. Sanderson and Co. Ltd. in their Vancouver office.

Knute Soros, until recently assistant city engineer of New Westminster, has taken a position with the B.C. Engineering Company in Vancouver. Mr. Soros had been with the City of New Westminster since his graduation from the University of British Columbia as a civil engineer in 1949.

H. J. Greenwood has accepted a position with Ventures as a geologist on their Lake Dufault property in Noranda, Que. Mr. Greenwood received his B.A.Sc. degree in geological engineering at the University of British Columbia in 1954, and has been working towards his master's degree.

J. B. Dyson has left the employ of the Department of Fisheries, Vancouver, and has taken a position with H. G. Acres and Co. Ltd. on the John Hart Power Development at Campbell River, B.C.

E. E. Olson, a 1952 civil engineering graduate of the University of British Columbia, is now studying for a M.B.A. degree at the Graduate School of Business Administration, University of California, Berkeley. He is on leave of absence from the Canadian National Railway's department of research and development at Montreal.

Bruce Tait has resigned his position with the bridge department of the Provincial Department of Highways, and has joined the Tidewater Contracting Company. He will continue to reside in Nanaimo.

I. D. Smith has accepted a position with the Linde Air Products Company at Tonawanda Laboratories, New York State. He will be leaving his position as associate research officer, Fraser River model, Department of Civil Engineering, University of British Columbia at the end of April. He also intends to study control engineering at the University of Buffalo.

L. A. Butterfield, previously with the eastern company of Ainsworth Electric, has accepted a position with Elworthy and Co. Ltd. of Vancouver.

D. H. Baker recently resigned his position with MacMillan and Bloedel Ltd. to become assistant manager of the new B.C. Forest Products Ltd. mill at Crofton.

J. H. Shumka, a 1950 chemical engineering graduate of the University of British Columbia, has been appointed technical supervisor, Harmac pulp division, MacMillan and Bloedel Ltd., the position left vacant by D. H. Baker.

Norman E. Cooke has recently joined the staff of Canadian Industries Ltd. in Montreal as a chemical engineering specialist. Dr. Cooke spent the past three and a half years at the Massachusetts Institute of Technology, where he recently completed work for his D.Sc. degree in chemical engineering. Prior to attending M.I.T., he served in Korea with the R.C.E. and, after graduation from the University of British Columbia (M.A.Sc., 1946), was employed by the Pacific Fisheries Experimental Station of the Fisheries Research Board in Vancouver.

J. A. Willcox is now with the Pacific Coast Pipe Co. Ltd. as a sales engineer. He was formerly with Lorado Uranium Mines Ltd. as property superintendent.

H. N. Halland has been appointed consultant to the Shawinigan Engineering Company in Montreal. Mr. Halland had been project engineer for the Greater Vancouver Water Board on the Cleveland dam.

A major shuffle in the Department of Highways has come up with several promotions for department engineers:

D. D. Godfrey, divisional engineer at Prince George since 1950, has been promoted to regional engineer of the Vancouver Island - Lower Mainland region. **R. S. Cunliffe,** divisional engineer at Prince Rupert, has been appointed regional engineer at Prince George. **M. C. Nesbitt,** district engineer at Fernie, has been appointed regional construction engineer at Prince George.

O. W. H. Roberts, divisional engineer at Pouce Coupe, has been promoted to regional maintenance engineer at Prince George.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Charles Osborn Wood, M.E.I.C., retired civil engineer and Dominion Land Surveyor, and former resident of Ottawa, died on December 2, 1955, in Montreal.

Born in Elwood, near Ottawa, on October 8, 1868, he attended Lisgar Collegiate, Ottawa. His first engineering duty, in 1890, was as a rodman with a survey party for the Great North Western Railway in the Saskatoon and Battleford, Sask., areas.

C. A. Wood, M.E.I.C.

Back in Ontario the following year, he became, in turn, transit man, assistant in municipal drainage engineering, engineer of roads and bridges, and township engineer for the communities of Gloucester, Kenyon and Casselman, Ont. In 1901 he joined the late Andrew Bell and was engaged for the next few years on hydraulic engineering and flood investigations for the Dominion government. Some of the projects on which he was employed while working with Andrew Bell, were the Rouge River electric power house and dam at Table Rock Falls, Que., the electric power house at Almonti, and the bridge and dam over the Mississippi River at Almonti.

The occupation of Dominion Land Surveyor had been already well established in the family as Mr. Wood's father, Henry Osborne Wood and his grandfather, Leonard Wood, had previously held the title.

He became associated with the Ottawa firm, Keefer and McKay, around 1910 as a civil engineer, and remained with the firm until his retirement in 1949, both as an engineer and later as manager of the Keefer and McKay estates. He was, also, for many years engineer for the village of Rockcliffe, in Ottawa.

For many years Mr. Wood served with the old 43rd Regiment, Duke of Cornwall's Own Rifles, retiring with the rank of captain.

Mr. Wood joined the Institute as an Associate Member in 1904, transferred to Member in 1940, and attained Life membership in 1947.

Gustave C. Piché, M.E.I.C., noted forest authority, died in Montreal, on February 7, 1956. Mr. Piché was president of Titanium Products Corporation, vice-president of Hebecourt Corporation, and consulting forester with the James MacLaren Company Ltd., Birmingham, Que.

Born in Montreal, on December 3, 1879, he attended Mount St. Louis College, Ecole Polytechnique, Yale Forest School, Laval University, and l'Ecole des Eaux at Forets, in Nancy, France.

He obtained his master of forestry degree at Yale in 1907, and a master of arts at Laval in 1923. Emeritus Professor, he was granted by the same university his doctorate in science (honoris causa) in 1937.

Before entering the Ecole Polytechnique and Yale University he worked as a clerk for the Canadian Pacific Railway, 1897-1900, and as a clerk for the Belgo-Canadian Pulp and Paper Company until 1903.

Upon his return from Yale, he served as forest engineer from 1907 to 1909 for the provincial government. He was then named chief of the forest service, holding this position until 1936. During the second world war he undertook the task of deputy wood fuel controller for Quebec.

As a representative of the province on special missions to Europe, he travelled widely in France, Italy, Germany, Belgium and Sweden.

Mr. Piché was the founder of Laval University's forestry school, in Quebec City, and was the first director of the institution from 1910-19. He was the promoter and first general inspector of the Ecole de Papeterie in Three Rivers, Que., and the School of Forest Rangers. From 1931 to 1936 he was secretary-manager of the Timber Products Commission of the Province of Quebec.

He was a member of the principal European, American and Canadian forestry associations. He delivered many papers in Europe, the United States and Canada and was responsible for articles on forestry and wood utilization.

G. C. Piché, M.E.I.C.

Recognized as the Father of Forestry in Quebec, he was awarded the O.B.E. for meritorious service, the Jubilee Medal, and the rank of Officier du Mérite Agricole, by the French government. The Association of Forest Engineers of the Province of Quebec presented him with a diploma of honour, for meritorious services and made him a life member of the association in 1954.

Mr. Piché was a life member of the Association des Anciens du Mont St. Louis, the Société Forestière de Belgique, the Quebec Forest Association, and the alumni society of Yale.

He joined the Engineering Institute in 1913 as an Associate Member, transferred to Member in 1940 and attained Life membership in 1946.

Alfred Netlam Beer, M.E.I.C., who retired as engineer for the Canadian Pacific Railway's Laurentian division in 1944, died on December 3, 1955, in Montreal.

Born in Canterbury, England, on August 31, 1870, he was educated at the College of Preceptors, South Kensington, London. His early experience as engineering assistant was gained at the Borough water works of Richmond, Surrey, during the years 1892 to 1898 and in 1899 he was resident engineer of Woking Water and Gas Company, Surrey. In 1907 he transferred to a similar position with a company in Bristol.

Mr. Beer left England in 1912 and, coming to Canada, assumed the position of assistant city water works engineer,

• Obituaries

in Ottawa. In 1921 he joined the C.P.R. and remained with the company until his retirement from active engineering work in 1944.

He was a life member of the Corporation of Professional Engineers of Quebec, and of the Engineering Institute. He joined the Institute in 1915 as an Associate Member and became a Member in 1940.

Charles E. Herd, M.E.I.C., retired consulting engineer with the Dominion Engineering Company Limited, of Montreal, former resident of Ventnor, Ontario, died on January 9, 1956, in Brockville, Ont. He had been ill for only seven weeks, after enjoying four years of retirement.

Mr. Herd was born in Crewe, Cheshire, England, on July 12, 1875. Educated at Crewe Academy, and the Mechanics Institute, Horwich, England, he was apprenticed to the Lancashire and Yorkshire Railway Company at Horwich.

Coming to Canada in 1895 he worked as fitter and assistant to the chief draftsman with the Canadian Pacific Railways in Montreal. From 1899 to 1910 he was with the Laurie Engine Company and in a few years had direct charge of design, and of the preparation of estimates and specifications for Corliss engines and other machinery.

In 1910 he was assistant draftsman to Allis Chalmers Bullock on hydraulic turbines, and had charge of the mechanical design of electrical apparatus. He went in 1911 to the Dominion Safe and Vault Company at Farnham, Que., as chief engineer. In 1916 he transferred to the Montreal Ammunition Company as assistant chief draftsman.

He became associated with Dominion Bridge Company in their design and estimate department in 1917.

In 1920 he transferred to the Dominion Engineering Company of Montreal, and remained with the firm until his retirement in 1952, being employed as mechanical engineer in the hydraulic department. He was appointed a consulting engineer with the firm in 1949.

Mr. Herd joined the Engineering Institute in 1920 as an Associate Member and transferred to Member in 1940. He attained Life membership in 1950.

A. M. MacKenzie, M.E.I.C., former assistant vice-president in charge of labour relations for Bell Telephone Company of Canada, died on January 30, 1956 in Montreal, after forty-seven years of service with the organization. He had retired to private life only shortly before his death.

Mr. MacKenzie was born at Guelph, Ont., on June 13, 1891, and it was there that he began his telephone career in 1908. Two years later he entered the University of Toronto to study electrical engineering, working for the Bell Company during vacations. He graduated in 1914 and was sent back to Guelph as plant wire chief.

In 1916 he was transferred to the engineering department in Montreal. On leave of absence overseas, with the Royal Signal Corps, 1918-19, he served as a lieutenant, and on his return to Montreal was given the position of outside plant and transmission engineer, in which capacity he remained until 1927. He was then successively named division plant engineer, in Montreal, general plant supervisor of the Eastern Area; and general plant supervisor of personnel, Eastern Area.

Invested as a Commander of the Order of St. John of Jerusalem by Vis-

A. M. MacKenzie, M.E.I.C.

count Alexander, then Governor-General of Canada in June, 1947, he received the award for his deep interest in the St. John Ambulance Association. In recognition of his services as secretary of the Bell centre of the St. John Ambulance Association he was recently endowed with the Coronation Medal. He was president of the Montreal Personnel Association, 1951-52, and was among the Canadian delegates attending the Tenth Congress of the International Committee for Scientific Management in Brazil in 1953. Last fall he attended an executive meeting of the Committee in Norway. He was also associated with the work of the Canadian Management Council.

Mr. MacKenzie joined the Engineering Institute in 1921 as an Associate Member, transferred to Member in 1940.

Robert G. Watson, M.E.I.C., retired power superintendent for the City of Edmonton, died in Victoria, late in the summer of 1955.

Mr. Watson was born at Blackhurst Hill, Essex, England, on September 22, 1880. In 1896 he enrolled at the Robert Gordons Technical College of Aberdeen, Scotland, where he spent six years as a student, while at the same time being apprenticed to a company of Aberdeen engineers, foundrymen and boilermakers. In 1902 he passed the Board of Trade examinations as first class marine engineer.

His career began with the Houlder Brothers and Company Limited, shipowners in London, as first class engineer and with the Measham Colleries Limited, Leicestershire, England, where he was assistant mechanical superintendent of the Iron Ore Mine, at Wabana, Newfoundland. In 1924 he became the chief engineer of the St. John Dry Dock and Shipbuilding Company, which position he held until 1929.

Then came a period of four years association with R. A. Ross and Company as chief draftsman and later as design engineer. He worked in 1929-1932 as supervisor of all mechanical work on the building of the Beauharnois canal and power house. In 1933 Mr. Watson entered into private practice as a member of the Toronto firm, Watson and Ferguson, consulting engineers.

In 1937 he accepted the position of power superintendent with the city of Edmonton, where he remained until his retirement in 1946.

Mr. Watson joined the Institute in 1921 as Associate Member and became Member in 1940. He attained Life membership in 1952.

Dr. W. B. Ross, M.E.I.C., assistant registrar and assistant professor of mathematics at McGill, died on December 27, 1955, in Montreal, following a lengthy illness.

Born in Westmount, Que., on September 25, 1905, he had his preliminary education there and led the province upon matriculation in 1923. He entered McGill University with the Sidney Hodgson Scholarship that year, graduated with first class honours in mathematics and physics. He was a recipient of the Douglas Tutorial Bursary in Physics, for three years, the National Research Council Bursary in 1930, and the Studentship. In 1931 he gained a master of science degree and in 1933, the Ph.D. degree, in physics.

His engineering included survey work in Montreal and test and experimental work for the Canadian Marconi Company. During his post-graduate years he took part in research work being done on dielectric constants, the Heaviside and Appleton Layers, and on air flow and sound. In 1932 he was in charge of McGill's National Research Council party at Newfoundland, to investigate radio effects of Solar Eclipse.

Dr. Ross joined the staff of McGill University as lecturer in mathematics in 1932, was promoted to assistant professor in 1942, and assistant registrar in 1946. He also served for a number of years as university marshall and warden of Douglas Hall.

He joined the Engineering Institute as a Student in 1929, became an Associate Member in 1935 and transferred to Member in 1940.

Frank Young, M.E.I.C., assistant city engineer for the City of Saskatoon, died at his home on January 19, 1956, after a lengthy illness.

Mr. Young was born in Marclesfield, Cheshire, Eng., on September 6, 1891, and attended a technical school in that city. He came to Canada in 1911 and soon joined the surveying firm of Phillips, Stewart and Phillips, in Saskatoon, working on subdivision surveys, drainage projects, road surveys and municipal engineering. He remained with the firm for more than ten years.

In 1921 he accepted a position with the City of Saskatoon as field engineer on various types of municipal construction. He continued to serve the community until last July when ill health intervened, except for a period of five years war-time service with the Federal Department of Transport in work concerned with the development and paving of prairie airports. This led Mr. Young to recognition as an expert on asphalt paving. Named assistant city engineer in 1947, Mr. Young had served in all phases of the engineering department, and at the time of his death he had been with the city for thirty-four years.

He was member of the Association of Professional Engineers of Saskatchewan. He joined the Institute as an Associate Member in 1938, transferring to Member in 1940.

Alexander Stuart Donald, M.E.I.C., former chief highway engineer and deputy minister of public works, resident of Moncton, N.B., died at Shediac Cape, N.B., on September 25, 1955.

Born in Moncton in 1885, he was well known throughout the province for his many contributions to public life. During world war I he saw service overseas, was wounded in action and awarded the D.S.O. for gallantry. In the second conflict he was appointed chief airways engineer for the Eastern Air Command, under the Department of Transport. For outstanding work in this position, he was awarded the M.B.E., in the Dominion Day Honours, 1946.

He was appointed chief engineer for the Department of Highways and Public Works of N.B. in 1946, and subsequently became deputy minister of highways and public works for the province.

Mr. Donald, who retired in December, 1953, joined the Engineering Institute in 1942, and was elected chairman of the Moncton Branch in 1944. He has supported the work of the Institute in Moncton, and was a familiar figure at annnual meetings and at Maritime professional meetings.

J. D. MacMillan, M.E.I.C., died suddenly at his home in Beaupre, Quebec, on January 31, 1956.

Mr. MacMillan was born in Richardsville, N.B., on June 6, 1921, attended high school at Campbellton and, graduating in 1939, entered the University of New Brunswick. Four years later he obtained a B.Sc. degree in civil engineering. He immediately joined the Canadian Army on active service, receiving his R.C.E. commission that fall. He was later recommissioned in the R.C.I.C.

Discharged at the end of the war, he worked as instrumentman with the engineering division of Canadian National Railways in Quebec City, for a time, then in 1947 accepted a position with the Abitibi Power and Paper Company Ltd. After a few months in the Sault Ste. Marie, Ont., division he went to the engineering department in Beaupre, where he remained.

He joined the Engineering Institute as a Student in 1943, transferred to Junior in 1946, and Member in 1951. He was a member of the Canadian Pulp and Paper Association.

J. S. Wilson, M.E.I.C., retired president of Tyee Machinery Company Limited, died in Vancouver on February 21, 1956. He was chairman and founder of the company.

A Scot, Mr. Wilson was born in Glasgow on August 15, 1882. He received his mechanical engineering grounding in the Royal Technical College, Glasgow, and his early shop training in a Clydeside machine shop. He finished these studies in 1904 and in 1907 he moved to the United States where he established himself on the west coast, joining the staff of the Washington Iron Works. He remained there until 1915, when he transferred his services to the Willamette Iron and Steel Works, Portland, Oregon. Within two years he was appointed chief engineer. He also designed the company's first duplex loader and high lead yarder. In 1919 he was named managing director of the Canadian Willamette Company of Vancouver.

However, a few years later he resigned in order to establish his own logging machinery firm, opened early in 1922 and named Tyee Machinery Company. The firm was to supplv the equipment needs of the B.C. logging operator, which Mr. Wilson thought should be built locally. It served also as the local representative for other machinery firms supplying equipment essential to industry on the coast. An affiliate company is the Tyee Equipment Company. Mr. Wilson had been president and general manager until his retirement in 1955.

He was a member of the Association of Professional Engineers of British Columbia, and had been a member of the Institute since 1942.

W. Chester Smith, M.E.I.C., retired civil engineer and town planner, died on December 19, 1955, in Toronto.

He was born in Strathroy, Ontario, on October 3, 1886, and had his early education in London, Ont. He was an art school graduate in 1902, and received a first class teaching diploma in 1905. In 1912 he graduated from the University of Toronto with a B.A.Sc. degree. He qualified for the degree of civil engineer at the same university, in 1917.

Prior to this date he worked as assistant city engineer in Victoria, B.C., and with the government of British Columbia in the Water Rights Branch. He was chief engineer on the Sumas Reclamation project and was instrumental in the investigation and development of waterpower rights and irrigation for that province. Later, in 1919, he was, for a short time, consulting engineer in Vancouver.

He was also concerned at time with the development of the Mesabi Iron Range near Duluth.

In 1921 he went to Toronto to work as an engineer for the Toronto transportation commission.

Mr. Smith accepted the position of city engineer for the city of Oshawa, Ont., in 1922, and during eight years supervised the rebuilding of the city's road, water sewage and fire fighting systems and in general conditions conducive to industrial investment, and expansion and residential comfort.

Mr. Smith joined the Cooksville Company Limited, of Toronto in 1931 as chief engineer, taking a prominent part in the development and full utilization of light-weight building products. He remained with the firm until his retirement in 1952, due to failing health.

Well known in civil engineering circles in the United States and England, he was, from 1946 until 1950, a director of National Concrete Masonry Association. He was a member of the Corporation of Professional Engineers of Quebec. He joined the Engineering Institute in 1936 as a Member.

F. A. Brownie, M.E.I.C., president of Canadian Western Natural Gas Company Limited, and prominent in the province's gas utility industry, died on January 23, 1956, in Calgary.

Mr. Brownie was born in Montreal, on April 16, 1908. He received his public and high school education in Calgary as well as a first class teaching certificate from the Calgary normal school. In 1933 he graduated from the University of Alberta with a B.A. degree and a year later he received a B.Sc. degree in civil engineering.

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

As a student he had worked on townsite surveys for the Canadian Pacific Railway and on the construction of Glenmore Water Supply project of the city of Calgary.

On graduating, in 1934, he spent the summer as instrument man on a seismic survey for Dominion Gas Service Limited. Later that year he became an inspector in the assessments branch of the Department of Municipal Affairs in Edmonton.

• Obituaries

He joined Northwestern Utilities Limited in Edmonton in 1935 as an assistant engineer. In 1939 he went to Calgary to assume the position of assistant to the general manager of Canadian Western Natural Gas Company Limited. Named general manager of the company in 1948, he became president of the two gas companies a year later. In 1954 he assumed also the presidency of Canadian Utilities Limited.

Mr. Brownie was a director of the Alberta Gas Trunk Line Limited and head of Sturdie Propane Limited, Hugh Gas Limited, and New Fidelity Trust Company.

A tireless worker in his direction of the various companies under his leadership, he found time for community work as well, through the Calgary Chamber of Commerce and the Canadian Red Cross Society.

He was a past-president of the Canadian Gas Association, a past director of the American Gas Association and a past-president of the Association of Professional Engineers of Alberta.

He had been associated with the Engineering Institute since his student days, joining in 1932, and transferring to Junior in 1935, to Associate Member in 1938, and to Member in 1940.

Professor A. E. Flynn, M.E.I.C., dean and professor of mining engineering at the Nova Scotia Technical College, Halifax, died suddenly on February 28, 1956, in Halifax.

Professor Flynn was born in London, England, on October 29, 1890. He received his preparatory eduction in the United States, where the family were then established, but later returned to England for specialized training at Finsbury Technical College, London, 1906-08, and the Royal School of Mines for the next three years. In 1912 he had qualified for the degrees of A.R.S.M. and D.I.C.

He gained his early professional experience in England, Germany and Spain, but soon after completing his studies was attracted to the development at Cobalt, Ont. He came to Canada to take up work in Cobalt for the Nipissing Mining Company from 1912-1916. He designed and built the mining laboratory of the Haileybury School of Mines in which he was one of the first instructors in 1916-1918. After two years spent in mining pyrites at Goudreau, Ont., and a year with the Hardinge Company at York, Pennsylvania, in 1921, he was offered the chair of mining engineering at the Nova Scotia Technical College, where he remained permanently. In 1953 he was made Dean of Faculty.

His service to Nova Scotia was not confined to teaching. Acting as development engineer in the provincial Department of Natural Resources for five years, and in many other ways, notably by extensive research in the utilization of minerals, he played an important part in developing the mineral industry of the province. He contributed many invaluable papers and discussions on the subjects in which he was an authority. He was a member of the Nova Scotia Advisory Board of Mineral Development.

Professor Flynn joined the Engineering Institute in 1940. He worked with the Halifax Branch and filled the offices of chairman and representative on the Institute council, the latter in 1945.

His support was felt by several professional organizations. He was elected president of the Canadian Institute of Mining and Metallurgy in 1953. He had earlier served that Institute as vice-president for the Maritimes in 1941-1942, and a member of council in 1937-1939, and chairman of the coal division in 1948-1949.

Prof. A. E. Flynn, M.E.I.C.

He was president of the Mining Society of Nova Scotia in 1939; president of the Association of Professional Engineers of Nova Scotia in 1947. He held membership also in the American and British Institutes of Mining and Metallurgy.

Professor Flynn was awarded the Leonard Medal of the Engineering Institute in 1930.

G. A. Sutherland, M.E.I.C., executive assistant with the electrical engineering and radio branch of the National Research Council, Ottawa, died on December 5, 1955, in Ottawa.

Mr. Sutherland, who was born in Winnipeg, on October 31, 1913, received his education there and in 1934 was graduated from the University of Manitoba with a B.Sc. degree in electrical engineering. He joined the firm of Fetherstonhaugh and Company soon after, but in 1935 transferred to the position of technical instructor at the Chicago Institute of Diesel Engineering in Winnipeg for a two year term. He became a member of the staff of Kipp-Kelly Limited, in Winnipeg, as a designing engineer in 1937, and later gained experience with the Western Steel Products Corporation Limited.

In 1940 he received the appointment of administrative assistant to the director of the Division of Physics and Electrical Engineering, with National Research Council in Ottawa. He became administrative assistant to B. G. Ballard, M.E.I.C., officer in charge of the electrical engineering and radio branch of N.R.C., in 1946 and was named executive assistant in 1953.

Mr. Sutherland joined the Institute as a Junior in 1938 and became a Member in 1948. He was active in the Ottawa Branch and had been its secretary-treasurer for two years when his untimely death occurred.

D. A. Buhr, M.E.I.C., died on January 22, 1956, in Swift Current, Saskatchewan,, following a lengthy illness.

He was born at Langham, Sask., on March 29, 1925, and received his schooling there. In 1943 he first joined the Prairie Farm Rehabilitation Administration in Regina, to work as rodman in the summer months while a student of the University of Saskatchewan. He graduated in 1947 in civil engineering, after a period of active service with the R.C.N.V.R., during the final months of the war. Going on to the Utah State Agricultural College in Logan, Utah, he obtained a master's degree in civil engineering. About this time he was awarded an Aluminum Company of America fellowship to conduct research on aluminum sprinkler irrigation tubing and couplings.

In 1949, once again with P.F.R.A. in Regina, he was engineer in charge of construction and drainage investigations and since that time had been resident engineer with the organization.

Mr. Buhr was a member of the American Society of Civil Engineers. He joined the Engineering Institute in 1946, as a Student, transferred to Junior in 1948, and became a Member in 1951. He was a member of the Association of Professional Engineers of Saskatchewan.

John A. Linney, M.E.I.C., electrical engineer with the Canadian National Railways, died on November 11, 1955, in St. Lambert, Quebec.

Mr. Linney was born in North Battleford, Sask., on November 3, 1924. He received his general education in Edmonton, and graduated from the University of Alberta in 1946 with a B.Sc. degree in electrical engineering.

Prior to graduation he had had experience with Calgary Power Company at Calgary, during the summer of 1944. He was on duty with the R.C.N.V.R. during 1945.

His association with the railway company began in Montreal immediately upon graduation in 1946. Since that date he was employed by the architects department in the design and layout of all types of electrical distribution systems in buildings throughout the system.

In 1950 Mr. Linney was transferred to Edmonton to take over the supervision of the electrical installations in the Canadian National Railways' McDonald Hotel extension, in Edmonton.

He returned to the chief architects department in 1953.

Mr. Linney joined the Institute as a Student in 1946, became a Junior in 1948 and a Member in 1955.

President

OF

The Engineering Institute of Canada

1956

Vernon Archibald McKillop

For its next president the Institute has chosen Vernon Archibald McKillop, M.E.I.C., general manager of the London Public Utilities Commission and of the London Railway Commission.

Mr. McKillop is a native of West Lorne, Ont., where he was born on March 12, 1899. Proceeding through the local schools and the course in electrical engineering at the University of Toronto, he received the degree of B.Sc. in 1924. His education was interrupted by a term of service with the Army Service Corps.

Joining the Public Utilities Commission immediately after graduation from the university, he has never had any other employer. His advancement in rank and responsibility has been regular from the grade of assistant engineer to that of general manager, to which post he was appointed in 1952. His duties involve the distribution of electricity, bought from the Hydro-Electric Power Commission of Ontario, in a city of 100,000 people, the distribution of water and the search for additional underground supplies, the operation of an extensive park system and recreation program, and the management of the hundred-year-old, city-owned railway from London to Port Stanley on Lake Erie.

Mr. McKillop's association with the Institute began in 1926, when he was admitted to membership as a Junior; he became an Associate Member in 1929 and a Member in 1940. From 1940 to 1955 he sat on council as the representative of the London Branch and he was a trustee of the Bennett Educational Fund from 1948 to 1956.

Active in the affairs of the London Branch, he was its chairman in 1933.

During and after the late war, Mr. McKillop served as a volunteer advisor to the London Board of Education in dealing with both civilian students and veterans who showed an interest in engineering as a career. He is a member of the Association of Professional Engineers of Ontario, of the Canadian Section of the American Waterworks Association (chairman as of April 24, 1956), of the Kiwanis Club of London (president, 1953), and of the Association of Municipal Utilities (president, 1942).

Mrs. McKillop is the former Frances Horton, R.N., of St. Thomas, Ont. Married in 1925, the couple has two sons and a daughter.

Newly Elected Officers of the Institute

At the Annual Meeting, the president, three vice-presidents and twenty-six councillors will take office, and will serve with others whose terms of office continue. The complete list of Council will appear in the next issue of the *Engineering Journal*.

H. W. L. Doane, M.E.I.C., manager and director of Standard Paving Maritime Ltd. of Halifax, has been elected vice-president of the Institute, representing the Maritime Provinces for a two-year term.

Mr. Doane was born in Halifax and received his general education at the public and high schools there. After three years of study at Dalhousie University, he attended the Nova Scotia Technical College, graduating with a B.Sc. degree in civil engineering in 1913. He is also a qualified Nova Scotia Provincial Land Surveyor.

He served with the rank of major during World War I with the Canadian Artillery and with the Imperial Forces in Egypt, Palestine and France, and upon his return to Canada, formed the 9th Siege Battery.

In 1919 Mr. Doane was appointed assistant city engineer for Halifax, which position he occupied until 1928 when he became manager of Argyle Motor Services. Three years later he undertook the management of Standard Paving Maritime Ltd. of which he is now manager and director. During 1944-47 he was manager of the Halifax Utilities Commission.

Mr. Doane is a member of the Association of Professional Engineers of Nova Scotia and of the Canadian Legion.

He joined the Engineering Institute as an Associate Member in 1919, transferring to Member in 1923, and has shown an active interest in its affairs. He is a former chairman of the Halifax Branch and a former member of Council, representing the Branch, and, again, representing the Association of Professional Engineers of Nova Scotia.

H. W. L. Doane, M.E.I.C.

George M. Dick, M.E.I.C., chief engineer of Canadian Ingersoll-Rand Company Ltd., has been elected vice-president of the Institute to represent the Province of Quebec.

George M. Dick, M.E.I.C.

Mr. Dick was born in Stirling, Scotland, and received his general education there. He came to Canada in 1913, and after a short period spent in Western Canada, came to Sherbrooke and joined Canadian Ingersoll-Rand as an apprentice. During the First World War he was employed in the design of machinery for the manufacture of munitions.

He became a student at Bishops University in 1920 and then came to McGill University, where he graduated with honours in mechanical engineering in 1924. He was British Association Medallist and holder of the Babcock and Wilcox Scholarship. His summer essay was awarded the Engineering Institute competition prize and the Pulp and Paper Association prize. During the summer months of his university course he was with the Brompton Pulp and Paper Company in East Angus, Que.; with Babcock Wilcox and Goldie McCullough Ltd. in Galt Ont.; and with Canadian Ingersoll-Rand Company Ltd. at Sherbrooke.

Mr. Dick rejoined the permanent staff of Canadian Ingersoll-Rand after graduation as designing engineer on mine hoists. He became chief hoist engineer in 1937, and in that position pioneered the design of a considerable number of mine hoists used in Canada today.

During World War II he was also chief engineer of the Sherbrooke Pneumatic Tool Company, a subsidiary of Canadian Ingersoll-Rand, and was responsible for the design of much of the shell manufacturing equipment used by this company. Later he became technical assistant to the works manager, a position he held until 1945 when he was appointed manager of engineering with duties which embraced management of all phases of the company's engineering and technical activities, also the complete control of the company's purchasing program. Since 1952 Mr. Dick has been chief engineer of the company and has recently devoted his time principally to the development of new products, materials and processes.

He is a member of the American Society of Mechanical Engineers, the Technical Association of Pulp and Paper Industry of U.S.A., the Canadian Institute of Mining and Metallurgy, and the Canadian Pulp and Paper Association. He is a past regional representative for the Eastern Townships on the Council of the Corporation of Professional Engineers of Quebec.

Mr. Dick joined the Engineering Institute in 1922 as a Student, transferred to Associate Member in 1928, and to Member in 1940. He is a charter member of the Eastern Townships Branch of the Institute, and served as its first chairman. He has also been a member of the Institute's committee on Confederation.

H. R. Sills, M.E.I.C.

H. R. Sills, M.E.I.C., design engineer with the apparatus department of Canadian General Electric Company Ltd. in Peterborough, Ont., has been elected a vice-president of the Engineering Institute representing the Province of Ontario.

Mr. Sills has designed or been responsible for the design of generators for the majority of hydraulic generating stations in Canada, as well as a number of foreign countries. He has been with Canadian General Electric since his graduation in electrical engineering from Queen's University in 1921.

In 1922 he was assigned to design engineering with the AC group and has served the company in a supervisory capacity since 1945. Mr. Sills has a number of important inventions to his credit and has been granted patents on twenty of these inventions so far. His work and responsibility has also covered large synchronous motors for pulp grinding and pumping applications, and large outdoor hydrogen-cooled, and outdoor and indoor air-cooled synchronous condensers.

Last year he was made a fellow of the American Institute of Electrical Engineers, having been an active member of that organization since 1920. For some years he has been a member of the A.I.E.E. technical committee on rotating machinery, and a member of the synchronous machine sub-committee.

Mr. Sills has always taken an active part in the affairs of the Engineering Institute which he joined as a Student in 1921. He transferred to Associate Member in 1936, and to Member in 1940. From 1940 to 1945 he was a councillor of the Institute, ~~and since 1945 he has been chairman of the Membership Committee of the Institute.~~

J. Roderick Wallace, M.E.I.C., chief metallurgist of Dominion Iron and Steel Limited, has been elected a councillor of the Institute to represent the Cape Breton Branch for a two-year term.

Mr. Wallace was born in Westville, N.S., and received his early education in Westville and New Glasgow, N.S. He graduated from McGill University in 1940 with a bachelor of engineering degree in metallurgy.

J. Roderick Wallace, M.E.I.C.

He became associated with Dominion Iron and Steel during the summers of his university course, working at the Sydney steel plant as a labourer in the open hearth department in 1939. In 1940 he joined the permanent staff as open hearth observer. Three years later he was transferred to the coke oven department and in 1944 was named assistant superintendent of that department.

Mr. Wallace was appointed assistant director of research in 1946 and director of research and development in 1950. He became chief metallurgist of the company in Sydney last year.

He is a member of the Canadian Institute of Mining and Metallurgy, and of the Association of Professional Engineers of Nova Scotia.

Mr. Wallace is a past chairman of the Cape Breton Branch of the Institute, which he joined in 1949 as a Member.

O. Nelson Mann, M.E.I.C., executive manager of the Atlantic Provinces Economic Council, has been elected to represent the Halifax Branch of the Institute on Council for two years.

Mr. Mann was born in Sydney, N.S.,

O. Nelson Mann, M.E.I.C.

and attended the public and high schools there. In 1933 he received his engineering certificate from Acadia University, and two years later, his B.Eng. degree in mechanical engineering from the Nova Scotia Technical College.

After graduation he was employed successively by Dominion Steel and Coal Co. Ltd. in Sydney, Imperial Oil Limited in Dartmouth, N.S., the Eagle Pencil Company in Drummondville, Que., and Defence Industries Limited in Brownsburg, Que., Verdun, Que., and Montreal.

At the close of the war he was associated in the consulting field with J. D. Woods and Gordon, Ltd., and Stevenson Kellogg, Ltd., in the Toronto area. He also gained wide experience in the metal and textile industries.

In 1950 Mr. Mann returned to his native province of Nova Scotia to join the Nova Scotia Research Foundation. He subsequently entered the provincial Department of Trade and Industry, and last year was appointed to his present position as head of the Atlantic Provinces Economic Council.

He joined the Engineering Institute as a Student in 1936, transferring to Junior the following year, and to Member in 1947. In 1954 he was elected chairman of the Halifax Branch.

Donald J. MacNeil, M.E.I.C., head of the department of geology at St. Francis Xavier University, Antigonish, N.S., has been elected to represent the North Nova Scotia Branch on the Council of the Institute.

Dr. MacNeil was born in Sydney, N.S., and received his early education there. After working as engineering assistant in the planning bureau of the New York Edison Company from 1925 to 1928, he entered St. Francis Xavier University and graduated in 1930 with a B.Sc. degree, and then received his Ph.D. degree in geology from Princeton University in 1935.

Donald J. MacNeil, M.E.I.C.

He worked as a petroleum geologist for the Shell Oil Company in Oklahoma and Texas for four years thereafter, and then joined the Texas Company in Illinois and Alberta in the same capacity. He accepted his present position in 1946.

In addition to the teaching and consulting work that he carries on at Antigonish, Dr. MacNeil is lecturer in the department of geology and geophysics at the Massachusetts Institute of Technology, and is lecturer in engineering geology at Nova Scotia Technical College. He is a member of the Advisory Board on Mineral Development for the province of Nova Scotia; executive secretary of the Nova Scotia Centre for Geological Sciences; secretary of the Associate Committee on Coal for the Nova Scotia Research Foundation; a fellow of the Geological Society of America; and a member of the National Advisory Committee on Research in the Geological Sciences.

Dr. MacNeil is a past vice-president of the Canadian Institute of Mining and Metallurgy, a past president of the Mining Society of Nova Scotia, and a past president of the Association of Professional Engineers of Nova Scotia.

He became a Member of the Engineering Institute in 1943, and was a vice-president of the Institute in 1952.

M. F. Keith Leighton, M.E.I.C., has been elected a councillor of the Institute to represent the Moncton Branch.

Mr. Leighton is a past-chairman of the Moncton Branch and a member of Association of Professional Engineers of New Brunswick.

He is with the Canadian National Railways in Moncton, N.B., as structural engineer. In this capacity he is responsible for the inspection of steel bridges and timber trestles, the design of steel and timber bridges, and the design of such reinforced concrete structures as abutments, piers, and retaining walls.

Mr. Leighton was born in Moncton

and received his early education there. He graduated from the University of New Brunswick in 1949 with a B.Sc.

M. F. Keith Leighton, M.E.I.C.

degree in civil engineering. Previous to his graduation, from 1941 to 1943, Mr. Leighton was a member of the original crew which surveyed and laid out Goose Bay Airport in Labrador. During this time he held the positions of rodman, foreman, and inspector, and worked on various types of construction for the Department of Transport.

During the summers of the last two years of his university courses, he was employed as instrumentman with the New Brunswick Department of Highways working on highway diversion, and then, also as instrumentman with Canadian National Railways working with the terminal engineer at Cape Tormentine, N.B., where he was in charge of surveys, setting grades and taking soundings for dredging.

In 1949, after receiving his degree, Mr. Leighton was named structural engineer with the bridge department of the Canadian National Railways.

Mr. Leighton joined the Institute as a Student in 1947, transferred to Junior in 1951, and to Member in 1953.

Robert C. Eddy, M.E.I.C.

Robert C. Eddy, M.E.I.C., vice-president and director of George Eddy Company Ltd., has been elected to represent the Northern New Brunswick Branch of the Engineering Institute on Council.

Born at Bathurst, N.B., Mr. Eddy spent one year at the University of New Brunswick before proceeding to Queen's University, where he graduated in 1941 with a B.Sc. degree and medal. After graduation he undertook post-graduate work at the University of Michigan and at Queen's University, but interrupted these studies to join the Royal Canadian Engineers in 1942. He received the Military Cross while serving in Holland.

Upon his return to Canada after the war he was appointed lecturer in chemical engineering at Queen's University. Subsequently he entered the family business in Bathurst and is now vice-president and director of this company.

Mr. Eddy is also a director of Eddy Hardware Limited, Raworth and Mollins Limited, Bathurst Broadcasting Company Ltd., the Maritime Lumber Bureau, and the Canadian Forestry Association. He is presently serving as president of the Maritime Retail Lumber Dealers' Association.

He joined the Engineering Institute in 1941 as a Student, transferred to Junior in 1946, and later the same year, to Member. In 1953 he was active in establishing the Northern New Brunswick Branch of the Institute and served as its first chairman.

C. H. Boisvert, M.E.I.C., chief engineer of the Public Service Board, has been elected to serve for a two-year term as councillor representing the Quebec Branch of the Institute.

C. H. Boisvert, M.E.I.C.

Born in Montreal, Mr. Boisvert completed the scientific course offered by Mont Saint-Louis College there. He continued his training at Ecole Polytechnique, graduating in civil engineering in 1925. During the summer months of his university course he was engaged in general and topographical survey work.

Upon graduation he undertook the student training course offered by Shawinigan Water and Power Company, and in 1926 joined the engineering staff of the Public Service Board in Quebec, becoming chief engineer in 1931.

Mr. Boisvert is a member of the Corporation of Professional Engineers of Quebec.

He joined the Engineering Institute as a Junior in 1927, transferring to Associate Member in 1932, and to Member in 1940. He served as chairman of the Quebec Branch in 1946-47.

Roger Brais, M.E.I.C.

Roger Brais, M.E.I.C., head of the department of chemistry and chemical engineering of Ecole Polytechnique, has been elected by the Montreal Branch to serve as councillor for three years.

A Montrealer by birth, Professor Brais completed the scientific course at Mont-Saint-Louis College in 1929. In 1933 he received the degrees of civil engineer and bachelor of applied sciences from Ecole Polytechnique, and the following year the degree of chemical engineer from the same university. He followed special courses in physical chemistry in 1938 at the Massachusetts Institute of Technology with Professors E. B. Millard and G. Dietrichson. In 1942 he received his Ph.D. degree from McGill University, having majored in physical chemistry since 1939 under Dr. O. Maass.

Professor Brais began his engineering career in 1934 as a chemical engineer with the Quebec Department of Health, becoming in 1936 a consulting chemical engineer and chemist for the mining industry in Abitibi. Two years later he joined the staff of Ecole Polytechnique as assistant professor of chemistry, being named associate professor in 1944, and professor and head of the department of chemical engineering and chemistry in 1948.

Elected a fellow of the Chemical Institute of Canada in 1950, Professor Brais is also a member of the American Chemical Society, the Society of Chemical Industry, the National Association of Corrosion Engineers, the Chemical Society (London), and the Corporation of Professional Engineers of Quebec.

He joined the Engineering Institute as a Member in 1949. That same year he served as chairman of the chemical engineering section of the Program Committee, and in 1950 and 1951 as vice-chairman and chairman of this Committee. During 1952 and 1953 he was a member of the Publications Committee, and in 1954 and 1955, a member of the Executive Committee of the Montreal Branch. During 1955 he also served as chairman of the Admissions Committee of the Branch.

Clifford E. Frost, M.E.I.C., who is building and structures engineer in the special contracts department of the Bell

Telephone Company of Canada, is one of three members elected to represent the Montreal Branch for a three-year term on the Council of the Institute.

Clifford E. Frost, M.E.I.C.

Mr. Frost was born in Danville, Que. He attended Lachine High School and McGill University, graduating with a B.Sc. degree in civil engineering in 1931. Upon graduation he became assistant engineer with the National Harbours Board.

He began his association with the engineering department of the Bell Telephone Company of Canada in 1937 and has remained with the company since that date except for a period of service during World War II with the Royal Canadian Air Force. In 1949 he was appointed special duties engineer, and in 1951, construction contracts engineer for the eastern area. Two years later he became construction contract engineer of special projects, and in 1954 he was appointed to his present position.

Mr. Frost joined the Engineering Institute as an Associate Member in 1936, becoming a Member in 1940. He served as chairman of the Junior Section in 1937, and as chairman of the Branch in 1955.

H. A. Mullins, M.E.I.C., purchasing agent for equipment and construction materials with Du Pont Company of Canada Ltd., is one of three newly elected councillors who will represent the Montreal Branch of the Institute for a three-year term.

H. A. Mullins, M.E.I.C.

Mr. Mullins, born in Herschel, Sask., received his general education in Winnipeg public and high schools, and graduated from the University of Manitoba with a B.Sc. degree in electrical engineering in 1936.

Upon graduation he joined Kipp Kelly Limited in Winnipeg and spent a year on the development and testing of mechanical separating machinery. Moving to Toronto in 1937, he became associated with Eastern Power Devices and Maloney Electric Company. In 1938 he served as chief engineer with the Taylor Electric Manufacturing Company in London, Ont., and in 1940 joined Defence Industries Limited in Montreal as project engineer on the design and construction of munitions plants at Nobel, Winnipeg, Shawinigan Falls, and various locations in Canada. He was transferred to Canadian Industries Limited in 1945 and occupied successively the positions of assistant project engineer, project engineer and coordinating engineer on the design and construction of chemical, explosives, films, and synthetic fibres plants.

Since July, 1954 Mr. Mullins has been employed by Du Pont Company of Canada Ltd. in the purchasing and traffic department as purchasing agent for equipment and construction materials.

He joined the Engineering Institute as a Student in 1937, transferring to Junior in 1942, and to Member in 1947. Active in the affairs of the Montreal Branch since 1940, he has served as chairman of the Entertainment Committee, and as member of both the Branch executive and the Publication Committee.

John M. Hawkes, M.E.I.C., owner of Parisien Beverages in Cornwall, Ont., has been elected to represent the Cornwall Branch on the Council of the Engineering Institute for a two-year term.

John M. Hawkes, M.E.I.C.

He was born in Oshawa, Ont., and received his early schooling in Oshawa and at King's College. After attending Adelaide University in Australia from 1927 to 1928, he received his B.Sc. degree from Queen's University in 1932.

He worked during the summer of 1931 in the engineering department of General Motors in Oshawa, and after graduation worked as a draughtsman with General Motors in Oshawa, the Skinner Bumper Company in Oshawa, and then in 1935 with the Duplate Glass Company, also in Oshawa.

In 1936 Mr. Hawkes was named chief engineer and production manager of Pepsi-Cola Company of Canada Ltd. in Montreal, and was in charge of all buildings and equipment for the company, including the Outremont plant which was built in that year. He remained with Pepsi-Cola until 1945 when he became owner of Parisian Beverages in Cornwall.

He became a Member of the Engineering Institute in 1945 and has taken an active part in the activities of the Cornwall Branch, serving as its chairman in 1953.

Robert F. Legget, M.E.I.C., director of the division of building research of the National Research Council since 1947, has been elected Ottawa Branch representative on the Council of the Institute for two years.

Robert F. Legget, M.E.I.C.

Mr. Legget was born in Liverpool, England. He received his general education at Merchant Taylor's School in Great Crosby, afterwards attending the University of Liverpool where he obtained his B.E. degree with honours in 1925, and his M.E. degree in 1927.

In 1925 he became assistant engineer with C. S. Meik and Buchanan in Westminster, and four years later accepted the position of resident manager of Power Corporation of Canada Ltd. He remained with this company until 1932 when he joined Canadian Sheet Piling Co. Ltd. in Montreal.

Mr. Legget served as lecturer on the civil engineering staff of Queen's University in 1936. Within the next two years he was appointed assistant professor of civil engineering at the University of Toronto, becoming associate professor in 1943.

In 1945 Mr. Legget was named chairman of the Committee on Soil and Snow Mechanics, and in 1947 was appointed to his present position. He has served as consulting engineer on soil and foundation problems for the Toronto Transportation Commission, Steep Rock Mine, the Polymer Plant, the Shipshaw Development, and others.

Mr. Legget holds the J. P. Joule and

J. Forest Medals, the Miller Prize and Telford Premium of the Institute of Civil Engineers, and the Society's Premium of the Liverpool Engineering Society. He is a member of the Institution of Civil Engineers (London); the American Society of Civil Engineers, and the Association of Professional Engineers of Ontario. He is also an honorary fellow of the Royal Architectural Institute of Canada, and a fellow of the Geological Society of America.

Author of "Geology and Engineering" (1939), and joint author with C. P. Disney of "Modern Railroad Structure" (1949), Mr. Legget has also contributed numerous papers on engineering and research in soil mechanics.

He joined the Engineering Institute as a Junior in 1929, and transferred to Associate Member in 1931, and to Member in 1940. He has served as chairman of both the Toronto and Ottawa Branches of the Institute.

A. J. Bonney, M.E.I.C., plant engineer for the Quaker Oats Company of Canada Ltd. in Peterborough, Ont., has been elected to represent for a two-year term the Peterborough Branch on the Council of the Institute.

A native of Oshawa, Ont., Mr. Bonney attended Queen's University, graduating with a B.Sc. degree in mechanical engineering in 1935. He also holds the Ontario first class stationary engi-

A. J. Bonney, M.E.I.C.

neer's certificate which he received in 1943.

Mr. Bonney joined his present company in 1935. He transferred from the mechanical maintenance department to the electric power department in 1936, and the following year to the steam power department. Previous to his appointment as plant engineer, he occupied successively the positions of electrical superintendent and chief steam engineer.

He joined the Engineering Institute as a Student in 1935, transferring to Junior in 1940 and to Member in 1947. In 1951 he served as chairman of the Peterborough Branch.

M. W. Huggins, M.E.I.C., associate professor of civil engineering at the University of Toronto, has been elected to serve for three years as a councillor of the Institute, representing the Toronto Branch.

A native of Toronto, Mr. Huggins was educated at Parkdale Collegiate and the University of Toronto. He received his B.A.Sc. degree in 1932, and his M.A.Sc. degree the following year. During the summers of his university course he worked as rodman with the roadway department of the City of Toronto, and as field engineer with the Consumer Gas Company in Toronto.

In 1933 Mr. Huggins joined E. P. Muntz Limited in Dundee, Ont., and was engaged in research work on prestressed concrete and on formwork accessories. He became associated with the Vernon Construction Company in

M. W. Huggins, M.E.I.C.

1936 as engineer in charge of design and erection of forms and falsework at Oakville, Ont.

After a year with Dominion Bridge Company as detailer and designer in Toronto, Mr. Huggins began his teaching career with an appointment as lecturer in civil engineering at Queen's University. He joined the faculty of engineering at the University of Toronto in 1941. At present he is also a partner in the consulting firm of Morrison, Hershfield, Millman and Huggins in Toronto.

Mr. Huggins is a member of the Association of Professional Engineers of Ontario and is a past councillor of the Association.

Joining the Engineering Institute in 1935 as a Junior, Mr. Huggins transferred to Associate Member in 1939, and to Member in 1940. He was elected chairman of the Toronto Branch of the Institute in 1955.

Paul E. Buss, M.E.I.C., president of Spun Rock Wools Ltd. in Thorold, Ont., will serve his sixth consecutive two-year term as representative of the Niagara Peninsula Branch on the Council of the Institute in 1956-57.

Mr. Buss was born at Three Rivers, Michigan, and received his engineering education at the University of Michigan. After service with the United States Army Engineers in France, Mr. Buss joined the engineering staff of Provincial Paper Limited on the construction of the first sulphite plant at Port Arthur, Ont. He was next associated with Dominion Engineering Works, and then served for a number of years as plant engineer at the Thorold division of Provincial Paper Limited.

During 1932-33 Mr. Buss and his brothers made experiments in the development of a new process for the production of rock wool by the spinning

Paul E. Buss, M.E.I.C.

method. A direct outcome of these was the setting up of the firm Spun Rock Wools Ltd. in Thorold, of which Mr. Buss is president.

Mr. Buss joined the Institute as an Associate Member in 1927 and became a Member in 1940. Previous to his activities as councillor of the Niagara Peninsula Branch, he served as its secretary-treasurer in 1931, and as its chairman in 1935.

Wm. R. Roberts, M.E.I.C., vice-president of Wm. Roberts Electric Ltd. in Kitchener, has been named councillor of the Institute representing the Kitchener Branch for two years.

Mr. Roberts was born in Kitchener where he received his general education. He attended Queen's University, graduating with a B.Sc. degree in electrical engineering in 1945. Upon graduation he undertook the one-year test course offered by Canadian General Electric Co. Ltd., after which he was appointed superintendent of the Davenport transformer test.

In 1947 he became vice-president of Wm. Roberts Electric Ltd. and has been

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in charge of all engineering and estimating.

Mr. Roberts joined the Engineering Institute as a Student in 1945, transferring to Junior in 1947, and to Member in 1953. He served as chairman of the Kitchener Branch in 1953.

L. C. Sentance, M.E.I.C., manager of the manufacturing department of the electronics division of Canadian Westinghouse Company Ltd., has been elected to serve as councillor representing the Hamilton Branch of the Institute.

L. C. Sentance, M.E.I.C.

Born in Melville, Sask., he received his early education in Saskatchewan and afterwards his B.E. degree in mechanical engineering from the University of Saskatchewan in 1935, and his M.Sc. degree in 1937. During the summers of his university course he worked as a surveyor with the Water Development Committee, and during his post-graduate studies he was an instructor in mechanical engineering subjects at the university.

Mr. Sentance began his career with Canadian Westinghouse immediately after receiving his master's degree, by enrolling in the engineering apprenticeship course at Hamilton. On completion of this course he was attached to the general engineering staff as mechanical engineer. Transferred to the manufacturing methods division in 1944 as manufacturing engineer, he was appointed director of manufacturing methods the following year.

In 1947 he was named assistant manager of works for the company, and then in 1951, manager of the manufacturing department of the apparatus division. He was appointed to his present position in 1952.

He is a member of the American Society of Mechanical Engineers, and of the Association of Professional Engineers of Ontario, having served as a past-councillor of the mechanical branch of that organization.

Mr. Sentance joined the Engineering Institute in 1936 as a Student, and transferred to Member in 1942. He is a past-chairman of the Hamilton Branch of the Institute.

H. C. Bates, M.E.I.C., of the Trans-Canada Highway division of the Department of Resources and Development, has been elected to represent the Huronia Branch for two years on the Council of the Institute.

Toronto born, Mr. Bates received his general education in that city and at the Woodstock Boys College. He graduated in civil engineering from Queen's University in 1917, having gained experience during his undergraduate years on survey, dredging and dock construction work with the Toronto Harbour Commission.

Upon leaving Queen's he was associated with the Grand Trunk Railway and with the Ontario Hydro-Electric Commission. He joined the Bell Telephone Company of Canada in 1923 as assistant engineer and subsequently became district engineer on construction design and maintenance of the outside plant. After completing 11 years of service with the company, he was associated with the Department of Northern Development, Sutcliffe Engineering Company, A. B. Crealock, consulting engineer, and Fred A. Bell, Elgin county engineer and Ontario land surveyor. In 1940 he was appointed county engineer for Lanark, and later, for Perth.

After almost 20 years of road building experience, he joined the engineering staff of the Trans-Canada Highway in 1953. His headquarters are located in Orillia and his territory extends from Norwood to the French River.

Mr. Bates has been a member of the Association of Professional Engineers of Ontario since 1923.

H. C. Bates, M.E.I.C.

He joined the Engineering Institute while a student in 1916, and transferred to Junior in 1920 and to Member in 1942. A charter member of the Huronia Branch, Mr. Bates is an active member of the Executive Committee.

R. A. McGeachy, M.E.I.C., administrative assistant to the refinery manager of Imperial Oil Limited in Sarnia, has been elected councillor to represent the Sarnia Branch of the Institute.

Mr. McGeachy was born in Collingwood, Ont. After attending public and high schools in Sarnia, he was for a time in the ground school of the Royal Flying Corps. After two years of study with the Case School of Applied Science, he completed his course at the University of Michigan, graduating with a B.Sc. degree in 1923.

R. A. McGeachy, M.E.I.C.

He began his engineering career in the employ of the bridge department of Nickel Plate Railroad, and later served as contractor's engineer in Michigan and Ohio.

Mr. McGeachy joined his present firm as a draughtsman in Sarnia. Four years later he transferred to the mechanical department and was engaged in construction and maintenance. Granted leave of absence in 1940, he served overseas with the Royal Canadian Engineers until September, 1945. He was discharged with the rank of major and was later awarded the M.B.E.. Upon his return to the Sarnia refinery of Imperial Oil Limited, he was named zone engineer. In 1953 he was appointed to his present position.

Mr. McGeachy is a member of the Sarnia Township Planning Board and the Sarnia Suburban High School Board. He also takes an active interest in the work of the Scouts and Sarnia Sea Cadets.

He joined the Engineering Institute as a member in 1945 and served as secretary of the Sarnia Branch in 1954.

G. G. M. Eastwood, M.E.I.C., of the Spruce Falls Power and Paper Com-

G. G. M. Eastwood, M.E.I.C.

pany in Kapuskasing, has been elected to represent for two years the North Eastern Ontario Branch on the Council of the Institute.

A native of Cornwall, Ont., Mr. Eastwood received his general education at the Collegiate Institute there. He entered the University of Toronto in 1933, graduating with a B.A.Sc. degree four years later.

By 1939 he had completed the two-year apprenticeship course offered by Canadian Westinghouse Co. Ltd., and the following year served the company as electrical draughtsman on switchboard layout. In 1942 he was appointed technical liaison between the engineering and sales departments of the firm which at that time was handling important war orders. At the close of the war Mr. Eastwood joined Courtaulds (Canada) Ltd. in Cornwall as assistant to the chief engineer, and was subsequently named plant engineer. He became associated with his present company in Kapuskasing in 1951. In his position as instrument engineer he is responsible for consolidating instrumentation and for assisting in the company's modernization program.

Mr. Eastwood has taken an active interest in the affairs of the Institute. While in Cornwall he served in 1948 as secretary-treasurer, and in 1950 as chairman of the Branch. In 1952 he was elected chairman of the western section of the newly formed North Eastern Ontario Branch, becoming chairman of the Branch in 1954. He was also a member of the committee which set up the Professional Development course in public speaking. This group is still active in the western section of the Branch.

D. C. Holgate, M.E.I.C., manager of Sault Structural Steel Co. Ltd., is the newly elected councillor representing the Sault Ste. Marie Branch of the Institute for a two-year term.

D. C. Holgate, M.E.I.C.

Mr. Holgate was born in Montreal. After receiving his general education at the Sherbrooke High School, he attended Acadia University where he graduated with a B.A. degree in mathematics in 1935. In 1938 he was granted a B.Eng. degree in civil engineering by McGill University.

He then became associated with MacKinnon Steel Corp. Ltd. as structural steel draughtsman and designer in Sherbrooke, Que., and afterwards joined Dominion Bridge Co. Ltd. in Toronto in the same capacity, transferring in 1941 to the company's subsidiary, Sault Structural Steel Co. Ltd. From that time until 1947 he was engineer in charge of all design and drawing office work by the company, and also served as assistant to the manager in the co-ordination of drawing office work, and the fabrication and erection departments on all contracts undertaken by the company. Mr. Holgate was granted a two-year leave of absence in 1943-44 to serve with the Royal Canadian Air Force. He was appointed to his present position in February, 1954.

Mr. Holgate joined the Engineering Institute as a Junior in 1942 and became a Member in 1947. Active in the affairs of the Sault Ste. Marie Branch, he has served as secretary-treasurer, chairman, and councillor representing the branch.

R. T. Harland, M.E.I.C.

R. T. Harland, M.E.I.C., chief engineer of the Winnipeg Hydro-Electric System, will represent for two years the Winnipeg Branch on the Council of the Engineering Institute.

A native of Winnipeg, Mr. Harland attended St. John's College School and graduated from the University of Manitoba in 1938 with a B.Sc. degree in electrical engineering. After a brief period with the City of Winnipeg Hydro-Electric System he resigned in 1939 to study at the Massachusetts Institute of Technology where he obtained his master's degree in 1941. He returned afterwards to the Winnipeg Hydro.

Mr. Harland served with the R.C.A.F. from 1942 to 1945, and then returned to the Winnipeg Hydro as operating engineer. He was appointed assistant principal engineer in charge of design in 1948, and principal engineer in charge of design in 1952. He was named chief engineer in November, 1955.

He is a member of the Association of Professional Engineers of Manitoba, and of the Manitoba Electrical Association.

Mr. Harland joined the Engineering Institute in 1938 as a Student and transferred to Member in 1944. He is a past secretary-treasurer of the Winnipeg Branch.

J. B. Mantle, M.E.I.C.

J. B. Mantle, M.E.I.C., associate professor of mechanical engineering of the University of Saskatchewan, has been elected councillor for a two-year term, representing the Saskatchewan Branch of the Institute.

Professor Mantle was born in London, England. He received his general schooling at Paynton, Sask., and at City Park Collegiate, Saskatoon. In 1941 he graduated with a B.Sc. degree in mechanical engineering from the University of Saskatchewan, and in 1947 he received his M.Sc. degree in theoretical and applied mechanics from the University of Illinois.

He completed the Canadian General Electric Company test course in 1942 and that same year joined the Royal Canadian Air Force, serving until 1945 as aeronautical engineer.

Professor Mantle became an instructor at the University of Saskatchewan after the war. He was named assistant professor of mechanical engineering in 1947, and was appointed to his present position in 1953. During the summer months of recent years Professor Mantle has been employed as stress analysis consultant with the National Research Council, Dominion Engineering Co. Ltd., the Department of Agriculture, and other government groups.

He is a member of the Association of Professional Engineers of Saskatchewan, serving as secretary-treasurer of the Saskatoon Section during 1947-49, and as councillor for two consecutive terms during 1949-51. He is also a member of the Society for Experimental Stress Analysis. Commanding officer of the University of Saskatchewan Squadron, R.C.A.F. during 1949-54, he is at present technical officer of 23 Wing H.Q., R.C.A.F. (Aux.), with the rank of wing commander.

Professor Mantle joined the Engineering Institute as a Student in 1941, transferring to Junior in 1943, and to Member in 1946.

W. A. Smith, M.E.I.C., general mechanical superintendent of Burns and Co. Ltd., has been elected councillor of the Institute representing the Calgary Branch for two years.

Born in Belfast, Ireland, Mr. Smith attended Calgary schools and afterwards the University of Alberta from which he received his B.Sc. degree in civil engineering in 1933. He gained experience during his undergraduate years while working during the summers with the City of Calgary, Canadian National Railways, and the National Parks of Canada.

In 1934 he joined the draughting office staff of Dominion Bridge Co. Ltd. in Calgary where he was employed on

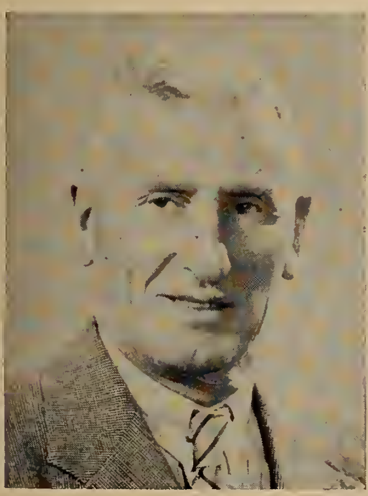
W. A. Smith, M.E.I.C.

structural steel assembly. The following year he became associated with the International Nickel Company of Canada in Sudbury, Ont., and was engaged successively in mucking, mine survey, ore reserves and underground construction work until 1937 when he joined Canadian Johns-Manville Co. Ltd. as sales engineer covering all mining districts in northern Ontario.

He was in the employ of John W. Fogg Ltd. in Timmins in 1939 and was engaged in sales, design, estimating and construction supervision for mine construction. In 1940 he was appointed superintendent of utilities for Burns and Co. Ltd. in Calgary, working on steam, refrigeration and plant construction, and in 1949 was appointed to his present position.

Mr. Smith joined the Engineering Institute as a Member in 1944. He was elected chairman of the Calgary Branch in 1950.

J. M. Campbell, M.E.I.C., has been re-elected to represent the Lethbridge



J. M. Campbell, M.E.I.C.

Branch on the Council of the Institute. Mr. Campbell retired from his position as division engineer with the Canadian Pacific Railway in 1952.

Born and educated at Dumfermline, Scotland, Mr. Campbell received his early training as an engineer in Scotland with the Fife County Council, as pupil to the road surveyor and master of works.

Coming to Canada in 1907 he joined the Canadian Pacific Railway at Souris, Man., as chainman and rodman. From 1910 to 1913 he was transitman at Souris and at Kenora, Ont., engaged on maintenance work, becoming resident engineer at Kenora in 1913, and then roadmaster from Winnipeg to Brandon, Man.

During the First World War he served overseas with the Canadian Railway Troops, and then returned to Canada in 1919 and rejoined the C.P.R. as roadmaster at Dryden, Ont. In 1920 he was named division engineer of the Portage division at Winnipeg, subsequently becoming division engineer at Kenora, Winnipeg, Moose Jaw, and Lethbridge, until his retirement.

Mr. Campbell joined the Engineering Institute in 1920 as Associate Member and transferred to Member in 1940. He was elected in 1954 to represent the Lethbridge Branch on Council.

H. L. Roblin, M.E.I.C., of Edmonton, Alta., has been elected councillor to represent the Edmonton Branch of the Engineering Institute. Mr. Roblin is a member of the consulting engineering firm of Stanley, Grimble, Roblin Limited in Edmonton.

A native of London, Ont., he received his early education there, and then graduated from the University of Toronto in 1913 with a B.A.Sc. degree.

H. L. Roblin, M.E.I.C.

During the First World War he served with the Canadian Expeditionary Forces and received the Military Cross.

In 1919 Mr. Roblin began his long association with the Canadian National Railway as resident engineer in Edmonton. He spent some time at Regina as roadmaster for the C.N.R. office there, and subsequently became division engineer at Edmonton. He retired from the company last September and then joined Stanley, Grimble, Roblin Limited.

During the Second World War he was in command of the 13th Field Company of the R.C.E. at Regina, retiring in 1945 with the permanent rank of major.

Mr. Roblin joined the Engineering Institute in 1919 as an Associate Member and transferred to Member in 1940. He attained Life membership last year and was also elected chairman of the Edmonton Branch of the Institute.

E. L. Hartley, M.E.I.C., general manager of Western Bridge and Steel Fabricators Ltd. in Vancouver, B.C., has been elected to represent the Vancouver Branch of the Engineering Institute on the Council for a two-year term.

Mr. Hartley was born in Liverpool, England, and graduated from the Liverpool Institute School in 1930, and then entered Queen's University, graduating in 1933 with a degree in civil engineering.

In 1934 he entered the properties department of Jas. Richardson and Sons, Ltd. in Winnipeg, Man. Two years later he joined W. G. Swan Engineering Company Ltd. in Vancouver. In 1937 he was appointed engineer in charge of construction of the Canada Packers Ltd. Vancouver plant, and also served as

E. L. Hartley, M.E.I.C.

assistant estimating engineer for the Western Bridge Company during this period. In 1938 he was associated with B.C. Appraisal Company Ltd., and with the Dominion Bridge Company during the construction of the Lions Gate Bridge.

At the beginning of World War II, Mr. Hartley joined the Royal Canadian Engineers as works officer in the Vancouver area. Subsequently he was promoted to the rank of captain in 1941 and served overseas until the end of the war. He was mentioned in despatches, named a Member of the British Empire, and awarded the E.D. for distinguished service. He was also named an officer of the Order of Orange Nassau by the Netherlands Government.

In 1945 Mr. Hartley, returned to Canada and joined Western Bridge and Steel Fabricators Ltd. in Vancouver as designing engineer, becoming contract engineer in 1947. He was named assistant general manager of the company in 1950 and general manager in 1955.

Mr. Hartley joined the Engineering Institute in 1933 as a Student, transferred to Junior in 1946, and to Member in 1947. He served as chairman of the Vancouver Branch of the Institute in 1953.

Personals

News of the Personal Activities of Members of the Institute

Dr. R. S. Jane, M.E.I.C.

Dr. R. S. Jane, M.E.I.C., has been elected president of Shawinigan Chemicals Ltd. He has been executive vice president of the company.

Dr. Jane graduated from the University of British Columbia in 1922 and was awarded a Ph.D. degree at McGill University in 1925. He attended the University of London on a Wembley scholarship for the following two years.

On his return to Canada in 1927, Dr. Jane was named chief chemist at Shawinigan Falls, Que., with Canada Carbide Company. When that company became the carbide division of Shawinigan Chemicals Ltd., a few months later, Dr. Jane took charge of plant research for the division. In 1936 he went to the Montreal head office, then in 1943 was transferred to Shawinigan Water and Power Company, heading, for the parent plant, the industrial research department, which was formed at that time. Three years later he returned to Shawinigan Chemicals Ltd., as director and vice-president in charge of research and development. The appointment as executive vice-president of the company was received in 1954.

He is also a director and vice-president of Canadian Resins and Chemicals Ltd., a director of B.A. Shawinigan Ltd., Montreal, and of Shawinigan Resins Corp., Springfield, Mass.

Dr. Jane has been active in the work of the Chemical Institute of Canada and was elected its president for 1952-53. He is a member of the Society of Chemical Industry and of other professional associations.

F. Y. Dorrance, M.E.I.C., technical advisor to the waterworks division of the Department of Public Works, for the city of Montreal, retired in February following a lengthy municipal career.

F. Y. Dorrance, M.E.I.C.

Mr. Dorrance was born in Troy, N.Y., and studied engineering at the Rensselaer Polytechnique Institute. As a young graduate he went to work for the City of Pittsburgh as a design and construction engineer, and later spent three years with a firm of consulting engineers.

With six years professional experience, he came to Montreal in 1912, where he was soon embarked upon the career that was to last 43 years. He was chiefly concerned, throughout his years of service, with the design and construction of water transmission lines and facilities, and he has been responsible for the recent enlargements of the Montreal filtration works. In 1935 he received the appointment of divisional engineer and in 1953 took office as consulting engineer on water supply.

A Life member of the American Water Works Association, he was in 1952 elected a trustee of the Canadian section of the Association. He was winner of the George B. Fuller award presented by the parent organization. He also holds Life membership in the American Society of Civil Engineers and is a Member of the Corporation of Professional Engineers of Quebec.

Dr. Dorrance joined the Institute as an Associate Member in 1915, transferred to Member in 1940 and attained Life membership in 1950.

P. L. Kuhring, M.E.I.C., has been promoted to chief engineer with the St. Lawrence Ship Channel.

Joining the Department of Marine in 1913, he was loaned to the River St. Lawrence Ship Channel as a junior engineer, and apart from three years spent overseas on military service, 1916-1919, he has spent his entire career in this field.

He is a member of the Professional

P. L. Kuhring, M.E.I.C.

• Personals

Institute of the Civil Service of Canada. In 1952 Mr. Kuhring was elected president of the Canadian Author's Association.

B. W. Pitfield, M.E.I.C., who is vice-president and general manager of Northwest Industries Ltd., has been appointed a member of the Board of Industrial Relations Department of Industries and Labour of the Alberta Government.

Mr. Pitfield is a past chairman of the Engineering Institute of Canada, Edmonton branch, and is presently a member of the Industrial Advisory Committee, Research Council of Alberta.

He was also a member of the Board of Governors, University of Alberta; president of the University Alumni Association; member of the Council of the Association of Professional Engineers for Alberta; and member of the Council of the Edmonton Chamber of Commerce.

As an executive of Northwest Industries Limited, Mr. Pitfield has had extensive experience in labour relations. He was formerly general superintendent of Northwest Utilities Limited, member of the Labour Management Committee of the Edmonton Chamber of Commerce, and chairman of the Chamber's Utility and Manufacturing Committees.

Mr. Pitfield graduated from the University of Alberta in 1934, obtaining a degree in civil engineering.

W. B. Pennock, M.E.I.C., has been elected chairman of the Ottawa Branch of the Institute.

Mr. Pennock was born in Ottawa and attended McGill University. He obtained a B.Sc. degree in 1915 and immediately joined the army, serving overseas with the Canadian Engineers, CEF. At the war's end he returned to Canada and for two years was District Vocational Officer in the Department of Soldier's Civil Re-establishment in London, Ont., and Toronto.

In 1920 he accepted a position with the Gray-Dort Motor Car Company as agent and field representative. Four years later he was named department manager with Canadian Fairbanks Morse Company Ltd., in Windsor, Ont., but in 1925 he set up a manufacturing agency and engineering contractor practice in Windsor, London and Hamilton. After ten years, he joined the Department of National Defence, Ottawa, as chief mechanical engineer. He later returned to his business as sales engineer, acting for a number of manufacturers.

The second world war called Mr. Pennock to further military service, and during the years 1940-45, he was in the Canadian Army, first as second in command of the engineer training centre, Petawawa, Ont., and latterly as C.R.E., 8th Canadian Division, in Western Canada, which appointment carried the rank of lieutenant colonel.

W. B. Pennock, M.E.I.C.

On discharge from the army he continued to operate his office as sales engineer until 1949 when Pennock Engineering Company was established in its present form, as consulting engineers, associated with Canadian-British Engineering Consultants, in Toronto, Halifax, and Vancouver.

Mr. Pennock's association with the Institute dates from 1919 when he was a Student Member. He became an Associate Member in 1936, transferred to Member in 1940.

J. H. Legate, M.E.I.C., superintendent of Canada Cement Company Limited, Plant No. 5, at Belleville, Ont., was promoted to manager in October last.

A. O. Drysdale, M.E.I.C., who has been assistant superintendent since 1951 was made superintendent.

A. O. Drysdale, M.E.I.C.

Mr. Legate has been associated with Canada Cement at Belleville since his graduation from the University of Toronto in 1921. He received his appointment as superintendent in 1924. He is a member of the Association of Professional Engineers of Ontario.

Mr. Drysdale graduated in mining engineering from McGill University in 1941. He worked for Canada Cement as plant engineer, but after five months joined the forces, serving overseas with the First Canadian Army. He was discharged as a major, in 1946. Returning to Canada, he resumed his career with Canada Cement Company Ltd., and became assistant superintendent of the Montreal East No. 1 plant, transferring, four years later to the plant in Belleville.

Mr. Drysdale is a member of the Association of Professional Engineers of Ontario, the Royal Canadian Electrical Mechanical Engineer Corps Association, and is a past chairman of the Belleville Branch of the Institute. He is serving this year as president of the Kiwanis Club and the Chamber of Commerce in Belleville.

R. H. Stokes-Rees, AFFIL. E.I.C., has been named president of Hydrotechnic Ltd., a company recently formed in Montreal as a water specialist organization, offering consulting and design services in association with Paul Pelletier, Consulting Engineers, and S.E.M. Prospecting Ltd.

Mr. Stokes-Rees was born and educated in England. He studied metallurgy and design, and later, following many years affiliation with the Royal Navy, came to Canada. He had served in such capacities as superintendent of armament design to the forces, and as a deputy in the British Admiralty Technical Mission to Canada, and in the submarine service.

In 1947 he was named general manager of the G. R. Marshal and Company Ltd., firm of engineering exporters, and the following year organized and was president of Stokes-Rees Corporation Ltd., (and Affiliates), hydro-electric suppliers and installers. He was appointed vice-president of the Kaiser Engineers Division of Henry J. Kaiser Co. (Can.) Ltd., Montreal, in 1953, and last year became associated with Rubenstein Bros. as a director.

Robert C. McMordie, M.E.I.C., the newly appointed chief engineer with the British Columbia Power Commission, Victoria, is a former senior project engineer of Ontario Hydro's generation department.

Graduating in 1930 from the University of Toronto, in civil engineering, he worked with the Ontario Hydro Electric Power Commission, first as a designing draftsman, then in 1934 as a structural design engineer. For a short time he was with Canadian Bridge Company Ltd., and Gordon L. Wallace, consulting engineer, in Toronto. In 1936 he joined the staff of H. G. Acres and Company Ltd., to work on the design of the Outardes Falls development, Que.

R. C. McMordie, M.E.I.C.

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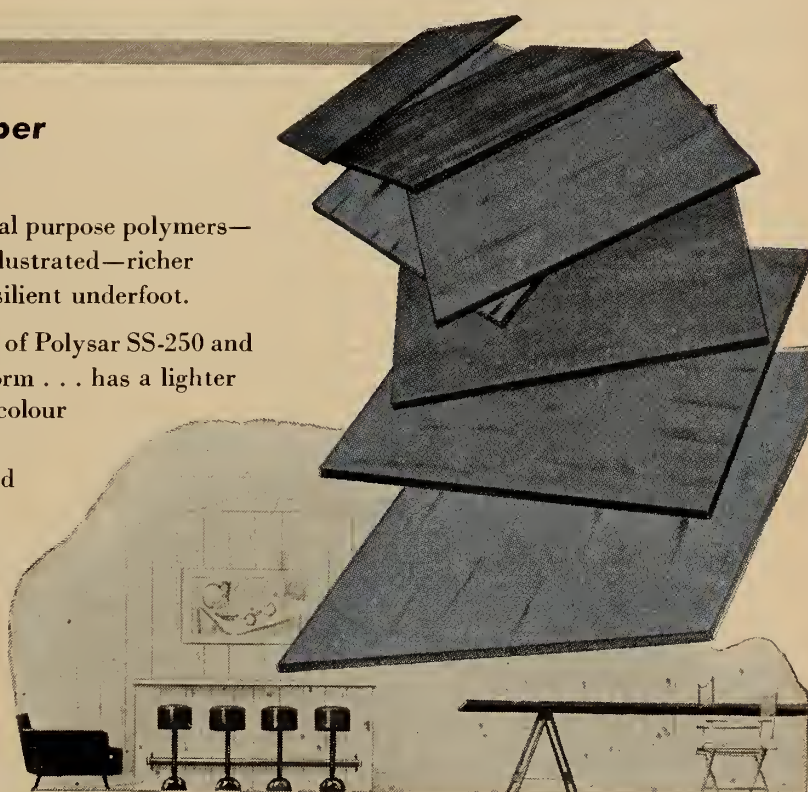

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• *Personals*

After further study at the University of Toronto, he obtained the degree, Civil Engineer, in 1940. He then renewed his affiliations with the Ontario Power Commission, serving successively as building engineer, program planning and control engineer, which latter appointment was made in 1953.

Mr. McMordie was among those elected in 1954, to the executive council of the Association of Professional Engineers of Ontario.

E. Frank Gillies, M.E.I.C., has been appointed by the Minnesota Mining and Manufacturing of Canada Limited as Supervisor, Reflective Products Group, for Eastern Canada.

A graduate in engineering from the University of Manitoba, Mr. Gillies has been with the company for the past four years. Prior to that time he was City Traffic Engineer for Winnipeg, Manitoba and Director of Manitoba Highway Safety Council for five years. Previously he had eight years experience with the International Nickel Company of Canada, Ltd.

Mr. Gillies is a member of the Association of Professional Engineers of the Province of Ontario, Canadian Institute of Traffic Engineers; Associate Member Institute of Traffic Engineers, (U.S.A.); Member Canadian Highway Safety Conference, and Engineering Committee, the Canadian Good Roads Association and the Ontario Good Roads Association.

E. F. Gillies, M.E.I.C.

William Aubrey Messenger, M.E.I.C., has been appointed vice-president of Barrett Company Ltd. In this capacity he will continue to direct the company's manufacturing operations at Montreal, Joliette, and Louisville; at Toronto, Winnipeg and Vancouver.

Mr. Messenger was formerly director of operations for the company, having been with them since 1940. He has also been superintendent of the Montreal plant of the company.

W. A. Messenger, M.E.I.C.

A McGill University graduate, Mr. Messenger worked in the construction and building material industries before joining the Barrett firm in 1940.

Dudley S. Young, M.E.I.C., has been appointed president and managing direc-

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tor of Powerlite Devices Ltd., Toronto. He was named vice-president of the company in 1949.

Mr. Young graduated in electrical engineering and later received an S.M. degree from the Massachusetts Institute of Technology.

Prior to that time he was associated for four years with Canada Wire and Cable Company Ltd., serving that firm for a period of sixteen years.

Active in professional affairs through the Canadian Electrical Manufacturers Association and the Canadian Transit Association, he has held offices in these, and in Manitoba and M.I.T. alumni groups.

W. T. N. Reeve, M.E.I.C., has been recalled by his firm, Sir Alexander Gibb and Partners, to their London, Eng., head office.

Mr. Reeve has recently spent some time in this country in connection with the firm's Toronto, Ont., interests.

He is a graduate of Cambridge University where he received an M.A. degree in mechanical sciences.

W. M. Walker, M.E.I.C., is with Atomic Energy of Canada Ltd., at Chalk River, Ont. He has been on loan for the past year from the B.C. Electric Company Ltd., in Vancouver, B.C., where he has been assistant system planning engineer.

A graduate of the University of British Columbia, he received a B.A.Sc. degree in electrical engineering in 1945, then worked with Imperial Oil Ltd., at Sarnia, Ont. Later, in 1947 he became industrial power engineer with the B.C. Electric Railway.

Baldur Sigurdson, M.E.I.C.

Baldur Sigurdson, M.E.I.C., has joined the staff of Mueller, Limited, of Sarnia, Ont., as Alberta sales representative, with residence in Calgary.

Formerly associated with Linde Air Products Company, Mr. Sigurdson is a 1949 graduate in mechanical engineering from McGill University.

J. B. Shallenberger, M.E.I.C.

John B. Shallenberger, M.E.I.C., has been elected president of the Albert Sheetz Corporation, in Hollywood, California.

In 1950 he was assistant to the president of Canadair Ltd. He has been associated in engineering and sales capacities with Douglas Aircraft Company Incorporated; General Dynamics Corporation, Aluminum Company of Canada, and Ford Motor Company.

He will retain the presidency of Shallway Corporation, Connellsville Manufacturing and Mine Supply Company, and Shallway International Corporation.


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Once a part-time lecturer at McGill, Columbia, New York, and Stanford Universities, Mr. Shallenberger is a graduate of Stanford, the University of Munich, and the Harvard Graduate School of Business Administration. He was also associated with the Aluminum Company school of international business administration, in Geneva, Switzerland, as lecturer and director of case study research.

Commander P. F. Fairfull, M.E.I.C., has been elected chairman of the Vancouver Island Branch of the Institute.

A native of the British Isles, Cdr. Fairfull began his engineering career as an apprentice with William Simons and Company, Ltd., of Renfrew, Scotland, engineers and shipbuilders. He also studied naval architecture at the Technical College, Paisley, Scotland.

Established in this country in 1925, he accepted a position in Toronto, with Chapman and Oxley, architects and engineers. In the early thirties he went to work for the Toronto Star as building supervisor and engineer, but with the onset of the war, once more was connected with shipbuilding. He served as chief engineer for the Crown operated Toronto Shipbuilding Company, which firm he joined in 1941. In the Naval Service, two years later, he was appointed overseer of ship construction on the Great Lakes. He then became manager of the constructive department, H.M.C. Dockyard, Esquimalt, B.C., and was ultimately chosen as principal ship overseer for the west coast. He still holds the rank of constructor commander, R.C.N. (R).

In 1948 the Department of Public Works of Canada named him superintendent of the Esquimalt, B.C., graving dock.

Cdr. Fairfull has been active in the work at the Institute, and has served the Branch as Secretary-Treasurer.

Cdr. P. F. Fairfull, M.E.I.C.

L. A. W. Davis, M.E.I.C.

L. A. W. Davis, M.E.I.C., has joined the staff of Computing Devices of Canada, Ltd., of Ottawa, as technical administrator in the guided missile department.

Since August 1954, Mr. Davis has been associated with the Canadian Armament Research and Development Establishment of the Defence Research Board, at Valcartier, Que., as trials controller, (technical), on the Velvet Glove guided missile project.

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Prior to this, Mr. Davis specialized in the development and trials of classified naval electrical installations in ships of the Royal Navy, the Royal Canadian Navy, and the Royal Australian Navy, serving with the Admiralty, and in the Naval Headquarters of Canada and Australia from 1940 to 1952. He was the electrical test engineer, from 1952 to 1954, for naval vessels at Canadian Vickers Ltd., in Montreal.

Mr. Davis was educated at Christ's College, London, England, at the London Polytechnic and the Melbourne Technical College, Melbourne, Australia. He became an Associate Member of the Institute of Electrical Engineers in 1951, and is also a member of the Association of Professional Engineers of the province of Ontario.

G. R. Doull, M.E.I.C., regional chief engineer with the Canadian National Railways at Moncton, N.B., has retired after long years of service.

Mr. Doull, a Nova Scotian, of New Glasgow, joined the C.N.R. engineering service in 1914. He worked as draftsman on the Halifax ocean terminals in 1916, and that same year was transferred to Moncton as assistant engineer where he remained until a 1921 assignment to the Toronto office of the engineer of standards. Later he was moved to Montreal as assistant engineer, but in 1943 returned to Moncton, being appointed bridge engineer for the Atlantic region in 1944.

Named principal assistant engineer in 1949, he became assistant chief engineer in 1952 and chief engineer the following year.

G. R. Doull, M.E.I.C.

D. W. Blair, M.E.I.C., has been appointed chief engineer with the Canadian National Railways, Atlantic Region, at Moncton, succeeding G. R. Doull, M.E.I.C.

Graduating from the University of New Brunswick in 1946 with a B.Sc. degree in civil engineering, Mr. Blair immediately joined the C.N.R. in the department of research and development in Montreal as a junior assistant engineer.

D. W. Blair, M.E.I.C.

In 1947 he worked as assistant engineer at Levis, Que., and later that year was named division engineer for the Laurentian division at Quebec City. Acting in the same capacity, in 1950, he worked at Montreal terminals and the St. Jerome division. He was named district engineer of the Southern Ontario district in 1953 with headquarters in Toronto, and two years later was transferred to Moncton.

C. N. Murray, M.E.I.C., general superintendent of the Dominion Steel and Coal

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Corporation, Sydney, N.S., has been elected president of the Association of Professional Engineers of Nova Scotia.

Born in Sydney and educated at Acadia University and the Nova Scotia Technical College, he graduated from the latter in 1935 with a degree in mechanical engineering. He joined Dominion Steel and Coal Company Ltd., as an instrument clerk in 1936 being appointed in 1943 superintendent of blast furnaces, and was subsequently named assistant to the general superintendent.

C. N. Murray, M.E.I.C.

Mr. Murray is a past-councillor of the Institute, and a past-chairman of the Cape Breton Branch of the Institute.

E. J. Durnin, M.E.I.C., construction engineer with the Saskatchewan Power Corporation, and 1956 president of the Association of Professional Engineers of Saskatchewan, has recently been elected chairman of the Saskatchewan Branch of the Institute.

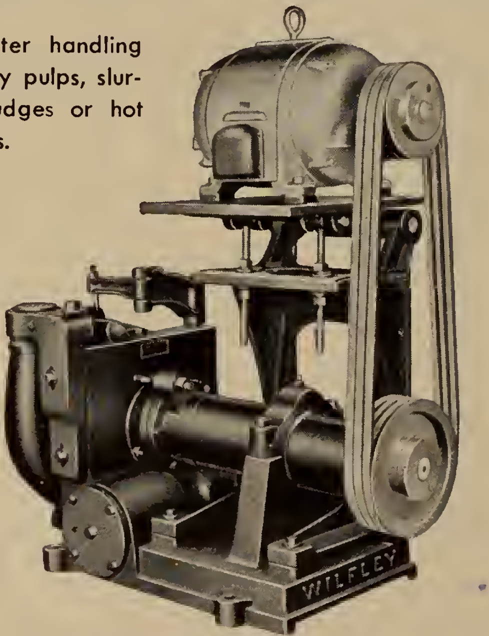
Born in Dauphin, Man., educated in Saskatchewan, he received a B.A. degree from that university in 1924, then joined the R.C.A.F. and spent the following three years as a pilot officer. In 1928 he qualified for a B.A.Sc. degree in electrical engineering at the University of Manitoba, and enrolled in an apprentice engineering course with the Canadian Westinghouse Company, in Hamilton, Ont., which he concluded in 1930.

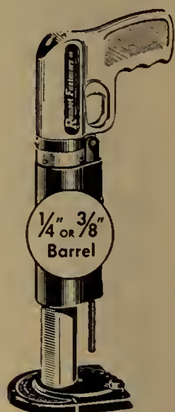
Returning to Saskatchewan, he accepted a position with the then Saskatchewan Power Commission, later known as the Saskatchewan Power Corporation, and became, successively, junior engineer, district superintendent, and commercial superintendent. At the onset of the second world war, in 1940, he joined the army and spent five years in Canada, Great Britain and Northwest Europe with the Corps of the Royal Canadian Engineers, retiring with the rank of major. In 1946 he resumed affiliations with the Power Corporation and was at once engineer in charge of

E. J. Durnin, M.E.I.C.

construction and transmission, distribution and substation projects, which position he has held to the present time.

He is a member of the Canadian Electrical Association. In 1948-49 he served as councillor with the Association of





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55-CAC-1

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Professional Engineers of Saskatchewan; in 1955 became vice-president of the organization. He has served the Engineering Institute also, being elected a councillor in 1951.

J. J. Green, M.E.I.C., Defence Research Member of the Canadian Joint Staff, Department of National Defence, at Washington, D.C., has presented the Institute with a copy of the eleventh British Commonwealth and Empire Lecture which he gave before the Royal Aeronautical Society in London, England, in October, 1955. The subject of Dr. Green's lecture was "The Growth of Aeronautical Research in Canada During the Post-War Decade."

The British Commonwealth and Empire Lecture was started in 1945, with the intention that it should form the focus for the aeronautical problems of the Commonwealth and Empire.

Dr. Green was the first president of the Canadian Aeronautical Institute in 1954. His transfer to Washington in September, 1955 interrupted a term of service to the Engineering Institute as councillor representing the Ottawa Branch. He is a past-chairman of the Branch.

The Journal will carry an abstract of Dr. Green's R.Ae.S. lecture in an early issue.

Mr. F. E. Regan, M.E.I.C., has been appointed vice-president and assistant general manager of Bepco Canada Limited.

Mr. Regan has been with Bepco Canada Limited and its associated companies, since 1924. He was appointed

F. E. Regan, M.E.I.C.

Ontario manager in 1934, became a director of the company in 1949, and vice-president in 1952. His new duties have necessitated a move from Toronto to the head office in Montreal.

H. H. Moor, M.E.I.C., who has been transferred to Dartmouth, N.S., by Imperial Oil Ltd., as refinery manager of their Halifax refinery has held the position of superintendent of the Edmonton refinery for the past eight years.

A chemical engineering graduate of the University of Toronto with a M.A. Sc. degree, Mr. Moor joined Imperial Oil upon graduation in 1923, and for the next ten years held various junior positions in the company's laboratory and research departments. This experience was followed by two years in France as engineer in charge of a lubricating oil plant with Standard Franco-Americaine de Raffinage, at Pt. Jerome, France. Returning to Canada he was given the position of assistant to the chief research chemist with Imperial Oil, becoming, in 1942, technical assistant superintendent of the Sarnia refinery,

H. H. Moor, M.E.I.C.

and finally, in 1946, assistant superintendent. His appointment to Edmonton occurred a year later.

Mr. Moor is a past president of the Association of Professional Engineers of Alberta.

Lt. Cdr. (E) V. F. O'Connor, R.C.N., M.E.I.C., has been appointed senior engineer with H.M.C.S., Magnificent, Halifax, N.S.

Lt.-Cdr. O'Connor began his engineering career as engine room artificer with the R.C.N. in 1934, imediately after receiving a mechanical engineering degree from the Nova Scotia Technical College. He became chief engine room artificer in 1940, and two years later received an appointment as engineer officer in the engineering branch. In 1946 he served as a lieutenant with H.M.C.S. Scotian, based at Halifax, and in 1953 was posted at naval headquarters, Ottawa, as a Lieutenant Commander with the Department of National Defence.

Richard F. Andretsch, M.E.I.C., is with H. A. Simons in Vancouver, B.C., as structural designer.

Mr. Andretsch obtained an engineering diploma from the Institute of Technology in Graz, Austria, in 1951.

In Canada only a short time, he has been employed by D. R. Stanley and Associates Ltd., in Edmonton, Alta.

J. Steudel, M.E.I.C., has accepted a position as structural design engineer with Samborn, Steketee and Associates, in Toledo, Ohio.

Mr. Steudel graduated in 1950 from Munich Institute of Technology. In Canada since 1953, he has been in reinforced concrete design work, in the West, mainly with Dominion Construction Company Ltd., Edmonton.

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S. W. Pappius, M.E.I.C.

B. J. McColl, M.E.I.C., is a consulting engineer in Strathmore, Que.

With Canadair in 1947, he was chief of the power plant section, (design office) in Montreal. Later, in 1948 he was given charge of the mechanization activities of the Woodlands section of the Canadian Pulp and Paper Association.

Mr. McColl is a mechanical engineering graduate of Queen's University.

Joseph J. Kelly, M.E.I.C., chairman of the Institute's Hamilton Branch has been named general manager of sales for Union Drawn Steel Company Ltd., in Hamilton.

Born and educated in Ontario, Mr. Kelly graduated from the University of Toronto in 1932, with a B.A.Sc. degree in electrical engineering. He immediately joined Lincoln Electric and was engaged in the development of arc welding and its application to industrial processes. Later he was named manager of the Hamilton district office, and a director in the company.

He is a member of the Association of Professional Engineers of Ontario and past national chairman of the Canadian Welding Society.

Gilbert Proulx, M.E.I.C., has been transferred from Saguenay Electric Company of Chicoutimi, Que., to the Aluminum Company of Canada Ltd., in Montreal, where he will hold the position of power operations engineer.

Employed for a short time by Dominion Bridge Company Ltd., Lachine, Que., following a 1941 graduation from Ecole Polytechnique, Mr. Proulx has been with Saguenay Electric Company since 1942. At that time assistant to the superintendent, he was named plant superintendent in 1946.

H. W. Carss, M.E.I.C., is with Bell Telephone Company of Canada, special contracts division, at Dawson Creek, B.C.

A 1945 graduate of the University of Saskatchewan in civil engineering, Mr. Carss was named city engineer, Swift Current, Sask., in 1946. More recently he has been associated with Poole Construction in Regina, Sask.

S. W. Pappius, M.E.I.C., has been appointed sales engineer with Canadian Vickers Ltd., in charge of the promotion and sale of hydro-electric equipment.

Attached to Canadian Vickers Ltd., engineering department since 1948, Mr. Pappius was originally employed by the company as design engineer. He transferred to standards engineer in 1952, participating in numerous projects within the hydro electric field.

He received his training in England during the war, in connection with the Royal Naval Engineering College and came to this country in 1948, serving briefly with the Canadian National Railway at Winnipeg, before joining Canadian Vickers.

H. F. Schmelz, M.E.I.C., consulting engineer, acting as works manager and chief engineer, since 1954, with Industrias Metalicas de Palmira, Palmira, Columbia, South America, has accepted a contract for an additional two years in his present capacity.

Mr. Schmelz organized the consulting firm of Engineering Associates in Montreal, in 1951, and later continued as an independent consulting engineer.

In 1953, living in the United States, he was associated with special engineering projects for the Channel Master Corporation of Ellenville, N.Y.

Prior to handling his own practice, he was in charge of the design and devel-

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opment division of Dominion Rubber Company, Montreal.

Mr. Schmelz is a graduate of the Technological Institute of Vienna, Austria.

Reginald Hugo, M.E.I.C., was appointed several months ago as western region bridge engineer with the Canadian National Railways, at Winnipeg, Man.

Mr. Hugo's career with the C.N.R. dates back to 1919 when, after service in the R.F.C. he was taken on the staff of the bridge engineer in the company's Winnipeg offices as draftsman. He was promoted to the position of designing engineer in 1924, assistant engineer in 1932, and in 1950 was named assistant bridge engineer. He graduated from the University of Manitoba in civil engineering.

He served on the council of the Association of Professional Engineers of the Province of Manitoba during the years 1951-1953.

G. M. Josephson, M.E.I.C., formerly secretary of the Amherst Branch of the Institute, has been named plant manager of Sifto Salt Ltd., in Sarnia, Ont.

Mr. Josephson started his engineering career with the Leckie Tannery in New Westminster, B.C., in 1946, then joined the Dominion Tar and Chemical Company Ltd., in 1949, at Goderich, Ont., later transferring to Amherst, N.S.

He is a 1946 graduate of the University of British Columbia in chemical engineering.

J. Devlin, M.E.I.C., has been transferred by McColl Frontenac Company Ltd., to Montreal, Que. Formerly with the company in Winnipeg, Toronto and Calgary, he had been assistant divisional manager of industrial sales since 1949.

Mr. Devlin joined the company in 1934 and was employed for a number of years as a lubricating engineer. He became manager of automotive and industrial lubrication in 1942.

Originally from Scotland, his first work in Canada was with Christie Brown and Company, Winnipeg in 1934. Prior to that time he held junior engineering positions with Cunard Steamship Company Ltd., and the P. and O. Steam Navigation Company, in England.

G. T. Hughes, M.E.I.C., has joined the firm of Ripley and Associates, in Vancouver. Professor Hughes was on the staff of the college of engineering, University of Saskatchewan, since receiving a M.Sc. degree in civil engineering from the University of Alberta in 1953. Most recently he was assistant professor in civil engineering.

P. J. Dowling, Jr.E.I.C., has been appointed divisional manager for Alberta and Saskatchewan for Franki Compressed Pile Company at Edmonton.

Mr. Dowling joined Franki Compressed Pile Company in Montreal in 1951 and was transferred to Toronto to become works manager in 1953. Awarded an Athlone Fellowship the following year, he devoted two years to advanced study in Great Britain.

He is a 1951 graduate of the University of Toronto, with a B.A.Sc. degree in civil engineering.

D. A. Slack, Jr.E.I.C., has been appointed division engineer for the Edmundston division of the Canadian National Railways Atlantic Region.

Mr. Slack entered the railway service in 1940 as a messenger in the communications department at Sackville, N.B. He enlisted with the R.C.A.F. in 1943 and at the conclusion of the war returned to the railway; whereupon he was granted leave of absence for purposes of study.

On graduating from the University of New Brunswick in 1950, with a B.Sc. degree in civil engineering, he was immediately employed as instrumentman with the C.N.R. at Edmunston.

R. C. Miller, Jr.E.I.C., formerly employed by Prudham Building Supplies Ltd., Edmonton, has joined Inland Cement Company Ltd., also of Edmonton.

Mr. Miller, a 1953 graduate of the University of Alberta, with a B.Sc. degree in civil engineering, has been associated with Alexander Construction Ltd., in Edmonton, as construction engineer, and the Calgary firm, Larwill Construction Company.

R. B. Sweet, Jr.E.I.C., has accepted a position with the Canada Paper Company, Windsor Mills, Que., as assistant mechanical superintendent.

Previously employed by Algoma Steel Corporation Ltd., in Sault Ste. Marie, Ont., he was, in turn, junior engineer, mechanical engineer, then project engineer and sales representative.

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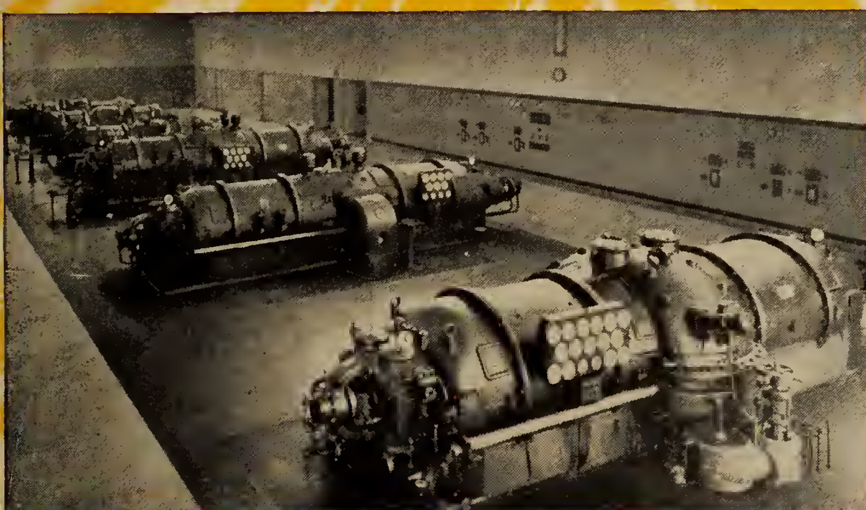
POWER

SPECIFY **STAL** BACK PRESSURE TURBO GENERATORS



Power Station of Celulosa Argentina, S.A., Rosario, Argentina, with 5 STAL Back-Pressure Turbo-Generators and 1 STAL Condensing unit.

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While in Sault Ste. Marie he served with 34 Tech Squadron R.C.E.M.E. Canadian Army Reserve, from 1950 to 1956, having transferred to supplementary reserve as a qualified captain, prior to departure from that city, January, 1956. He had previously held the rank of lieutenant.

Mr. Sweet is a member of the Association of Professional Engineers of Ontario. He graduated from the University of Saskatchewan in 1949.

Harry F. Burns, Jr.E.I.C., has received an appointment with the staff of A. D. Margison and Associates Ltd., of Toronto. He will head the traffic section of the firm's municipal department, now engaged jointly, with an American firm, on the design of the Metropolitan Toronto Expressway.

H. F. Burns, Jr.E.I.C.

On graduating in 1950 from the University of Manitoba, where he won the McKechnie memorial scholarship, Mr. Burns entered the Winnipeg city engineering department. Two years later he was named city traffic engineer. In the war he served with the Royal Canadian Navy on North Atlantic corvette convoy patrol.

He was elected president of the Canadian Section of the Institute of Traffic Engineers in 1955; and is a member of the Association of Professional Engineers of Manitoba.

John Daniels, Jr.E.I.C., has gone to Bolivia where he has accepted a position as distribution engineer in La Paz. He is with the Bolivian Power Company, a subsidiary of the International Power Company Ltd., of Montreal, Que.

With Bepco Canada Ltd., in Toronto, he was switchgear engineer in 1953, and has more recently been associated with ECC, Canada Ltd.

Lt. J. G. Forth, R.C.E., Jr.E.I.C., is now second-in-command of No. 1 Airborne Troop, Royal Canadian Engineers which is the engineering support for the airborne component of the Canadian Army. He is stationed at Calgary.

After graduating from the R.M.C. in 1952 he served a one year tour of duty

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with the twenty-third Field Squadron in Korea. In 1953 he attended the University of Toronto, where he obtained a B.A.Sc. degree in chemical engineering the following year. He has since been on the staff of the Royal Canadian School of Military Engineering at Camp Chilliwack, B.C.

Lt. Forth is a member of the Association of Professional Engineers of the Province of Ontario.

J. K. Wood, Jr.E.I.C., has accepted a position with Canadian Industries Limited, Montreal, as an assistant engineer.

Mr. Wood is a 1949 graduate of the University of Toronto, with a B.A. Sc. degree in chemical engineering. Later he worked with Canadian Kodak Co. Ltd., in Toronto. The past two years have been spent in England on an Athlone Fellowship.

H. C. L. Joe, Jr.E.I.C., has joined R. A. Hanright, consulting engineer, in St. Catharines, Ont., as an electrical engineer.

For the past seven and a half years he has been design engineer with the English Electric Company of Canada Ltd., St. Catharines, in their transformer, switchgear, motor and industrial control divisions.

Mr. Joe has represented the English Electric Company on the Canadian Electrical Manufacturer's Association industrial control technical committee for the past three years. He served as an executive member of the Niagara Peninsula Branch of the Institute for three years, one of which he was secretary-treasurer. He has also served twice on the committee for the annual joint E.I.C.-A.P.E.O. dance for Niagara Peninsula.

He is a graduate of the University of Toronto with a B.Sc. degree, class of '48.

E. H. Clayson, Jr.E.I.C., has accepted employment with B. F. Goodrich Chemical Company in Paducah, Kentucky.

Mr. Clayson joined the staff of Dominion Oilcloth and Linoleum Company in Montreal as development engineer in 1949 and the following year was named department head of the plasticizer and special resins unit, which position he held until his recent apointment.

He graduated from McGill University in 1949 with a B.Eng. degree in chemical engineering.

Stuart Lyon, Jr.E.I.C., is at Stilfontein, Transvaal, South Africa, working for John Laing and Son (S.A.) Pty. Ltd. of Johannesburg. He is engaged in road construction.

Mr. Lyon graduated from the University of Toronto with a B.A.Sc. degree in civil engineering, class of 1954.

D. A. McRae, Jr.E.I.C., now holds the position of vice-president and electrical engineer in charge of all electrical construction, with Cemco Inc., industrial designers and builders, Downey, California.

Quite recently, Mr. McRae has been associated with Adams Electrical Contractors, in California, and prior to that time worked with Dominion Steel and Coal Company, in Sydney, N.S.

He is a graduate of the University of Manitoba, class of 1948, with a B.Sc. degree in electrical engineering.

D. R. Francis, Jr.E.I.C., is with the Department of Mineral Resources, Regina, Sask.

He joined the department of geology, at the University of Saskatchewan in 1952, having gained a B.Eng. degree in geology in 1950, at that university.

Frank G. Oravec, Jr.E.I.C., is working with Atomic Energy of Canada Ltd. in Chalk River, Ont.

He graduated in 1952 from Queen's University in mechanical engineering, and was previously associated with Montreal Cottons Limited, a branch of Dominion Textile Company, in Valleyfield, Que., where he was employed in the standard department as an industrial engineer.

Captain J. F. Clarabut, Jr.E.I.C., is with the Canadian Army Staff College at Fort Frontenac in Kingston, Ont. He was formerly in Quebec City, Que., with the C.A.R.D.E.

Captain Clarabut graduated in mechanical engineering from the University of Toronto in 1950 and has been at Valcartier, Que., with the Canadian Armament and Research Establishment, and also spent some time in England at the Military College of Science at Shrivenham.

Dick Jamieson, Jr.E.I.C., is chief metallurgist with Trenton Steel Works Ltd., Trenton Industries Ltd., and the Eastern Car Company, at New Glasgow, N.S.

In 1954, Mr. Jamieson was a research fellow at the Ontario Research Foundation in Toronto, and had before that time been associated with the Dominion Steel and Coal Corporation in Sydney, N.S., as junior metallurgical engineer.

J. T. Denley, Jr.E.I.C., has joined the consulting engineering firm of H. A. Simons, Ltd., in Vancouver. He is a design engineer associated with the construction of pulp and paper mills.

A 1949 graduate of the University of Alberta, he was associated shortly after graduation, with Perforating Guns of Canada, Ltd., and as a logging engineer with the Oil and Gas Well Servicing Company, in Edmonton, Alta.

E. H. Clayson, Jr.E.I.C.

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• Personals

J. R. Dupuis, JR.E.I.C., has been transferred by the Aluminum Company of Canada to McKenzie, British Guiana, from Arvida, Que., where he served as electrical engineer. Mr. Dupuis is a 1950 graduate in electrical engineering from the University of New Brunswick.

R. R. Cheyne, JR.E.I.C., has been transferred by the Aluminum Company of Canada to British Guiana where he will fill the position of assistant mechanical superintendent of the Demerara Bauxite Co. Ltd., at Watooka, McKenzie, British Guiana.

He has, since graduating in mechanical engineering from the University of Saskatchewan, in 1949, been associated with Shawinigan Chemicals, at Shawinigan Falls, Que., General Steelwares Ltd., at London, Ont., and for the past five years has worked for Aluminum Company of Canada, recently at Arvida, Que.

E. R. Cleveland, JR.E.I.C., has joined the Department of Highways, bridge branch, in Edmonton, Alta., as resident engineer. He is a 1954 graduate of the University of Alberta, in civil engineering.

W. Edward Donahue, JR.E.I.C., has accepted a position with Intrusion Prepakt Ltd., of Toronto, at Kemano, B.C.

Mr. Donahue is a 1948 graduate of the University of New Brunswick in civil engineering and has previously been in London, Ont., with the Department of Public Works of Canada.

B. G. Butler, JR.E.I.C., is in Toronto with the harbours and rivers engineering branch of the Department of Public Works of Canada.

He graduated from the University of London in 1954 with a B.Sc. degree in engineering and has since then been employed as instrumentman with Canadian National Railways at Senneterre, Que., and was design engineer for hydraulic structures with H. G. Acres and Co. Ltd. of Niagara Falls, Ont.

Russell H. Smith, JR.E.I.C., was recently named sales manager of Hysol (Canada) Limited, Toronto, Canadian affiliate of Houghton Laboratories Inc. of Olean, N.Y. He was formerly chief sales engineer of Burndy Engineering in Toronto where he was in charge of salesmen, advertising and promotion.

Mr. Smith received his B.Sc. degree in electrical engineering from the University of Manitoba in 1947, and studied business administration at the University of Toronto. He has also spent some time with the Canada Cement Company in Montreal.

Paul F. Karrow, JR.E.I.C., is studying for a Ph.D. in pleistocene geology and soil mechanics at the University of Illinois. Mr. Karrow received a B.S. Sc. (Geol.) degree from Queen's University in 1954.

D. C. Patel, JR.E.I.C., who graduated in 1954 from the University of Nebraska with a degree in electrical engineering is working as a methods engineer for the firm of George Angus and Co. Ltd., Oil Seal Division, Newcastle upon Tyne, England.

Mr. Patel has for some time been engaged in post graduate study at the University of Durham.

George H. Milne, JR.E.I.C., has been appointed comptroller of Horton Steel Works Limited in Fort Erie, Ont. He joined the company three years ago and has been industrial engineer with the company prior to his present appointment.

Mr. Milne received a commerce degree from McGill University and then his bachelor's degree in mechanical engineering in 1953. He became a chartered accountant in 1954.

R. H. Smith, Jr.E.I.C.

He is a member of the Association of Professional Engineers of Ontario and of the Corporation of Professional Engineers of Quebec; a member of the American Society of Mechanical Engineers, and of the Institute of Chartered Accountants of Ontario and Quebec and the Dominion Institute.

R. P. Fillmore, JR.E.I.C., has been transferred from Ottawa to North Bay, Ont., with the Department of Public Works. Mr. Fillmore has been associated with the department since 1952 and was formerly with the forests and scientific services of the topographical survey, Department of Mines and Resources, Ottawa.

He is a 1949 graduate of the University of New Brunswick in civil engineering.

Rolland Marcotte, JR.E.I.C., is a project engineer with Hydro-Quebec, at Montreal. He was formerly in Longueuil, Que., with the Stowell Screw Co. Ltd., in the position of assistant to the chief engineer.

Mr. Marcotte is a 1951 graduate of the Ecole Polytechnique in civil engineering.

Arthur Denis, JR.E.I.C., is now with the Square 'D' Company Ltd., of Canada, Montreal, Que., as field engineer.

He received a degree in electrical and mechanical engineering in 1953 from the Ecole Polytechnique, Montreal.

C. M. Goodrich, S.E.I.C., is now with the Peace River Oil and Pipeline Company at Valleyview, Alta.

Mr. Goodrich graduated from the University of Saskatchewan last year with a B.Sc. degree in mechanical engineering, and then was employed as a mechanical engineer with Canadian Gulf Pipe Line Company, in Edmonton.

Gerald A. O'Brien, S.E.I.C., has accepted a position in Quebec City with North-eastern Paper Products Limited.

Since his graduation as a mechanical engineer from the University of New Brunswick, class of 1955, Mr. O'Brien has been active as a research engineer for Anglo-Newfoundland Development Co. Ltd., Grand Falls, Newfoundland.

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Activities of the Forty-seven Branches of the Institute and abstracts of papers presented at their meetings

Amherst

W. G. Miller, jr.e.i.c.
Secretary-Treasurer

General Meeting

The Amherst District Branch met February 17, 1956 in the Amherst Hotel for a dinner and general business meeting. The meeting was under the chairmanship of Charles Archibald. Reports were read from various committees and a full agenda of new business matters were dealt with.

Belleville

J. A. Grant, m.e.i.c.
Secretary-Treasurer

J. Rywak is Guest Speaker

The regular monthly general meeting of the Belleville Branch was held on March 12, 1956. This was the sixth meeting of the 1955-56 season and approximately 25 members and guests attended.

The speaker was J. Rywak who read a paper on "Automatic Digital Computers". Mr. Rywak has recently returned from a nine-month assignment on loan to Defence Research Board, Ottawa, where he was engaged in research work associated with the digital computer. Mr. Rywak's talk dealt with the distinguishing features of the various forms of automatic computation and with analysis of digital techniques.

The speaker was introduced by W. Benger and thanked by E. Flinn.

Refreshments were served at the close of the meeting.

Cornwall

L. H. Snelgrove, m.e.i.c.
Secretary-Treasurer

V. A. Harrison, m.e.i.c.
Branch News Editor

President's Annual Visit

Wednesday, February 22, 1956, was the date of the president's annual visit to the Cornwall Branch. Dr. Heartz, accompanied by E. C. Luke, acting for Dr. Austin Wright, met with the Branch executive for an enjoyable luncheon and subsequent business session.

Dr. Heartz, Mr. Luke and members of the executive then proceeded to the main administration office of the Ontario Hydro's St. Lawrence power project. Gordon Mitchell, project director, after explaining details of the power project and the Longue Sault section of the St. Lawrence Seaway, conducted the group on a most interesting tour of the project. The group was also accompanied by W. M. Hogg, field project engineer.

Mrs. Heartz, accompanied by wives of the Branch executive, also enjoyed a separate post luncheon tour of part of the power project, including a visit to Hydro's newly constructed hospital.

Canada's Need for Engineers

In the evening, Dr. and Mrs. Heartz, Mr. and Mrs. Gordon Mitchell and Mr. and Mrs. Drummond Giles, attended a most enjoyable dinner dance at the Cornwall Golf and Country Club. Later, Dr. Heartz in addressing Branch members, stressed the present and growing need for more engineers to keep pace with Canada's expanding economy. He also emphasized the desirability of establishing more technical centres for training suitable assistants for engineers. These, he stated, were required in the ratio of about three technicians per engineer and would result in the more effective utilization of engineering skills. A further system of obtaining a relatively small percentage of more highly qualified graduates to meet with increasingly difficult technical problems was also advocated by President Heartz.

Dr. Heartz, who had been introduced by Drummond Giles, was thanked by Gordon Mitchell.

Fredericton

O. I. Logue, m.e.i.c.,
Secretary-Treasurer

N. E. Donahoe, jr.e.i.c.,
Branch News Editor

Joint Meeting at Officers' Mess

Brigadier J. R. B. Jones, officer commanding of the N.B. Military Area, was chairman at a joint meeting of the Military Engineers Association of Canada and the Fredericton Branch of the Engineering Institute of Canada, held in the Officers' Mess, N.B. Army Area Headquarters in Fredericton on February 20, 1956.

H. F. Peters, federal supervising engineer for Nova Scotia on the Trans-Canada Highway, addressed members of the Halifax Branch at their December meeting on the progress and the problems encountered in highway construction. Seated by Mr. Peters (insert) is W. A. Deveraeux, chairman of the Branch.

Congratulations

TO THE HYDRO-QUEBEC AND THE CONTRACTORS WHO ARE BRINGING THE BERSIMIS PROJECT TO COMPLETION

The Engineers of Hydro-Quebec, together with the Engineers of Atlas Construction Co. Ltd., Angus Robertson Limited, Cartier Construction Ltd., Dufresne Construction Co. Ltd., Komo Construction Co. Ltd., and B. Perini & Sons (Canada) Ltd. have co-operated in a modern miracle in Quebec's north country.

JOY equipment has been employed in all phases of this huge project, and has again demonstrated its rugged strength and versatility.

For the construction of the dams, TM-500 tractor-mounted Blast Hole Drills were used for quarrying fill. In the 8.5 miles of tunnel which had to be driven, the TM-500 Drill jumbo-mounted was used for burn cuts, and LBM-47 Airleg Drills and SLB-47 Stopers were also used. JOY AF-111 Hoists were used on turn plates, to turn the trucks carrying the muck from the face. Tunnel and jumbo lighting was sectionalized with JOY String-A-Lite installations. Electrical power distribution throughout the tunnel was sectionalized with JOY Connectors, and maintained with cable vulcanizers, and the entire tunnel system was ventilated with JOY Axivane Fans.

For any project, large or small, JOY Construction equipment pays dividends in time and money saved.

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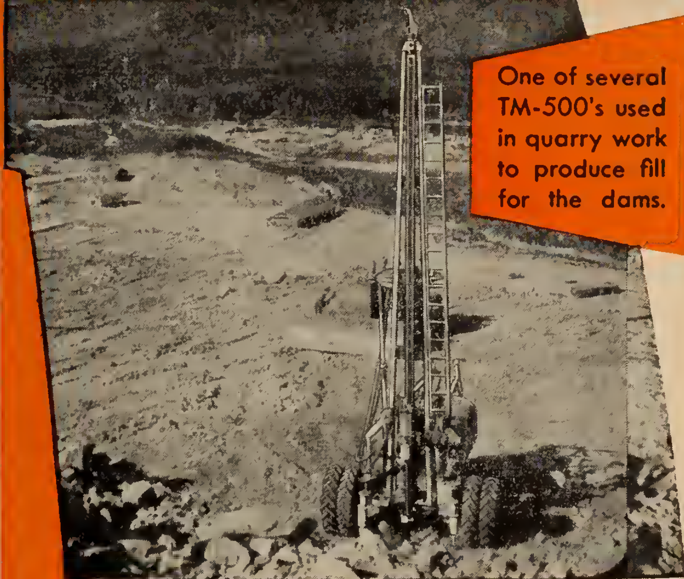
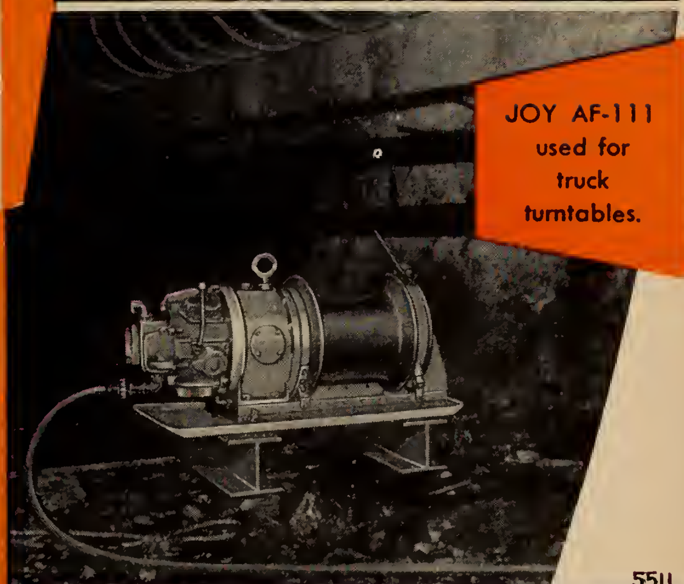


One of several TM-500's used in quarry work to produce fill for the dams.

JOY LBM-47 air leg drilling at tunnel adit.



JOY AF-111 used for truck turntables.

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• Branch News

The meeting began with the presentation of the "Royal Canadian Engineers Book of Remembrance" to the Engineering Department of the University of New Brunswick. The book, which contains the names of all the members of the Royal Canadian Engineers who were killed in the Second World War, was presented by Major Garnett, chairman of the Military Engineers Association of Canada to Major Gillespie of University of New Brunswick.

Brigadier Jones next presented Officer Commanding L. D. Richards with a military scholarship. This scholarship is presented to a worthy senior student and a member of the C.O.T.C. or R.O.T.P. at each university in Canada.

G. L. Wiggs Describes Gagetown Heating

Professor H. MacFarlane next introduced G. Lorne Wiggs, senior member of the firm of Wiggs, Walford, Frost and Lindsay, and president of the Corporation of Professional Engineers of Quebec. Mr. Wiggs is one of the leading authorities in North America in radiant heating and cooling, air conditioning and high temperature water heating, the last being well illustrated in his talk at this meeting.

The subject of Mr. Wiggs' speech was "The Central Heating Plant and Heat Distribution at Camp Gagetown, N.B."

Briefly, Mr. Wiggs informed his audience of the vastness of the Camp Gagetown project, illustrating the areas to be served and, as a result, the tremendous quantity of heat to be supplied. He indicated the problems arising on such a project and the methods used by his firm to combat these problems. A history and explanation of this method of supplying heat was given and further illustrated by an explanation of the plant which is being built at Camp Gagetown.

After, both Associations enjoyed the hospitality of the Officers' Mess which provided a chicken dinner for those present.

Town Planning Panel

On March 20, 1956, the Fredericton Branch held a supper meeting at the Students' Centre of the University of New Brunswick.

After the supper Prof. H. W. McFarlane was moderator for a panel discussion on "Town Planning". Members of the panel were: D. Johnson, provincial architect and chairman of the Fredericton Town Planning Commission; L. Mercereau of the Department of National Defence and closely associated with town planning for Oromocto, N.B.; H. Marshall of the N.B.E.P.C. and member of the Provincial Planning Board; and D. McN. Lowe of Defence Construction (1951) Ltd. who has been closely associated with town planning in England as well as Canada.

The discussion was opened by Mr. Johnson who explained the purpose of town planning and the problems which arise in striving to obtain a well-planned town.

Mr. Mercereau next spoke on traffic directions in planned towns, the strategic location of neighbourhoods and business sections and the planning of a network of roads to avoid congested traffic, the design of roads to eliminate speeding. He used the town of Oromocto, location of the permanent married quarters for the Army at Camp Gagetown, as an illustration of well planned traffic direction.

Mr. Marshall spoke from a property owner's point of view, of the rights of the property owner as well as of the responsibilities which he owes to his community in aid of town planning.

Finally, Mr. Lowe compared the type of planned town such as Oromocto with the gradually expanding town. He spoke of the ever increasing demand in the services for such a town under gradual expansion and the results of overloading these services. Also Mr. Lowe discussed the "garden cities" of England and Scotland, the ideal towns of 50,000 which are considered the most efficient types of town from both the planner's and the dweller's point of view.

An interesting discussion followed. Conclusions reached were that there should be more co-operation between town and province; that the public has not been exposed enough to town planning but that advertising of town planning is up to the town planning commission.

The underground power house at the Bersimis Power Development. This cavern is 565 feet long, 65 feet wide and 80 feet high. It houses eight Francis turbines—fifty-five feet apart—each rated at 150,000 h.p. under a 785-foot head at 277 r.p.m. The power house was constructed by Dufresne Engineering Company Limited.

HEARTIEST CONGRATULATIONS to Quebec Hydro-Electric Commission on the completion of the Bersimis Power Development.

This Company is proud of its part in this great engineering feat. We constructed the power house, excavated the tailrace open cut, supplied the mixed concrete for lining all tunnels and were responsible for the maintenance and operation of all machinery and equipment during the entire period of construction.

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• Branch News

Halifax

W. D. Pippy, M.E.I.C.,
Secretary-Treasurer

F. H. Tremain, M.E.I.C.,
Branch News Editor

H. F. Peters Speaks on T.-C. Highway

The regular December meeting of the Halifax Branch was held in the main showroom of the Wm. Stairs, Son and Morrow new plant on Kempt Road, Halifax, N.S. Over 125 members attended.

H. F. Peters, federal supervising engineer for Nova Scotia on the Trans-Canada Highway, was the guest speaker.

Mr. Peters outlined the progress made on the Trans-Canada highway and some of the problems encountered. His address was of great interest to the large number attending and was illustrated by slides. A film entitled "Roadblock" was also shown and much enjoyed. Members were taken on a tour of the new plant and saw some of the largest and latest models of earth moving machinery.

Hamilton

F. A. Barnard, Jr.E.I.C.,
Secretary-Treasurer

Ross R. Packer, Jr.E.I.C.,
Branch News Editor

Hon. R. H. Winters Addresses Branch

Guest speaker at the annual meeting of the Hamilton Branch in February was the Honourable R. H. Winters who spoke on "The Place of the Trans-Canada Highway in the Story of Canadian Communications."

Canada's Minister of Public Works was introduced by Mr. Cooch.

"The history of Canada," Mr. Winters said, "has been shaped by the development of communications perhaps more than by any other single factor; our growth has from the first been interwoven with the story of the development of water, rail. road and air transportation. Step by step, a web of communications has been built across this country and economic development has followed. By boat, train, motor and airplane, we Canadians have linked our communities, opened the way to our resources and stimulated our economy. Postal services, telephone, telegraphs, radio, news agencies and now television, have brought us closer together and have helped to interpret Canada to Canadians. This story is constantly being extended: at this very moment in fact, by great projects quite worthy to take their place with the episodes of the past.

"The St. Lawrence Seaway, the proposed Trans-Canada Pipeline, the Trans-Canada Highway — all these now are underway or planned; all of them fit into the broad perspective of Canada's eternal struggle with her environment; of the conquest of her space."

Mr. Winters, responsible federally for one of these three—the Trans-Canada Highway, said "the movement of population and trade first followed the waterways, then expanded westward along the line of the railway. A network of roads spread out between cities and towns and became important for long-distance travel with the coming of the automobile age. Finally the invention of the airplane enabled Canadians to develop the mineral wealth of our northern lands, and to bring our cities closer together through speed."

To all these, he said, we have meanwhile added the other forms of communications. We have linked our coasts and our communities by telephone. Through such agencies as the C.B.C. in the fields of radio and television, the Canadian Press in news-gathering, the Canadian National and Canadian Pacific Telegraphs in the field of telecommunications, we have brought our peo-

• Branch News

ple together and helped to make them one.

The fact that this is an aeronautical age does not mean that Canada's waterways have lost their significance or that the railways have become obsolete or that roads are no longer necessary. Under our constitution, he said, roads are normally considered to be a provincial responsibility. But since 1919 the federal government has shouldered part of the financial burden for road-building. For six years now provincial and federal authorities have been working together on the task of completing a 5,000 mile highway from St. John's to Victoria.

Trans-Canada Highway in 1960

"Nine provincial governments signed agreements with the federal government to complete their share of this project by December 9, 1956," he said. "But progress has been slower than we had hoped. At the end of 1955, just one year away from the anticipated completion date, about one-third of the total mileage remains unpaved and for some 250 miles of the route there is no highway of any kind. However, we have re-examined the problem and devised a new formula providing for increased federal assistance. It is designed particularly to close the gaps and we now expect to see the highway a completed reality by the end of 1960.

"The engineering tasks have been stupendous. Muskeg, the old C.P.R. enemy, has been an important difficulty in Northern Ontario as it has been in Newfoundland and elsewhere. A wide, marshy tract full of dead trees, leaves and debris must be excavated before a stable foundation can be laid, and in some places it goes as deep as 50 feet. Then there is the prairie "gumbo"—the treacherous, heavy clay soil covering 25 to 30 per cent of the route in this area. It requires the use of reinforced concrete and other special techniques. And in British Columbia the roadbuilding crews have literally had to move mountains.

The Annual Meeting

MONTREAL

MAY 23 - 25, 1956

The program is on Page 437 of this issue

Engineering Work Hazardous

"Work is hazardous in the extreme in the Fraser Canyon and the Kicking Horse Canyon, where hard-rock miners blast away the mountain wall 500 to 1,000 feet above a turbulent river, and land slides are frequent. Since in most places the railway runs below the new highway, great care must be taken to protect the tracks and tons of rubble must be carried away. In one nine-mile stretch between Field and Golden two million tons of rock and an equal amount of dirt have been moved, by means of 5,000 tons of explosives. The cost of construction in this area is estimated at $1 million a mile and one half-mile stretch has cost $1,500,000.

The various stages in our story of communications, Mr. Winters said, have each made their contributions to Canadian development. There could hardly have been a Canada without them. The Trans-Canada Highway is part of this story and part of the eternal job of nation-building. It is by no means un-

• Branch News

fair to compare it with the greatest of our transportation achievements of the past.

Mr. Winters was thanked for his informative talk by Hamilton Branch councillor, N. A. Eager.

During this meeting also, the minutes of the last annual meeting were read and adopted. These showed that Branch membership had increased from 465 to 474 over last year. Two Life memberships were announced: those of H. G. Bertram and J. Stodard. In addition, the 1955 Student and Junior Papers Night prizes were presented; and Bill Filer, director of the Professional Development Program, spoke of the success of the program and described the annual Employers' Night.

Chairman F. E. Milne introduced the new chairman, J. J. Kelly, and the members of the new executive after which D. Annan expressed the appreciation of the Branch of the work of the 1955 executive.

Employers' Night

The annual Employers' Night sponsored by the Professional Development group of the Hamilton Branch took place in February.

J. J. Kelly, chairman of the Hamilton Branch, introduced W. Filer, director of the Professional Development Program, who outlined the history of the program and its objectives. The treasurer then reported a small surplus. After the treasurer's report, the Nominating Committee announced the new executive which was elected unanimously. H. Hone, the newly elected program director, was then introduced. He referred to the need of assistance on the part of employers of engineers in Hamilton, after which G. Scheinder reported on the progress of the Constitution Committee.

G. E. Miller is Guest Speaker

The guest speaker, G. E. Miller, chief engineer, maintenance of way, for the Eastern region of Canadian Pacific Railways, was introduced by the chairman. Mr. Miller's subject was "Transportation is Important".

He said he was pleased to address a group of young engineers interested in broadening their perspective on topics outside their own particular fields, and to their employers who are interested in the professional development of engineers.

Among the various problems facing engineers in industry today is the major one of transportation. In his talk Mr. Miller emphasized the dependability of railway transportation throughout the year. Canada as a country, he said, has been developed first, by water routes, then by land, and finally, by rail. This particular sequence has now changed, however, with exploration by air, followed by the laying of railroads, and finally, and if economical, the building of highways.

Mr. Miller illustrated railroad building in Canada by means of a series of scenic slides.

Members from Smiths Falls, Perth, Lanark, Merrickville and Cardinal, attend a recent dinner meeting of the Institute held for the first time in Smiths Falls on February 29. Left to right, seated, W. G. Cooke, W. L. Dickson, R. H. Wallace, chairman, Brockville Branch; Robert Marshall, J. G. MacLaurin and L. F. Grant. Left to right, standing, F. Trewartha, K. R. Bullock, T. W. Reade, F. R. V. Billie, C. S. Dinsmore, W. N. Simmons, J. G. Kerfoot, vice-chairman, Brockville Branch, R. M. Powell, and F. Walsh.

Ottawa

W. V. Morris, M.E.I.C.,
Secretary-Treasurer

Carl B. Crawford, Jr.E.I.C.,
Branch News Editor

Yukon River Watershed

The power development that is taking place in the Canadian Northwest was described to the members of the Ottawa Branch on February 23 by J. M. Wardle of Northwest Power Industries. Mr. Wardle outlined the preliminary work of the last three years which resulted in the decision to spend $800,000,000 over the next 15 years for the development of nearly 5,000,000 horsepower.

Canadian Development

Mr. Wardle recalled the application in 1947 of the Aluminum Company of America for permission to develop 1,500,000 horsepower on the Yukon River. This resulted in the decision in 1950 by the Canadian Government to establish a policy that all power developed on Canadian Waterways was to be developed by Canada herself. Northwest Power Industries, an organization formed jointly by Ventures Limited, Frobisher and Quebec Metallurgical Industries, investigated all rivers in the Northwest area to establish the best method of power development. Many factors had to be studied such as water storage, flooding of communities, sale of power, construction and operating difficulties and potential competition from atomic energy.

A satisfactory solution of each of these problems together with the known increasing demand for power resulted in the decision to proceed with the development. Water is to be obtained for the development of power by reversing flow in the Yukon River and by diversion of other river and lake systems to create a large storage to supply water to a tunnel emptying into a deep mountain valley which will result in a head greater than 1,000 feet.

News of Other Societies

The Canadian Standards Association (National Research Building, Ottawa). The 29th annual meeting will be held on Friday, June 8, 1956, at the Nova Scotian Hotel, Halifax, N.S.

•

American Society of Civil Engineers (33 West 39th St., New York 18, N.Y.) has arranged a symposium on arch dams to be held as part of the summer meeting of the Society at the University of Tennessee in Knoxville, Tenn., June 4-9, 1956.

Fifteen papers reviewing a wide scope of experience will be presented. *Civil Engineering* will announce the availability of papers, and discussions will be welcomed by the Symposium Committee chairman R. E. Glover, 1936 South Lincoln Street, Denver, Col.

•

Institution of Production Engineers (10 Chesterfield Street, London W-1). The production exhibition, Olympia, London, England, May 23-31, 1956, has for its purpose to provide technical information on ways in which British goods can be improved in quality and quantity and to demonstrate the research effort and production techniques.

The production conference of the Institution will be held simultaneously.

The organizers (Andry Montgomery Limited, 32 Millbank, London, S.W. 1, invite Canadian visitors to the exhibition.

• Branch News

Moderate Temperature

Mr. Wardle explained that due to the Japanese current the weather at the power development site is not extreme. He quoted figures to show that the mean monthly temperature was only a few degrees colder than Ottawa during winter and correspondingly only slightly cooler than Ottawa in summer. The lowest temperature ever recorded at the site is —27°F.

Industrial Site Planned

An industrial site for the use of power is to be created just inside Canada on an inlet through the Alaska Panhandle. Mr. Wardle illustrated the economics of establishing an industrial site in this area by pointing out that it was possible to bring ore a distance of nearly 6,000 miles to the site for about $3 a ton. When this figure is compared to the market value of certain metals which require great power consumption for their purification, it is apparent that it would be economical to process raw ores in this remote region of Canada.

Dean R. E. Jamieson is Speaker

At a luncheon meeting of the Ottawa Branch on December 8, Dean R. E. Jamieson of the faculty of engineering, McGill University, outlined some of the problems which are accompanying the increasing enrolment in engineering at Canadian universities. He reminded the audience that the present total university registration in Canada of 67,000 students is expected to increase by 31 per cent within five years and by 92 per cent in ten years. The engineering enrolment is expected to increase similarly. Dean Jamieson pointed out that enrolment had increased threefold since World War II with only minor increases in teaching facilities.

Defends Academic Standards

In defending the high academic standards which are maintained at Canadian universities, Dean Jamieson outlined a study of the individual performance of the students of two classes which had graduated from McGill: the first class of the World War I period and the second class of the World War II period. By comparative figures, he showed that the later group had faired academically as well or better than the earlier group. Therefore he recommended that further restrictions on entry to universities should not be imposed except as a last resort. Further he argued against any increase in student fees in an attempt to restrict entry.

Relief of Engineering Facilities

Dean Jamieson presented two ideas for the relief of the present engineering facilities at Canadian universities which must be doubled by the fall of 1964. First he recommended that the so-called "feeder" engineering schools be given increased support and secondly, that much greater financial support be given to the degree-granting universities. Dean Jamieson thought that the required financial support would be obtained with the backing of informed public opinion and he called upon the professional organizations to foster this development.

This luncheon was sponsored by the

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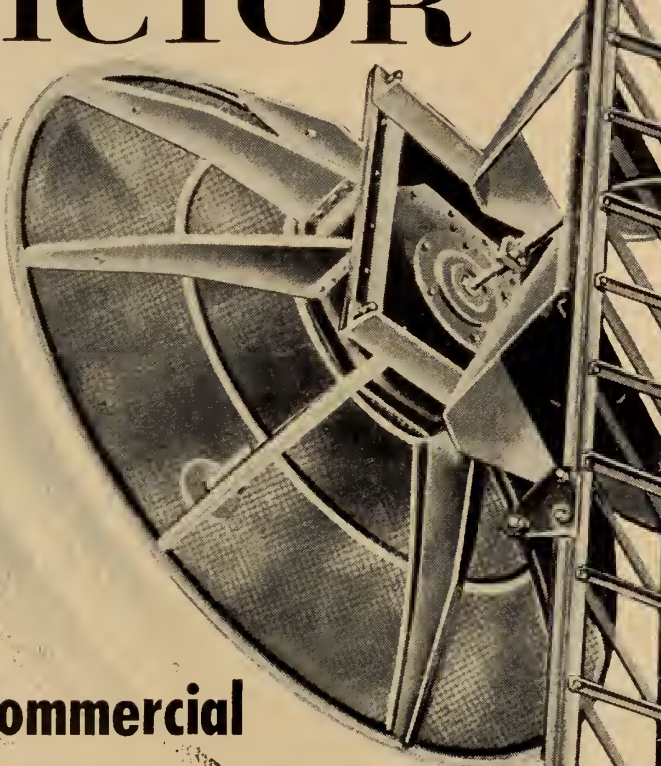

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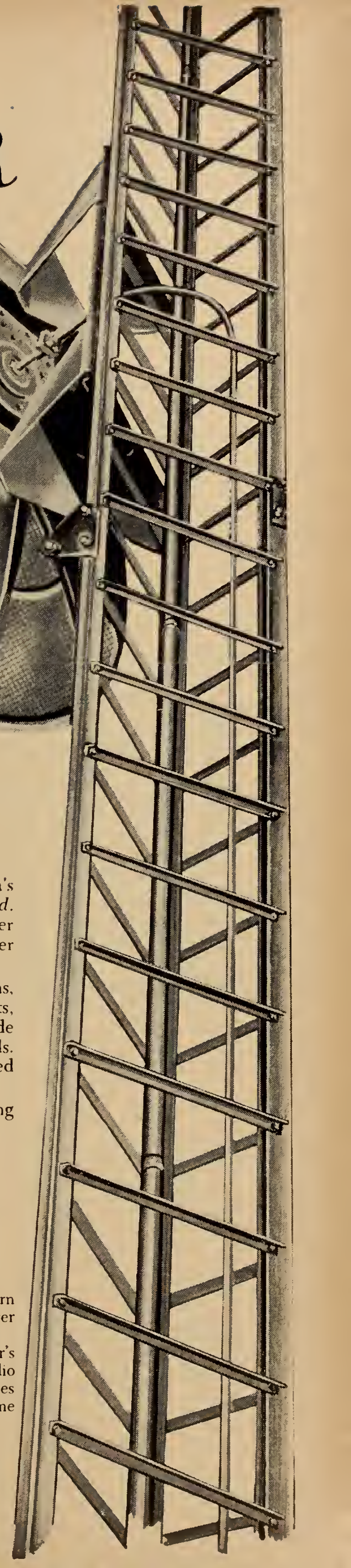


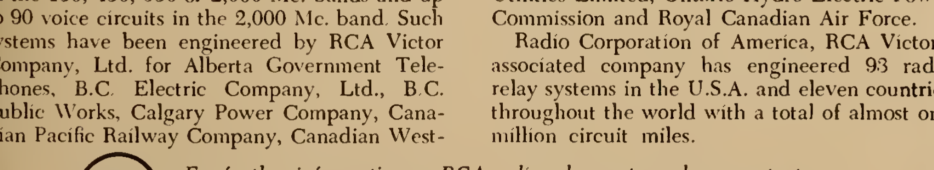
Hydro-Québec's BERSIMIS Project

Quebec Hydro-Electric Commission will control its Bersimis power houses by Canada's longest private commercial microwave system supplied by *RCA Victor Company, Ltd.* Beauharnois and Montreal will be linked by this microwave system with the new power development on the Bersimis River more than 440 miles away. Operation will start September 1st, 1956 to coincide with the commencement of operation of the first power house.

The microwave system operates in the 2,000 Mc. radio frequency band, has 15 stations, carrying 20 voice, 18 telemetering, 3 load frequency control circuits and 2 teletype circuits, ultimate capacity 36 voice circuits. The system is supplied on a turn-key basis to include buildings, towers, antennas, transmission lines, power supply units, fences and access roads. It will also feature complete UHF radio coverage for about 30 mobile radio equipped maintenance vehicles.

RCA Microwave Systems, like the Bersimis project, are engineered to carry the following circuits:

FACSIMILE SWITCHBOARD PRIVATE LINE PARTY LINE TELETYPE DATA RECEIVING



They are available for 12, 24 or 30 voice circuits in the 150, 450, 950 or 2,000 Mc. bands and up to 90 voice circuits in the 2,000 Mc. band. Such systems have been engineered by RCA Victor Company, Ltd. for Alberta Government Telephones, B.C. Electric Company, Ltd., B.C. Public Works, Calgary Power Company, Canadian Pacific Railway Company, Canadian Western Natural Gas Company, North Western Utilities Limited, Ontario Hydro-Electric Power Commission and Royal Canadian Air Force.

Radio Corporation of America, RCA Victor's associated company has engineered 93 radio relay systems in the U.S.A. and eleven countries throughout the world with a total of almost one million circuit miles.

For further information on RCA radio relay system please contact:

Engineering Products Department,
RCA VICTOR COMPANY, LTD.
1050 Lacasse Street, Montreal, Que.
Telephone: Montreal — WEllington 7551

• Branch News

Junior Section of the Ottawa Branch The speaker was introduced by A. H. Graves, chairman of the Junior Section and thanked by S. G. Frost.

Sudbury

H. M. Whittles, Jr.E.I.C.,
Secretary-Treasurer

H. C. Coffin, Jr.E.I.C.,
Branch News Editor

Dr. Lillian M. Gilbreth, Hon. M.E.I.C., was the speaker for the Toronto Branch Professional Development Group at ladies' night on February 28. Her subject was "You and Your Husband's Job".

Application of Nuclear Energy

The regular monthly meeting of the Sudbury Branch was held at the Granite Club on Thursday March 8, 1956.

"The Application of Nuclear Energy" was the subject of an interesting lecture given to 35 members and guests by J. E. Matthew of the nuclear power division, Canadian General Electric Company.

NPD Plant Construction

Early in 1954, a study was begun on the feasibility of developing economical nuclear power in Canada. Following completion of the preliminary design study, Atomic Energy of Canada Limited, the Canadian General Electric Company and Ontario Hydro agreed to undertake the design and construction of a nuclear-electric power plant in Ontario. The plant known as NPD (nuclear power demonstration) will supply power to Ontario Hydro at a location adjacent to the System's existing Des Joachims generating station on the Ottawa River. Under the agreement, the Canadian General Electric Company undertook the design and manufacture of the reactor portion of the plant and the construction work for the project. Atomic Energy of Canada Limited was to provide special development services and data required for the reactor design.

In the group, from left to right: J. A. Gingrich, Jr.E.I.C., E. A. Cross, M.E.I.C., Dr. Gilbreth, E. M. Spencer, Jr.E.IC., and L. F. Grant, Hon. M.E.I.C.

NRX and NRU Experience Helpful

NPD is to be a heterogeneous reactor of the natural-uranium heavy-water moderated and heavy water cooled type. Experience gained from NRX and NRU at Chalk River indicated that this design would be as promising as any for the production of economic nuclear power in Canada. Natural uranium fuel type was considered because Canada has an abundant supply but has not built a plant for separating the uranium isotopes. This initial cost will be higher on account of high cost of heavy water (about $300. per gallon), but operating costs will be less because natural uranium may be used as a fuel.

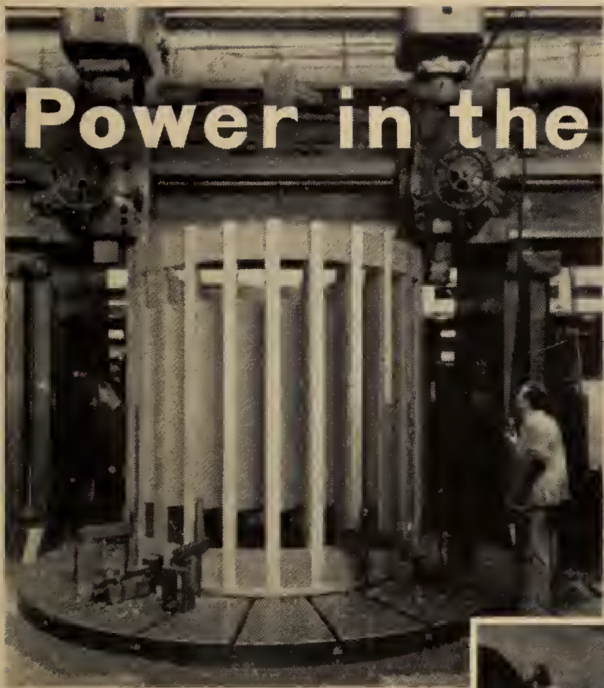
Mr. Matthew also mentioned the graphite moderated and the natural water cooled reactors and cited their advantages and many disadvantages.

Design Problems

Some of the design problems of NPD were considering the size of reactor, procuring proper type of pressure vessel and deciding upon type of head for it, containment of the process (securing pumps and valves to withstand the high pressures without wasting the expensive heavy water), heat generation, high heat transfer and releasing power.

The control and emergency shutdown of NPD will be accomplished by moder-

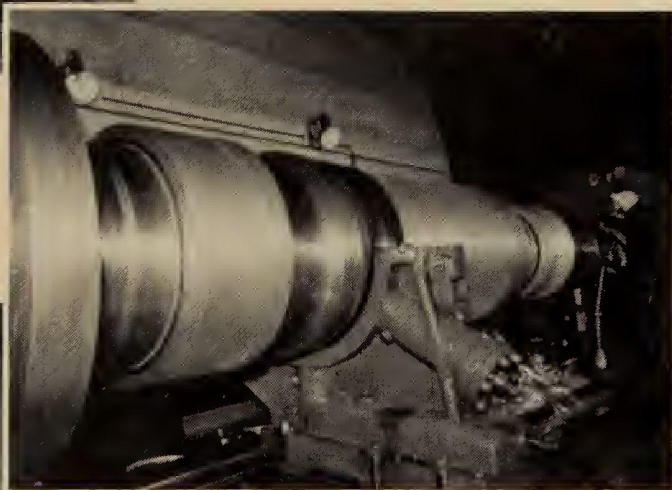
Power in the making...



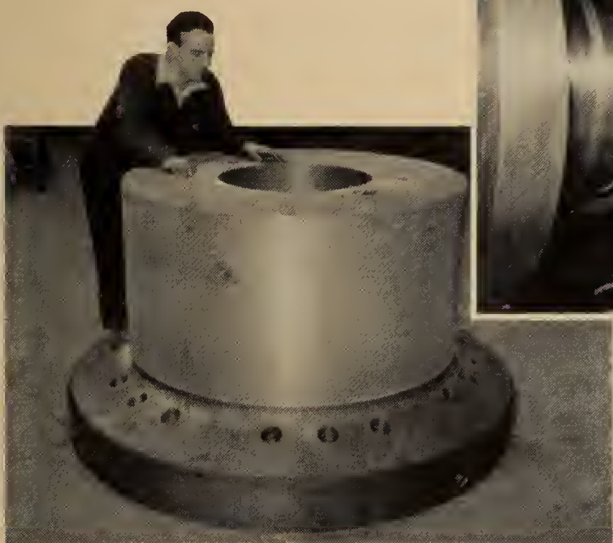
Machining the rotor spider

BERSIMIS

Vertical water wheel generators of larger capacity than any hitherto constructed are being built by Metropolitan-Vickers for the Bersimis Lac Casse development of the Quebec Hydro-Electric Commission. Four generators will be supplied, each having an output of 138 MW at 277 r.p.m. These photographs illustrate some of the work in progress.



Machining the rotor shaft. The completed rotor will weigh 300 tons.



The thrust block which will carry 360 tons dead weight, and 190 tons of water thrust.

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• Branch News

ator level. This results in no moving parts in the reactor vessel. This system provides fail-safe operation since moderator level falls if the circulating pumps or valves fail.

To Provide Information

"The high unit capital cost of this plant will prevent its unit energy cost from being competitive with that of water and steam plants at the present time but it will provide information for designing a future full-scale plant," Mr. Matthew said. Slides of diagrams of the power cycle were shown and a discussion period followed. Mr. Matthew was introduced by J. Smith and thanked by E. Savage.

Another highlight of the meeting was the showing of the Aluminum Company of Canada film, "The Kitimat Story". Mr. Monaghan of the Aluminum Company spoke briefly on the film. He was introduced by L. T. Lane and thanked by Roy Snitch.

Toronto

Louis Bresolin, Jr.E.I.C.,
Secretary-Treasurer
A. C. Davidson, M.E.I.C.,
Branch News Editor

Annual Meeting

The annual meeting of the Toronto Branch was held in the Fiesta Room of the Prince George Hotel on January 12, 1956. There were 140 members present.

The chairman, M. W. Huggins, introduced the guest speaker, Dr. C. R. Young, who is a past-president of the Institute, and dean emeritus of the Faculty of Applied Science and Engineering of the University of Toronto.

Dr. Young Discusses Engineering History

Dr. Young related some fragments of the history of engineering in Canada, in relation to five outstanding engineers of 100 years ago. His talk was about persons and personalities. He told how engineering grew with the advent of railways through the efforts of a few versatile men who turned their hand to whatever task called them. By mutual co-operation they enhanced the profession, and although they did not gain a great deal financially, they made great reputations. One of the engineers discussed came to America from Poland in middle life. He had no money, and no knowledge of the language, yet managed to study law in order to acquire facility in English.

Dr. Young emphasized the importance of history by quoting George Santayana: "Those who cannot remember the past are condemned to repeat it."

In thanking Dr. Young for his address, K. F. Tupper noted that the number of engineers in Canada had increased during the last 100 years from just a few to some 35,000 at the present time. It would now be extremely difficult to select as being outstanding among them any group of five individual engineers.

Business Meeting

During the business meeting which followed Dr. Young's address, Mr Huggins announced the student competition on construction topics sponsored by the Ontario General Contractors Association.

The minutes of the 1955 annual meeting, and the year's financial statement and auditor's report were accepted. The secretary-treasurer in the membership report indicated that total membership has decreased by 62 during the year to 1,791. Mr. Tupper reported informally on the work of the Papers Committee which met frequently. The members of this committee were applauded for the program they had prepared.

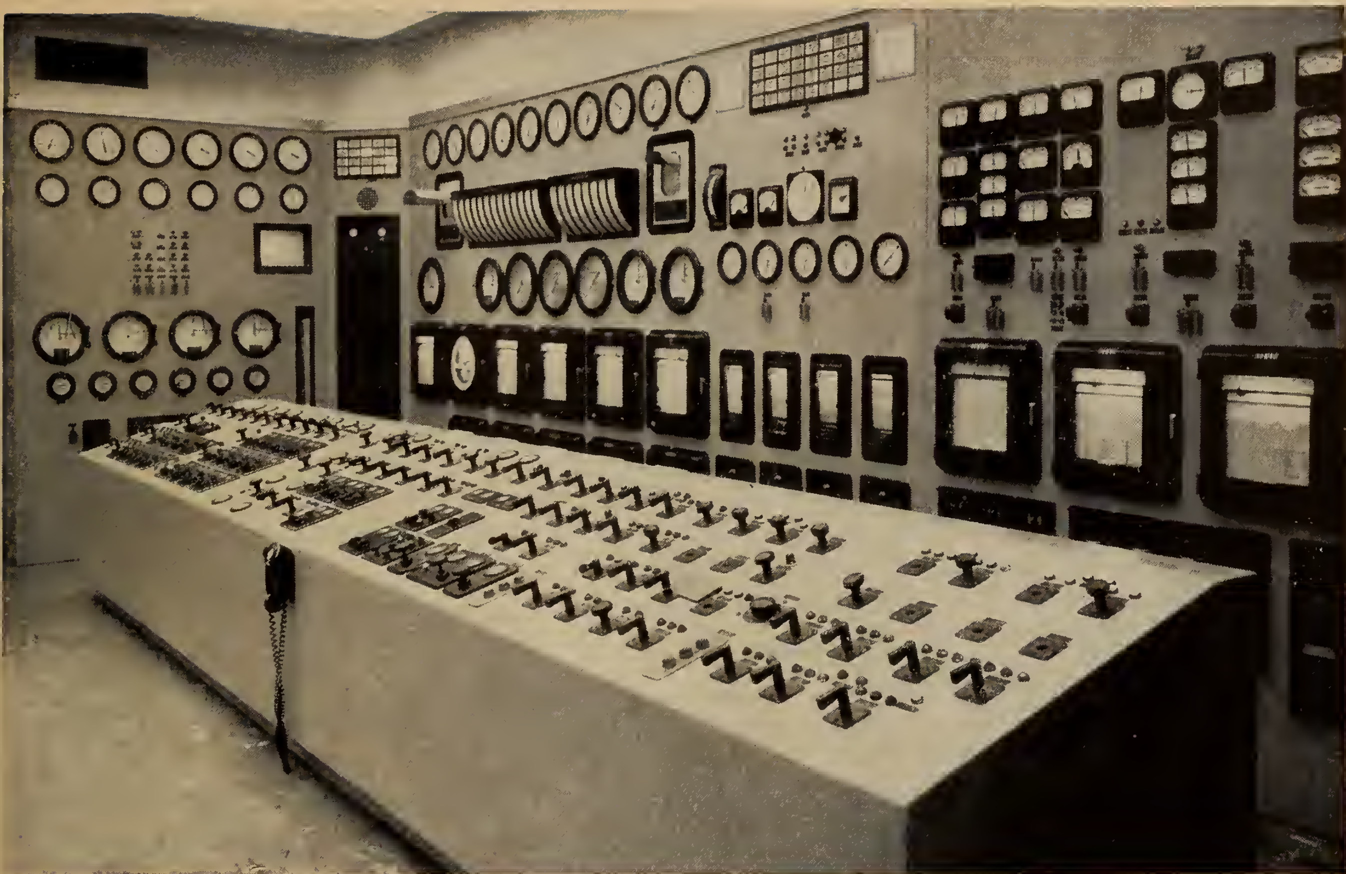
E. Spencer, chairman of Professional Development Course I, reported that there were two courses in operation. The basic course, P.D.I had been chosen to cover topics of other than business or engineering interest. Enrolment in this course had increased from 26 to 80. The advanced course, P.D.II had been chosen to cover business topics, and offered the Harvard Case Method of study. Enrolment in P.D.II is six. The continuing help of Col. Grant and Mrs. Robertson in these courses was gratefully acknowledged.

Tribute was paid by Mr. Huggins to those members who had become Life Members: J. R. Burgess, C. E. Bush, W. B. Dunbar, T. F. Francis, A. Hadley, O. Holden, H. C. Kendall, E. R. Logie, J. F. McLaren, and A. U. Sanderson.

Mr. Huggins, the outgoing chairman, reported on the year's activities. After the report of the scrutineers on the newly-elected executive had been accepted, Mr. Huggins presented the gavel to the incoming chairman, K. F. Tupper, after which M. McMurray expressed the appreciation of the membership to the retiring chairman, Mr. Huggins.

Panel Discussion at Joint Meeting

A joint evening meeting of the Toronto Branch of the Engineering In-



Centralized controls for station service switching, two 125,000 kw turbines, generators and boilers are in this room. Republic sub-panels on the bench board provide for either automatic or manual control of the boilers.

Operating Boilers Electronically at Alabama Power Company's NEW BARRY PLANT

At the new Barry Steam Plant near Mobile, Alabama, two 900,000 lbs. per hour pulverized coal fired boilers operating at 1875 psi and 1000°F. are controlled by a Republic Electronic Master Combustion Control System.

Electronic impulses control pneumatically operated fuel, draft, and feedwater regulators on the boilers. Master control signals are transmitted practically instantaneously, permitting fast control response and close boiler control.

To ensure that both final firing rate and air flow will rapidly and accurately follow changes in steam load, the control system normally follows a dual element master control. This master controls the boiler auxiliaries from a rapid and proportional steam flow function together with a stabilized steam pressure function. Such a system combines the features of derivative control with automatic correction for fuel variation in such a manner that the effects of load swings are minimized almost to the vanishing point. Other control problems such as feedwater control and steam temperature control are simplified by the coordination of boiler auxiliary functions due to this system of combustion control.

Boiler feedwater is controlled automatically by a Republic three-element feedwater control. To prevent heat damage to feedwater pumps during low flows, a Republic pump by-pass system has been installed. It automatically maintains a minimum flow of 125 gpm through each pump (two pumps per boiler) returning by-passed water to the deaerating heater storage tank.

Final efficiency tests recently completed at the Barry plant indicate the expected plant heat rate has been fully realized. There are Republic Automatic Combustion Control Systems — electronic or pneumatic — for all sizes and types of boilers, all methods of fuel firing and for any arrangement of draft equipment. For full details, write today.

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• Branch News

stitute and the Toronto Section of the American Institute of Electrical Engineers was held on March 1 in the University of Toronto mechanical engineering building. Approximately 175 members of both Institutes and guests provided the panel with an attentive audience. After the panel members developed their topics, the listeners had numerous questions which pointed up the important ideas the panel had emphasized.

Dr. Otto Holden, chief engineer of the Ontario Hydro, was an able moderator. His pleasant commentary helped to knit the various discourses together to make the evening more enjoyable.

Dr. Percy Dobson

Dr. Percy Dobson led off the panel's remarks with an historical outline of power development in Canada. As Dr. Dobson said, all the information is available in greater detail, but he hoped to touch on the highlights only.

From the fundamental discoveries of Faraday and the mathematical statements of these discoveries by Maxwell came the generation of electrical power as we know it today. Canadian developments were emphasized, beginning with Barber's plant in Georgetown, Ont., in 1882, and J. J. Wright's plant in Toronto which ran first in 1881. Steam and hydro developed more or less side by side with hydro predominating where such sources were available. Hydro plants have grown larger and larger and have moved farther and farther from cities as sites near population centres have become fully developed. The transformer permitted this development, otherwise industry would have had to move to the power source.

An interesting sidelight on the troubles besetting the early generating plants was illustrated by the complaint made to the operator of an early generating plant in Calgary by the late Lord Bennett (then R. B. Bennett), ". . . Theodore, the light was very poor last night, I could hardly see to go to bed."

"Yes, Mr. Bennett, there wasn't enough water."

"It seemed to me there was too much water in the light," retorted Mr. Bennett.

George D. Floyd

George D. Floyd, assistant general manager of engineering for the Ontario Hydro, spoke on the topic of "Future Developments: Limitations of Hydro and Conventional Fuels". As far as future developments are concerned, the rate of increase is expected to continue indefinitely. The average increase for Canada is expected to be about six to eight per cent per year, that is, the generating capacity will have to be doubled every 12 to 16 years.

The Ontario Hydro has projected past trends into the future. It is expected that 1.1 x 10^6 kw. of hydro power presently undeveloped will be nearly all utilized by 1960. Steam plants will then be built to take care of the demand until 1965. From that point other sources must be utilized, particularly nuclear fuel plants. By 1975 about one-third of the total generating capacity will be powered by nuclear fuel. The

• Branch News

station at Des Joachims using nuclear fuel is for experimental purposes, and is not expected to operate much before 1958.

Hydro plants are limited by accessibility and cost. To keep costs down, transmission using d-c will have to be used. Steam plants are limited by the availability and cost of fuel. Size of unit also will be a factor. High pressure high temperature units of 300 mw. capacity will become fairly common.

Prof. A. E. Allcut

Professor A. E. Allcut discussed "Possibilities of New Sources and Improved Utilization of Existing Sources".

The demand for more power will increase with the population and the standard of living. Canada is not alone in this increasing demand. World supply and demand will affect the North American situation, and that in Canada as well. To show how the demand will increase, Professor Allcut quoted figures showing the change in world population. Numbers rose from 500 x 10^6 in 1650 to 2 1/3 x 10^9 in 1950 and are expected to reach 6 x 10^9 in 2050. Roughly three times as many people a hundred years hence will demand more power.

At the present time the primitive areas of Africa and Asia contain about a billion people, and as anyone can readily see, are stirring politically. Demands for improved living conditions by these people will bring demands for power. Obviously the Middle East oil reserves which form about half the world reserves will be cut off from the rest of the world by this demand. The western world will have to look elsewhere for fuel.

Energy consumption is rising at tremendous rates and by 2050 is expected to lie between seven and 30 times that of 1950, according to various estimates. Although there are great discrepancies in the estimates of energy resources, it is expected that the peaks of consumption for various fuels, regardless of how many new sources are found, and regardless of the depletion of known resources, will be 1955-60 for oil and gas, and 1975-90 for coal. Obviously new sources must be found. Remaining water power, fossil fuel sources, solar energy for heating, heat of the earth itself (volcanoes and hot springs), the heat pump, wind power and tidal power will all have to be used although the foreseeable contributions by each method are not large.

Improvement in methods of generating power will have to be made, and inefficient plants replaced. Larger plants will be employed, operated by highly skilled technicians. Gasifying coal at mines will probably be employed and gas will be used in gas turbines—a poor quality gas is advantageous here.

There are obviously numerous varied and crucial problems which must be solved. Our civilization depends on their solution.

W. L. Thompson

W. L. Thompson of the Bailey Meter Company discussed the engineering and manpower facilities required in the power industry. He spoke briefly but emphatically. Canada has neither the experience nor the equipment to design and build complete thermal units but could do so if necessity demanded. Mr. Thompson reiterated Mr. Floyd's remarks concerning the trend to large steam power plants.

Boiler efficiency is now 80-90 per cent and overall efficiency of steam power plants is between 30 and 35 per cent. About 1 kw. of power is being generated by 1 lb. of fuel.

There is manpower to build the plants but the plants themselves are critically understaffed. There is none for nuclear power plants and none for the large steam plant. Manpower requirements for a present day plant are about five professional engineers together with the necessary instrument mechanics and operating staff, who vary in number with the plant complexity. Some training is being undertaken for new staff, but the number being trained is nowhere near adequate.

Instrumentation and automatic control are adequate at present, and will obviously have to be used more and more in the future.

At no time in the discussion was the "standard of living" ever defined nor was there any thought given to the moral implication of the increasing demand for power. In the opinion of the branch news editor, this problem is worth exploring. Engineers as a body evidently do not feel that this aspect of the problem should be considered. Let the demand increase; somehow it will be met.

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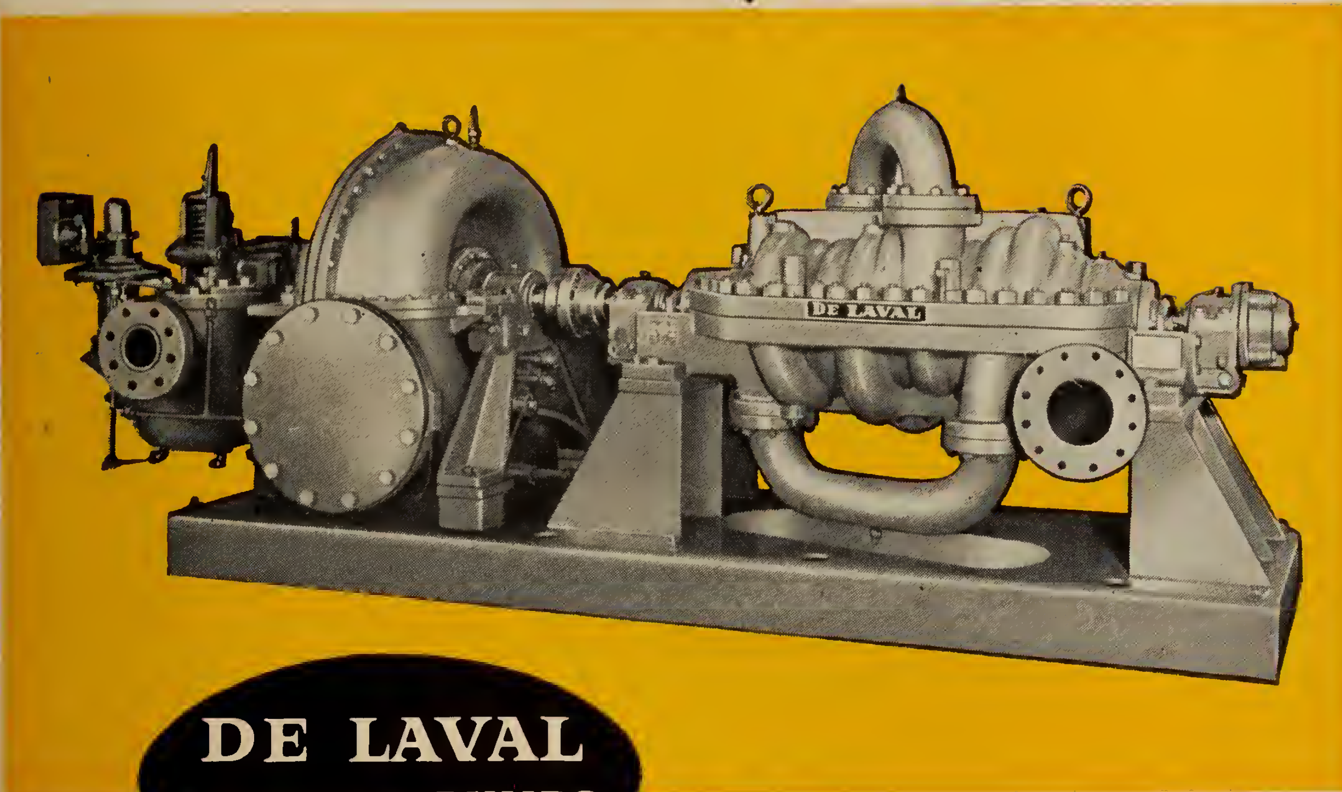

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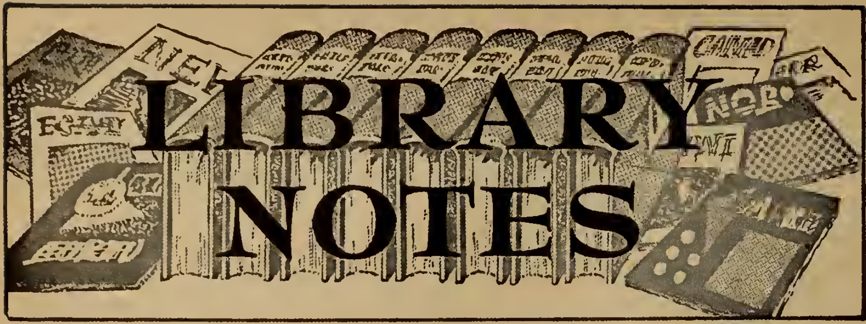


Additions to the Institute Library

Reviews — Book Notes — Abstracts

BOOK REVIEW

Design of piping systems, 2nd ed. M. W. Kellogg company. New York, Wiley, 1956. 365 pp., diagrs., $15.00.

Since the publication of the first edition of this volume in 1941, the Kellogg General Analytical Method for evaluating the stresses, reactions, and deflections in an irregular piping system in space, has been recognized as an important contribution to piping design. The demands of the war years were only a forerunner of the technological progress during the post-war decade which has resulted in a new concept of the importance of sound piping design. To meet this rapid expansion safety codes and rules have been set up and committees have been organized to keep abreast of developments.

The objective of this second edition is to supplement present information with specific mechanical design approaches for entire piping systems as well as their individual components. To achieve this, it contains material on the strength and failure of materials, followed by a study of the capacity of piping to carry various prescribed loadings. It also includes more detailed treatment of local flexibility and stress intensification. The Kellogg General Analytical Method is extended to include all forms of loading and more sample calculations are given.

There are new chapters on expansion joints and on pipe supports that offer what is believed to be the first broad treatment of these items with regard to critical piping. The subject of vibration is discussed in the final chapter from the standpoint of the piping designer.

This book will assist engineers in evaluating piping stresses as well as in understanding the significance of stresses on piping performance, and will help to solve other piping design problems.

M. R.

BOOK NOTES

Prepared by the Library
The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

Analysis of structures. M. Smolira. London, Concrete publications, 1955 173 pp., diagrs., $4.00.

The deformation method of analysing statically-indeterminate structures is described in this book. Continuous frames with curved members and Vierendeel trusses both continuous and simply supported are treated in detail. There are sixty examples covering nearly all types of frame and loading, including the effects of changes of temperature and settlement of supports. A useful feature is the treatment of beams on a rectangular or diagonal grid, a subject on which little has been published in the English language.

Arithmetic for engineers, 5th ed. C. B. Clapham. Toronto, British Book Service, 1955. 540 pp., $3.60.

Because this new edition was produced by the photo-offset process, few changes and little new material have been incorporated in the text. However, an addendum has been added at the end of the book which includes some new matter and more difficult exercises.

Both the theory of mathematics and its practical applications in engineering are contained in the eleven chapters which cover fractions, symbols, equations, logarithms, mensuration, graphs, the slide rule, and trigonometry.

Automatic process control for chemical engineers. N. H. Ceaglske. New York, Wiley, 1956. 228 pp., diagrs., $8.75.

Intended as a text for undergraduate chemical engineering students, this book presents the basic mathematical principles of process control and their application in an elementary form.

The various types of control system are described, and two chapters cover the derivation of all equations needed in the analysis of control systems, and the integration of first and second order equations. Also considered are the transient analysis and the frequency response of control systems. The final chapter shows the application of the procedures to the analysis and design of completely automatic process control systems.

Catalysts, special compounds and chemical-resistant materials. E. Molloy, ed. Toronto, British Book Service, 1955. 222 pp., illus., $3.60.

Written by specialists, this book provides an up-to-date survey of the main catalytic agents and of the special compounds which are now used in many chemical processes.

The first section includes a chapter on the platinum metals as catalysts, activated carbon and its applications, and catalytic gas purifiers.

The special compounds cover ion exchange resins, non-ionic compounds, the silicofluorides, the benzoates, ethylene glycol, dichlorodiethylether and dicyandiamide.

The concluding section discusses corrosion-resistant metals, ceramics, cements, plastics and glass.

Concrete and constructional engineering, 50th anniversary number: January 1956, v. 51, No. 1. London, Concrete publications, 1956. 258 pp., illus., 15/-.

Representatives of eighteen European nations and of the United States have combined to present a comprehensive account of new developments in reinforced and prestressed concrete in the most important concrete-using countries of the world. Included are descriptions of the use of high-strength steel, the economical use of materials, new methods of design, construction, and prefabrication. Historical notes are also given.

Control of nuclear reactors and power plants. M. A. Schultz. Toronto, McGraw-Hill, 1955. 313 pp., diagrs., $7.50 (U.S.).

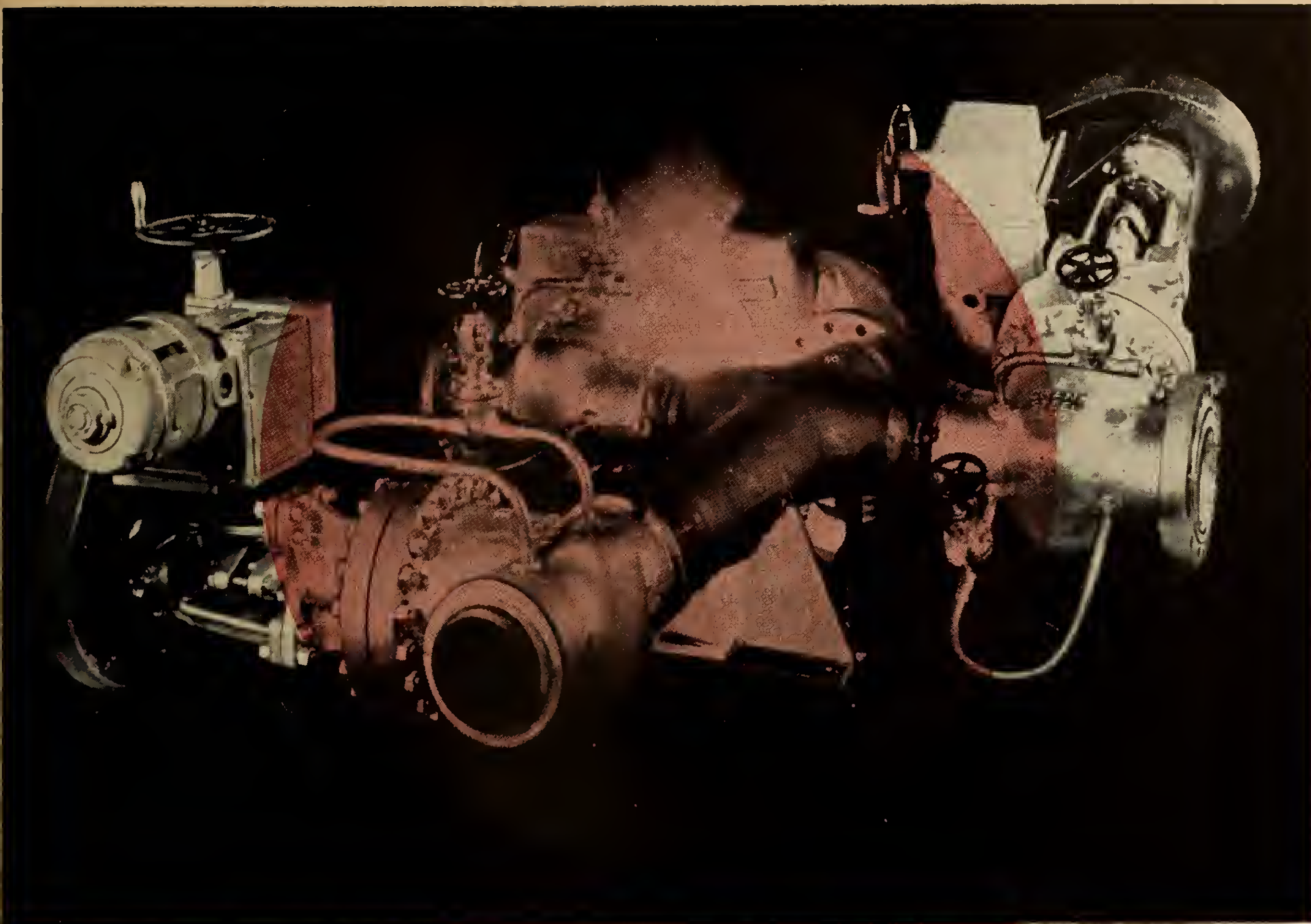
The currently available information on reactor and power plant control is here presented for the first time, treated from the viewpoint of servo engineering. The solid-fuel heterogeneous reactor is used for descriptive and illustrative purposes.

The book begins with a discussion of the interrelationship of the physics, servo engineering, and thermodynamic requirements of a nuclear control system, then develops elementary control concepts and definitions. The responses of nuclear reactors are described in engineering terminology.

Special attention is given to operating control problems during startup, power level operation, and shutdown. The author discusses many phenomena which have not been covered elsewhere.

***Design of a modern highway bridge.** Odd Albert. Brooklyn, Polytechnic Institute. Dept. of Civil Engineering, 1955. 103 pp., pa. $1.50 (U.S.).

The design method utilized in this pamphlet takes into account the fatigue strength properties of structural members as well as the static strength properties, and therefore opens with a paper on "the effect from frequency of heavy vehicles". Following sample stress and moment problems, the author presents the complete design of a typical continuous span highway bridge in its original form.



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• Library Notes

Diesel engine manual, 3rd ed. E. Molloy, ed. Toronto, British Book Service, 1955. 224 pp., illus., $3.00.

This is a practical manual on the installation, maintenance and operation of stationary, marine, and automobile diesel engines of the two- and four-stroke class. There are also detailed descriptions of fuel-injection equipment, governors and starting gear, testing methods for I.H.P. and B.H.P., and exhaust gas analysis tests.

Since the second edition, published in 1953, new material has been added on the Wilson & Kyle fuel injection system and the Simms GP pneumatic governor.

***Distillation in practice.** C. H. Nielsen, ed. New York, Reinhold, 1956. 133 pp., diagrs., $3.00 (U.S.).

This small book is made up of six papers delivered by a group of experienced engineers to an audience of young engineers. Basic, practical information is given on tower design, physical design of plate columns, techniques in petroleum fractionation, control systems, the operation of distillation equipment, and commercial aspects of vacuum distillation. This is the second volume in an "Experience in Industry" symposium series.

***Electronic transformers and circuits,** 2nd ed. Reuben Lee. New York, Wiley, 1955. 360 pp., $7.50.

The design of transformers and the effects of their characteristics on circuits are dealt with using a minimum of mathematics and stressing physical concepts. As in the previous edition, the arrangement of material is for the most part by general types of apparatus with design data for a particular transformer presented in connection with the purpose for which it is intended. Some sections have been deleted from this edition, some sections have been expanded, and new chapters on magnetic amplifiers and pulse circuits have been added.

Encyclopédie technologique de l'industrie du caoutchouc, v. 3. G. Génin et B. Morisson, eds. Montreal, Fomac, 1956. 614 pp., illus., $21.60.

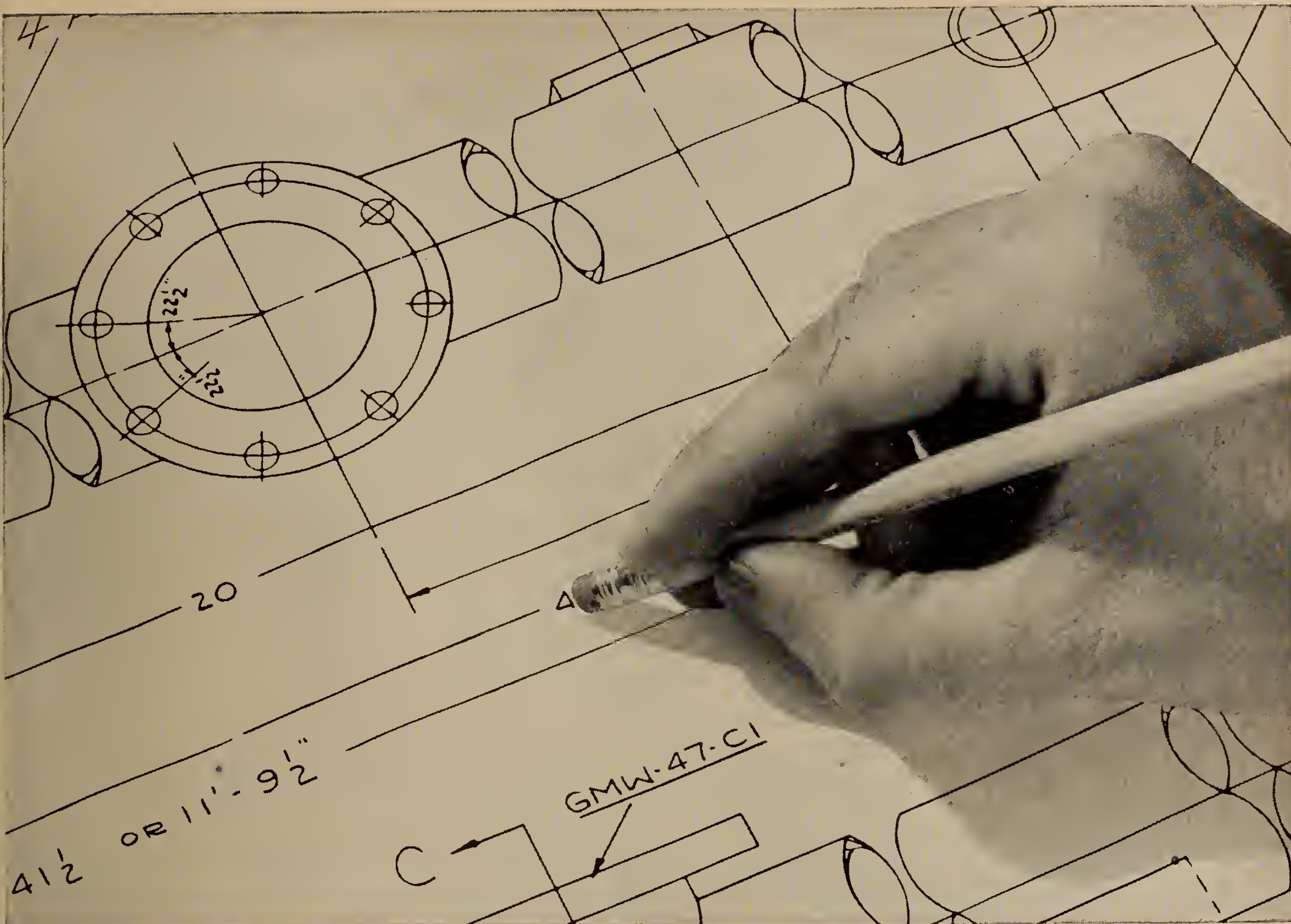
While this work will eventually consist of four volumes, dealing with all aspects of the rubber industry, the first two are still in the course of preparation. The third volume describes rubber technology and the various uses of the material.

Among the chapters in the first section are those covering the use of driving belts in the industry, rubber tube, molded and ready-made articles, the treatment of metals with rubber, rubber cylinders, cellular and sponge rubber, and hard rubber.

There are many uses of rubber described in the second part of the book, including the manufacture of boots and shoes, rubbers, carpets, cables, tennis and golf balls, and erasers. The concluding three chapters are devoted to the value of rubber in civil, military and industrial protective equipment.

Engineering drawing and geometry. R. P. Hoelscher and C. H. Springer. New York, Wiley, 1956. Various pagings, illus., $8.00.

Since this text was prepared for engineers rather than draftsmen, the em-



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phasis is on the understanding of principles rather than on manual skills. Another objective is the development of visual perception in three dimensions and the stimulation of creative imagination.

The book is primarily for instructional use in university courses at the sophomore level. Each chapter contains problem sections while the necessary data for their solution is found in the Appendix. Uniform nomenclature and notation is a useful feature.

The first section contains chapters on lettering, in which both upper- and lower-case letters are presented, on geometric projections, sketching, orthographic projection and sectional views. The authors then go on to such subjects as shop terms and processes, intersections and developments, axonometric and oblique projection, perspective, and charts and diagrams. The last chapters treat various types of drawing: map, architectural, structural, pipe, machine, tool, welding and patent office.

Flood estimation and control, 3rd ed. rev. B. D. Richards. Toronto, British Book Service, 1955. 187 pp., diagrs., $6.00.

The author considers flood estimation and control in this book from a theoretical point of view, beginning with factors affecting the intensity, duration and discharge of floods. He then goes into the subjects of flood formulas and rainfall, the progress of floods, and coefficients for their estimation, regulating reservoirs and storage basins as systems of flood control, and floods in relation to soil erosion.

In this new edition the "unit hydrograph" method of flood estimation is more fully treated, and the disastrous flood at Lynmouth is reviewed.

Fluidization. D. F. Othmer, ed. New York, Reinhold, 1956. 231 pp., diagrs., $7.00 (U.S.).

In this book, fluidization is taken to mean the maintenance of fine solid particles suspended by a vertically rising column of gas.

The work is based on a symposium sponsored by the Polytechnic Institute of Brooklyn and the American Institute of Chemical Engineers, and has for its purpose a description of fluidization as practised in many modern processes. The first chapters consider the interrelation of hydromechanics, heat transfer and mass transfer, and the background, history and possible applications of fluidization. The remaining chapters, written by engineers, consider the engineering aspects of the design and operation of plants.

***The frost penetration problem in highway engineering.** A. R. Jumikis. New Brunswick, N.J., Rutgers University Press, 1955. 162 p., $5.00 (U.S.).

The main part of this book deals with the application of the following methods and theories to the analytical treatment of frost penetration in soil materials for highways and airports: the steady-state flow of heat; the unsteady-state flow of heat, F. Neumann's theory; J. Stefan's theory; and the suction force theory. Brief introductory chapters discuss the structural parts of highways, factors

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causing damage, and the national importance of the frost problem. The concluding chapters cover remedial measures, factors to be studied in frost action research, and some of the better known frost criteria.

*__Hydraulic and pneumatic operation of machines.__ H. C. Town. New York, Philosophical Library, 1956. 192 p., illus., $7.50 (U.S.).

The first part of this book provides practical information on pumps, valves, circuits, and rotary drive; hydraulic machine tool operation; and hydraulic presses. Also dealt with in this part are general features of the design of cylinders, pipe lines, and protection devices; hydrokinetic automobile transmission; automotive controls; and hydraulic accumulators. The second part of the book covers air compressors; pneumatic tools; the design of pneumatic circuits; hydro-pneumatic operation; and applications of air control to jigs and fixtures, brakes, clutches, conveyors, and aircraft components.

International association for bridge and structural engineering. Publications. v. 15. Zurich, Leemann, 1955. 275 pp., diagrs.

The sixteen papers in this latest volume of the Publications, five in French and eleven in English, are written by specialists from all parts of the world.

While there is not space to list all of these important papers, they deal with such subjects as measuring damping and frequencies of high modes of vibration of beams, matrix-analysis of successive moment-distribution, analysis of suspension bridges by the minimum energy principle, stresses in non-uniformly supported cylindrical tanks, thin walled box beams under pure bending, and the design diagram of composite beams.

*__Knife-edge bearings.__ P. J. Geary. Chislehurst, Kent, British scientific instrument research association, 1955. 61 p., 10/6. (Bibliographic survey of instrument parts, No. 2.)

A bibliography of 166 references with a 29-page technical introduction dealing with the different aspects of the subject covered by the literature cited: materials, contact surfaces, friction, mounting, compound bearings, etc. In the bibliography, presented in three parts, principal texts are given relatively full abstracts, secondary references are briefly annotated, and supplementary references are listed without comment.

Law and the engineer. C. F. Mayson. Toronto, British Book Service, 1955. 470 pp., $10.75.

This new book on those aspects of English law which concern the engineering profession was written especially for mechanical and electrical engineers, and for the advanced engineering student. The author deals with civil law and presents basic principles combined with some practical application.

There are chapters covering the law of contract in most of its aspects, the law regarding negligence and nuicance, the law relating to employment, and safety rules. Patent and trade mark law are omitted.

Since the book is largely concerned with principles, Canadian engineers interesting in legal questions should find it useful.

The machinist dictionary. F. H. Colvin. New York, Simmons-Boardman, 1956. 496 pp., illus., $7.50 (U.S.).

Those engineers who design machine parts, operations men, purchasing agents, and many others, will welcome a dictionary which attempts to bring some order out of the confusion in machinery terminology. Arranged in a convenient form, this volume gives the reader information on present and past terms and on the many standards which have been adopted in the United States. Cross-references are included to assist in finding both the old and new terms. Some of the definitions are brief, while others contain detailed data.

Tables, charts, lists and illustrations are used to clarify and extend the information in the text.

Modern petrol engines, 2nd ed. rev. A. W. Judge. Toronto, British Book Service, 1955. 564 pp., illus., $9.65.

Since the appearance of the first edition in 1946 there have been many advances in engine design and performance and these have been noted in this new edition. New chapters are devoted to detonation research, combustion chamber design and alternative fuels for petrol engines, including those for high output and racing engines. Selected examples of engine types in the last chapter indicate the progress made in recent years.

Among the important chapters in the book are those describing the thermodynamics of the gasoline engine, maximum output and supercharging, cooling

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of engines, carburation and fuel injection, ignition, lubrication, and combustion chamber design.

The National Research Council Review, 1955. Ottawa, Committee of the Privy council on scientific and industrial research, 1955. 268 pp., illus.

The work of the National Research Council during 1954 is here reviewed, with some later work included. There are reports of the service units, the science laboratories, of the engineering laboratories, and of the committees associated with NRC.

Many of the important advances in Canadian science and engineering are contained in this review.

Paint and varnish manufacture. H. W. Chatfield, ed. Toronto, British Book Service, 1955. 440 pp., $6.00.

A large number of experts in the British paint industry joined forces to produce this practical guide to the background and modern developments of this branch of technology.

The first part of the book deals with the properties of raw materials used in manufacturing paints and varnishes. Among these are vegetable and fish oils, synthetic resins, natural resins, metallic soaps, cellulose derivatives, emulsifying agents, and pigments and extenders.

In the second section the use of these materials in producing finished products is described under the headings of Decorative products and Industrial finishes. The latter part includes information on car and furniture finishes, marine paints, insulating varnishes, special novelty finishes, and paper finishes.

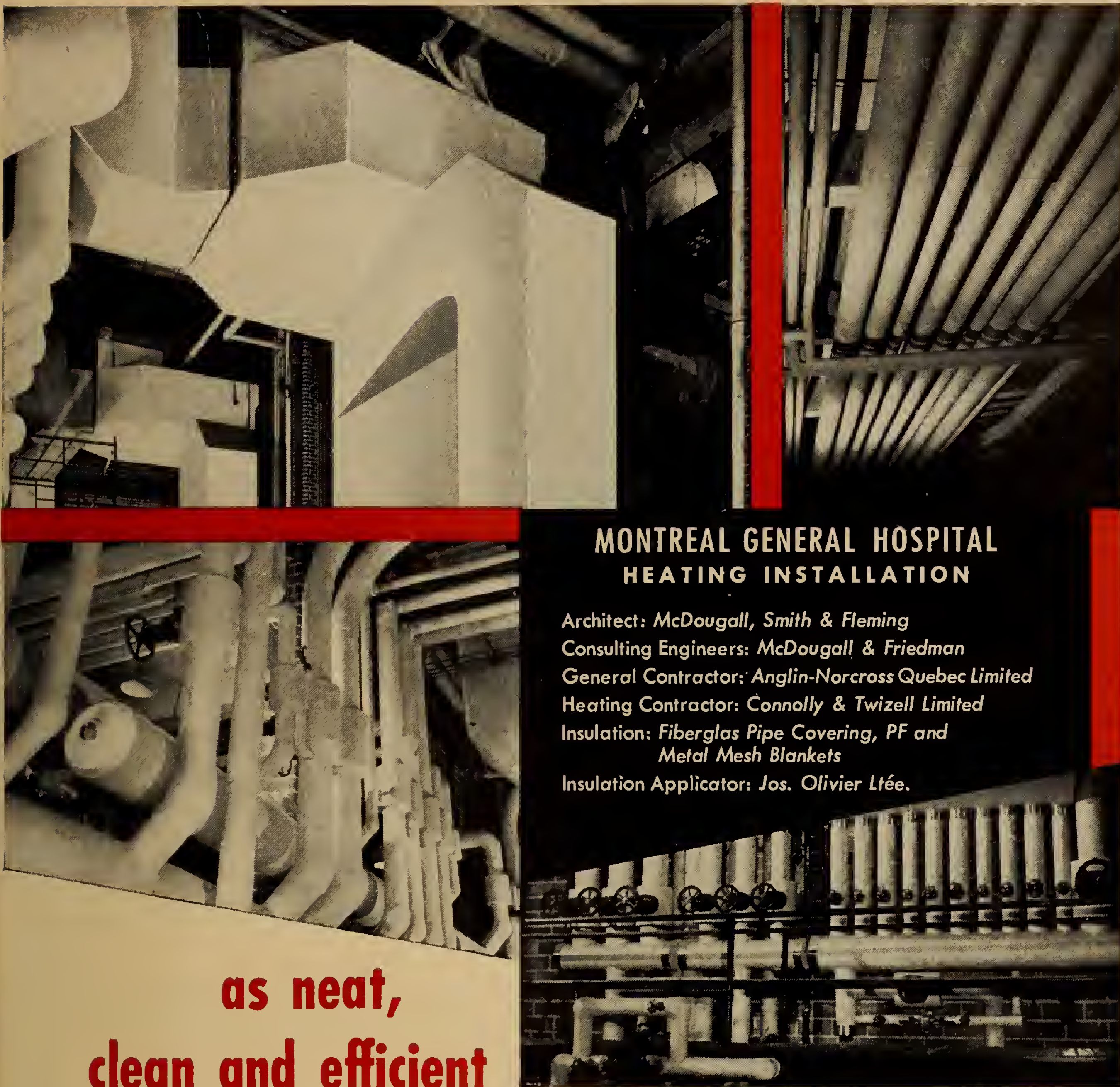
The physical properties of solid materials, 2nd ed. I. F. Morrison and G. Ford. Edmonton, University of Alberta, 1955. 192 pp., illus., $2.25.

The first edition of this book, which is used at the University of Alberta in courses on strength of materials and materials of construction, was published in 1937. While little new material is found in the new edition there has been a rearrangement of chapters which may help in a clearer understanding of the subject.

The purpose of the book is to link up the theories of Strength of materials with the practical aspects of the manufacture and properties of engineering materials. To do this, the authors have included chapters on tension, compression and shearing tests, toughness, hardness, and fatigue, stress-concentration and fracture, and the physics of materials.

Plastics progress, 1955. Phillip Morgan, ed. London, Iliffe, Toronto, British Book Service, 1956. 432 pp., illus., 50/-.

Based on papers given at the British Plastics Convention in 1955, this edition covers polymer structure and properties; expanded plastics; thermoplastics; extrusion; work study and productivity; injection moulding; patents; foundry resins and glass reinforced plastics. Some of the papers were based on original investigations and the whole book describes the more important developments in this rapidly expanding field.



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Power system plant. E. O. Taylor, ed. Toronto, British Book Service, 1955. 307 pp., illus., $5.10.

The material in this book was originally presented in lectures given at the Heriot-Watt College, Edinburgh, and its aim is to give the power system engineer a comprehensive knowledge of developments in all aspects of the subject.

Each chapter has been written by a specialist and many topics are discussed: synchronous machines of the non-salient and salient-pole type; transformers, reactors and voltage regulators; switchgear principles and practice; underground cables; and overhead lines.

Production control manual. J. A. Parton and C. P. Steres. New York, Chilton, 1955. 454 pp., diagrs., $6.00 (U.S.).

This manual presents the principles of production control, and their practical application. Much of the information given is based on experience, that of the authors' and of many companies.

The book is divided into three main sections, the first of which discusses the history, basic concepts and definitions of production control functions. The next six chapters consider functions which influence production control: engineering, tool manufacturing, methods, purchasing and quality control. The final seven chapters present the functions of production control: forecasting, scheduling, material control, stores control and dispatching.

There are many tables and diagrams, making this a valuable quick reference tool as well as a guide to the subject.

Spheroidal wave functions. J. A. Stratton and others. New York, Wiley, and Technology Press, M.I.T., 1956. 613 pp., $12.50.

This volume of tables is very important for several reasons. It provides a means for the electrical engineer and physicist to handle wave problems in spheroidal coordinates as easily as was previously posible for rectangular, circular, cylindrical and spherical coordinates. It also makes certain calculations in applied physics, acoustics, and radar more practicable. To make these complex tables more reliable than ever before, all the numbers were determined by the electronic digital computer Whirlwind I at the Massachutetts Institute of Technology, and the tables were computed, tabulated and printed automatically.

The book covers spheroidal wave functions appropriate for prolate or oblate spheroidal boundaries. Standard forms of their solutions are defined and a collection of formulas giving the important mathematical properties of these functions is included. There is also a set of tables from which values of the solutions can be obtained for the more interesting ranges of the variables.

Steels for the user, 3rd ed. R. T. Rolfe. New York, Philosophical Library, 1956. 399 pp., illus., $10.00 (U.S.).

Considerably revised since the publication of the second edition in 1941, this practical book considers carbon steels and their uses, mentioning alloy steels only in connections where carbon steels are unsuitable. Among the topics covered are bright and free-cutting steels, heat treatment of steels, casehardening, the use of steels at elevated temperatures and fatigue and weld testing.

Technique et utilisation des jauges de contrainte. U. Zelbstein. Montreal, Fomac, 1956. 255 pp., illus., $8.80.

This is a detailed treatment of strain gauges, beginning with their mechanical and electrical characteristics, and going on to their use in industry. A large section describes measuring methods with this type of gauge, including both static and dynamic measurements. The last section deals with the utilization of strain gauges in measuring the strain on turbo blades, measuring vibrations, etc., and with their use in determining physical and mechanical sizes and quantities.

Television: how it works, 2nd ed. J. R. Johnson. New York, Rider, 1956. 346 pp., diagrs., $4.60 (U.S.).

Intended for anyone concerned with television receivers, technician, student or hobbyist, this book explains in simple terms how they work. Among the

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topics covered are propagation, antennas, transmission lines, amplifiers, sound channels, synchronizing section, sweep circuits, the picture tube and power supplies. There is also a chapter on colour television. The book is illustrated with very clear diagrams.

***Temperature: its measurement and control in science and industry,** Volume II. Edited by H. C. Wolfe for the American Institute of Physics. New York, Reinhold, 1955. 467 pp., diagrs., $12.00 (U.S.).

The emphasis in the twenty-four papers contained in this volume is on the basic physics involved in temperature concepts and measurements. Included are discussions of temperature in very hot gases and in matter near absolute zero, standards and scales in use at present, the use of semiconductors and superconductors for measurement, and sound velocity as a measurement of gas temperature. Engineering aspects of the subject deal with standard and specialized methods of measurement, and with temperature measurement in steel making.

Les ventilateurs et leurs applications. D. Thin. Paris. Eyrolles, 1956. 152 pp., diagrs., fr. 1510.

In this book the author considers the actual use rather than the construction of ventilators. The approach is essentially practical, and there are sections describing the various types of ventilator for different uses, and maintenance and repair.

Last year the author published a similar book on pumps.

The world almanac and book of facts, 1956. Harry Hansen, ed. New York, New York World-Telegram and Sun, 1956. 806 pp., pa. $1.10 (U.S.).

Here again is a resume of world facts and events with their impact on the United States. New developments in relations with Russia highlight the 1956 edition but other major political events are covered as well. The almanac also reports on developments in the U.S., on scientific discoveries and on other fields too numerous to list.

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

Aeronautical research

The growth of aeronautical research in Canada during the post-war decade. J. J. Green. (11th British Commonwealth and Empire lecture.)

Automation

The automation handbook. (2nd International automation exposition.)

Bridges

Suspension bridges: the aerodynamic problem and its solution. D. B. Steinman.

Building construction

Course on better building. (Canada. NRC. Div. of building research. Technical paper No. 31) 75c.

Influence of roughness of base and ground-water conditions on the ultimate bearing capacity of foundations. G. G. Meyerhof. (Nova Scotia. Technical college. Tech. pa. No. 1.)

Proceedings of the conference on building research, October 21-23, 1953. (Canada. NRC. Div. of building research. Bulletin No. 1.) $3.50.

Electrical engineering

Bibliography and abstracts on electrical contacts, 1954 supplement. (A.S.T.M., S.T.P. No. 56-1.) $1.00 (U.S.).

Bridge for the measurement of the admittance of electrical insulation at very low frequencies. G. Mole and D. C. G. Smith. (E.R.A. report V/T116.) 12s 6d.

Corrosion of internal tank surfaces in non-conservator transformers. M. Waters. (E.R.A. report Q/T130.) 10s.

The effect of dipoles on electric strength. H. Pelzer. (E.R.A. report L/T320.) 7s 6d.

The effects of dissolved gases in the design and operation of oil immersed transformers. M. R. Dickson. (E.R.A. report Q/T139.) 18s.

Improvement of line regulation by series capacitor. S. Silbermann. (E.R.A. report Q/T128.) 12s.

Station protection by a length of cable. R. Davis. (E.R.A. report S/T62.) 15s.

Electronics

A-M detectors. Alexander Schure, ed. (Rider review series No. 166-5.) $1.25 (U.S.).

Limiters and clippers. Alexander Schure, ed. (Rider review series No. 166-6.) $1.25 (U.S.).

Machlett Laboratories. (Cathode press memorial issue.)

Engineering research

Co-operation in engineering research between educational institutions and industry. (I.Mech.E. Proceedings. v. 169, No. 27, 1955.)

Review of current research and directory of member institutions, 1955. (American society for engineering education. Engineering college research council.) $2.00 (U.S.).

Engineers. Training.

Detroit industry engineering training program. H. P. Seelye, ed. (Engineers council for professional development.) $1.00 (U.S.).

Training programs of industry for graduate engineers. M. J. Kelly. (Bell telephone system. Technical publications. Monograph 2512.)

Highway systems

Functional report on proposed Don Valley parkway to the Municipality of Metropolitan Toronto. Foundation of Canada engineering corp. and F. R. Harris of Canada.

Metallurgy

The application of electricity in primary non-ferrous metal industries in Canada. (Canadian electrical association. Committee of the industrial power section, Eastern zone. Report)

Elevated-temperature properties of carbon steels. W. F. Simmons and H. C. Cross. (A.S.T.M. S.T.P. No. 180.) $3.75 (U.S.).

Miscellaneous

Bibliographical abstracts on evaluation of brightening agents for detergent use. L. E. Weeks. (A.S.T.M. S.T.P. No. 177.) $1.50 (U.S)

Effects of velocity and temperature of discharge on the shape of smoke

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plumes from a funnel or chimney: experiments in a wind tunnel. L. W. Bryant and C. F. Cowdrey. (I.Mech.E. Proceedings. v. 169, No. 23, 1955.)

Philosophical writings of Peirce. Justus Buchler, ed. New York, Dover, 1955. $1.95 (U.S.).

Procedure for payment: construction claims. Defence construction (1951).

Transactions of the fifth annual conference on sanitary engineering. (Kansas. University. Bulletin of engineering and architecture No. 34.)

Stresses

Proceedings of the Society for experimental stress analysis, v. 13, No. 1, 1955.

Television

TV repair questions and answers: deflection and H-V circuits. Sidney Platt. (Rider publication No. 173-4.) $2.10 (U.S.).

STANDARD REVIEWED

British standards, British standards institution, 2 Park Street, London, W.1. British standards are available from the Canadian standards association, National research building, Ottawa, Canada.

B.S. 11: Part 1: 1955 — Flat bottom railway rails. 4/-.

Part 1 of this revised standard specifies quality of material, chemical composition and mechanical properties and includes requirements for lengths and for the condition of the finished rails, etc. It differs from the previous edition in a number of respects, the main changes being the deletion of grades other than the so-called 'medium manganese' grade and the inclusion of dimensional tolerances.

B.S. 24: Part 3B: 1955 — Helical and volute springs and spring steels — Railway rolling stock material. 4/.

The standard specifies the following:

1. Hot rolled spring steel bars for helical and volute springs.
2. Helical and volute springs made from the above material.
3. Steel helical springs cold coiled from a drawn material.
4. Ground spring bars for helical springs.
5. Helical springs made from round section ground steel bars.

Also covered are the chemical composition of the steels, the quality of the material, and the tolerances to which these springs are to be made. The Appendix contains the recommended method for calculating the total number of coils for helical compression springs.

B.S. 1490: 1955 — Aluminium and aluminium alloy ingots and castings for engineering purposes. 10 -.

This is a revision of the 1949 standard, and introduces four new alloys. Alloys L.M.17 and L.M.19, which were in the original edition, have been omitted.

Some of the alloys have been included in conditions not previously covered. A number of amendments have been made to the chemical compositions and mechanical properties of the other alloys.

ENGINEERING CAREERS

The Canadian Railways

THE RAILWAYS OF Canada are among the largest employers of industrial manpower, and the wide scale of their operations offers many opportunities for members of different branches of the engineering profession.

The undergraduate engineer is encouraged to learn the fundamentals of railway practice by taking advantage of the summer employment that is available, and which can show him the possibilities that exist in a railroading career.

To the graduate engineer there are many varied fields in which to apply his knowledge and to increase it through the training courses provided and through practical experience. As the country and the industry grow, so do the opportunities for advancement increase, and the engineer with the railways may progress through supervisory and administrative posts to the upper levels of management.

The fields open to the engineer may be covered in broad outline by considering the operations involved in running a railroad. Track has to be laid and maintained, bridges and buildings constructed, rolling stock must be operated and kept in operating condition, signalling systems installed and maintained, communications developed, power and other services provided, and research and development work carried out continuously to keep abreast of technical advances and operating progress.

Though the departments responsible for these operations may differ in detail (for example, in scope and nomenclature) between the different railway companies, the operations are the same in general and will be considered under the general headings that follow.

In general, the graduate engineer will be given practical training and field experience in one or more of these departments or divisions when he joins the organization, to familiarize him with different aspects of the work, before proceeding on the course of progress to which he is best suited.

RAILROAD ENGINEERING

Under this general heading are considered the design, construction, and maintenance of roadbed and the structures that accompany the system. The latter include station and warehouse buildings, bridges, wharves, culverts, and aqueducts. This field is largely that of the civil engineer, who can gain experience in design of structures, soil mechanics, basic instrument work, and construction in a variety of materials (steel, concrete, timber, etc.).

Signals

A particular, and highly important aspect of railroad engineering is signalling. This is mainly the province of the electrical engineer, who deals with design, installation, and maintenance of signalling systems to control train movements, and also such items as level crossing gates and warning signals at intersections of railway and highway.

Operation

As part of his basic training the engineer is also made familiar with the routine of train operation, a knowledge of which is necessary when planning work to be carried out without disrupting schedules.

The engineer may remain in one of the departments just discussed and proceed to senior positions in any of the fields, such as bridge or building construction, or signals.

MECHANICAL ENGINEERING

Mainly of concern to the mechanical and electrical engineer are the departments that deal with the maintenance, repair, and servicing of locomotives and rolling stock.

Though rolling stock is mostly purchased from outside manufacturers, the task of maintenance involves the operation of shops equivalent to a major manufacturing organization; also the railways have much to contribute to the design of the material to meet the exacting and very varied conditions of operation encountered across a continent the size of Canada, with its extremes of climate and topography.

Though the steam locomotive is eventually to be superseded, there is still much stock to be serviced, and new designs are constantly being developed for its diesel counterpart. The gas turbine is already making some progress in other parts of the world, and could well be another responsibility of the railway engineer.

Passenger and freight cars have also to be designed and maintained to meet modern service requirements. Air conditioning, heating, refrigeration, and lighting are among the services that have to be developed and installed.

Apart from the rolling stock itself, there is much static equipment to engage the mechanical and electrical engineer, including shop

The electrical engineer may deal with the design, installation, and maintenance of signalling systems.
(Photo: Canadian National Railways)

design, machinery and machine tools, and electrical and steam power plants. Standards and methods engineers may be engaged in promoting the efficiency of maintenance operations and the control of materials.

COMMUNICATIONS

The successful operation of an extended organization such as a railroad is particularly dependent on rapid communication and the transfer of essential information. The communications department of a railway may thus be likened to its nerve centre.

As is well known, the major Canadian railway companies operate public telegraph services and commercial communications services, but there is also a vast network of communications essential to the operation of the railways themselves.

The engineer has responsibilities in the planning and design of telephone, telegraph, and teletype circuits, and radio systems, together with maintenance of these facilities.

Particular examples include the maintenance of standards connected with open wire lines; cable loading, balancing and testing, and installation of gas pressure systems; planning and testing radio systems, including developing estimates, making initial layouts, and carrying out acceptance tests.

Standards are set for the field layout and installation of communications equipment. Standard inter-connection drawings and specifications are prepared for the guidance of plant forces installing equipment for multi-channel carrier telephone and telegraph, teletype switching, program broadcasting, train dispatching circuits, and micro-wave. Reports are also made on standard specifications proposed by the Canadian and American standards associations.

RESEARCH AND DEVELOPMENT

The civil, mechanical, electrical, and metallurgical engineer may find suitable opportunity in the fields of research and development. Research may be into purely technological problems or into the economic aspects of particular situations, usually with the aim of improving operating efficiency.

Examples of the type of problem tackled include the economic effects of converting from steam to diesel locomotives, improved methods of handling perishable freight, and development of new types of air-conditioning equipment for passenger cars.

Development concerns the expansion of existing facilities and the study of new areas of potential economic expansion and activity. Reports and surveys are made to investigate how best any such expansion or development can be served by railway facilities. The establishment of new industry is one aspect of this work; and another, the opening up of new and often hitherto inaccessible areas of great mineral wealth, has assumed great importance in recent years and will continue to be to the fore as Canada's natural resources are developed.

On the technical side, the engineer has to develop specifications and standards for materials used in the railway's wide operations. Inspection staff ensures that purchases comply with specification.

Materials testing and the development of new materials is also carried out in chemical, metallurgical, textile, spectrographic and physical testing laboratories.

One aspect that may concern the engineer is the construction of all types of switch yards and improvement of existing facilities. *(Photo: Canadian Pacific Railway)*

OTHER DEPARTMENTS

There are many other departments of a railway in which the engineer might find potential for applying his particular bent. These include finance, statistics, economics, and marketing.

Electronics

In common with many major industries, the railways are making ever wider use of electronics in fields other than communications. Electronic business machines are coming into general use for accounting, recording, computing, and so on, and the electronic engineer will be required to install and maintain such equipment.

SALARY AND BENEFITS

The salary scales for the graduate engineer in the railways compare favourably with those prevailing in other branches of industry, having regard to the different levels that apply in different geographical and economic zones. Salary increases are generally on a merit basis.

Benefits are also comparable with those in industry in general. They include pension schemes and health insurance.

TRAINING

As has been outlined before, training is available to the undergraduate in the form of summer employment, when he can learn different aspects of the work. The graduate joining a railway company is given a period of training with practical experience in all the departments necessary to his useful development and future progress. That progress, as stated earlier, can lead to supervisory, administrative, and management levels.

The St. Lawrence Seaway

(*Continued from page 461*)

mit shippers to compete with Lake Superior ore, which paid no tolls of any kind.

Regional Authority Needed For Montreal

Addressing the Montreal Branch, Engineering Institute of Canada, George S. Mooney, director, Montreal's Municipal Seaway Bureau, and C. E. Campeau, director of the Montreal City Planning Department, called for a regional planning and development authority.

Mr. Mooney stated the seaway and its related problems had brought the need for economic and physical planning in the city dramatically to a head. "There is need for close cooperation among and between the basic utilities which will be called upon to provide and extend their services to this area: railways, power utilities, water and sewerage services and the like," he said.

There is need, too, for soil surveys and conservation plans, both with respect to the forested areas in the Vercheres region and with respect to water supply throughout the area. Natural resources must be carefully appraised and plans made for their orderly control and use."

Mr. Campeau urged that the functional development of land and facilities be undertaken according to an integral master plan covering the whole region, from Sorel to Valleyfield, and from Pont Viau to St. Jean. A belt parkway would be indispensable to the south shore, with riverfront parks to serve the whole metropolitan region and protect well established communities. If the opportunity were lost it might never come again because natural beauties and amenities would have been destroyed.

Seaway Will Benefit Inland Cities and Towns

Seaway Authority President Chevrier, speaking at London, Ont., in March, forecast that the co-ordinated use of highway, railroad and water transport methods can have the effect of "putting inland cities and towns on the water's edge."

Stressing that the seaway will be of major importance for the carriage of bulk traffic, he pointed out it would also give freer play to the specialized advantages of water transport, and that on general mer-

(*Continued on page 600*)

The St. Lawrence Seaway

(Continued from page 599)

chandise traffic he felt a specialized traffic pattern would emerge.

He looked to a variety of new services springing up, including coordination of different types of carriers and improvements in existing services. "Benefit thus will be extended far beyond the immediate port areas," Mr. Chevrier believed. It was not to be supposed that the seaway would have the effect of drying up the flow of traffic on the existing land routes by rail or highway.

"With the coordination of the different means of transportation now moving out of the experimental state, we are undoubtedly on the verge of a new period of development in transport techniques, one with which completion of the seaway will coincide," Mr. Chevrier told his hearers, adding that "particular progress is being made in newer methods of handling, transferring, lifting, loading, where costs have been most burdensome."

"It is well to note that these costs can be particularly heavy to shippers located beyond the ports, such as in fact, the shippers of your own local industries, but the effect of the newer methods by eliminating extra handling between ship and shore, and between rail and truck will offer your industries a much wider range of transport services. It can have the effect, figuratively speaking, of putting inland cities and towns at the water's edge."

News of Other Societies

The Earthquake Engineering Research Institute is arranging a world conference on earthquake engineering at the University of California, Berkeley, June 12-16, 1956.

This conference marks the 50th anniversary of the San Francisco quake. Cooperating in the work are the American Society of Civil Engineers, the Structural Engineers Association of California, and the University of California.

Information can be obtained from the Department of Conferences and Special Activities, University of California, Berkeley 4.

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The Society of Naval Architects and Marine Engineers (74 Trinity Place, New York 6, N.Y.) will hold the annual meeting this year in Canada for the first time. It will be at the Sheraton-Mount Royal Hotel, Montreal, May 3 and 4, 1956.

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ALL THE POWER

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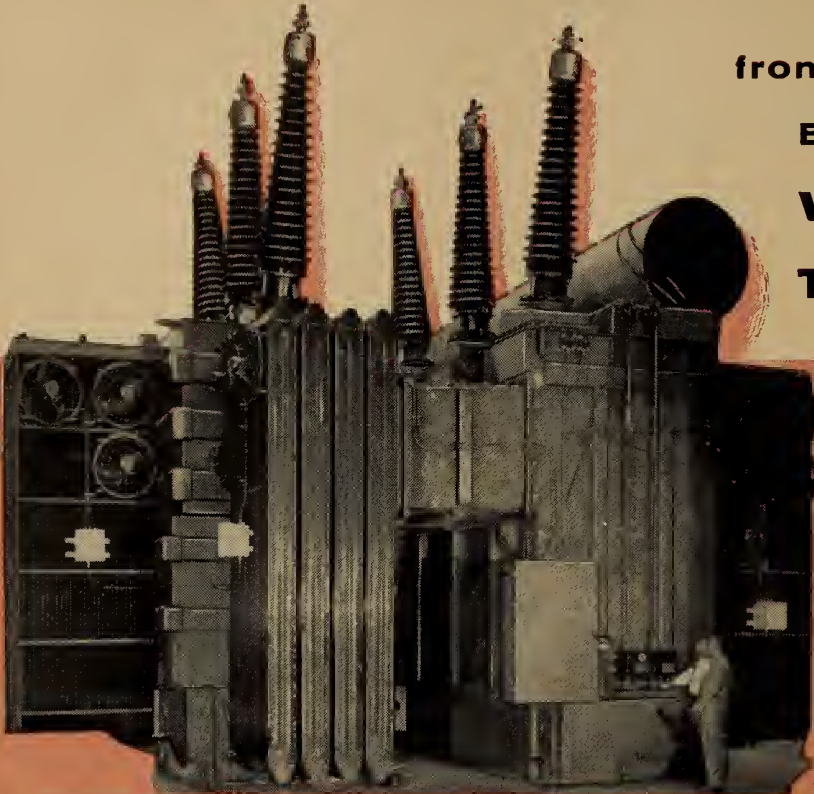
Bersimis system is
WESTINGHOUSE TRANSFORMED



Largest autotransformers with TCUL ever built in Canada, this is one of five supplied for the Bersimis system by Westinghouse.

Beneath the hills at right is the huge Bersimis generating station. Westinghouse transformers boost the voltage of the generated electric power for transmission over miles of countryside such as this.

The townsite of Labrieville.

One of the huge dams on the Bersimis system. These dams make possible a lake containing 350 billion cu. ft. of water.

From the underground generating station in Labrieville, townsite of Hydro-Québec's Bersimis River project and from the Lower Bersimis Generators will come 1,800,000 hp of electric energy. This power will travel over 400 miles of transmission lines to Quebec and Montreal.

Transformation of power on this system is accomplished by thirty-six Westinghouse power transformers, among them Canada's largest phase-shifting and autotransformers with TCUL* located at Charlesbourg and Bout de l'Ile to step down and shift voltage for the Shawinigan and Montreal systems.

Hydro-Québec has done a magnificent job. Westinghouse, a major supplier, congratulates the farsighted men who made Bersimis a reality.

Today, as in the past, it may be said of this, Canada's oldest land "Québec sont là!"

* TCUL Tap Changing Under Load.

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CANADIAN WESTINGHOUSE COMPANY LIMITED, HAMILTON

56 A 350

The Metal Bonding of Aircraft Assemblies

J. J. Waller,

Chief Materials and Process Engineer,
Canadair Limited.

In this paper is described the metal bonding process as we are using it in the manufacture of our CL-28 maritime reconnaissance airplane, starting with the basic decisions that had to be made, and following through to the time when we were in full production of bonded assemblies of specification quality. Although based on our experience with the application of metal bonding to a particular airplane, the principles and procedures involved would also apply to aircraft of other design, and could include the use of the process in other industries.

Metal bonding was found to be a necessity, rather than an alternative joining method, in the case considered here. Other advantages are also shown in this comprehensive description.

The CL-28 airplane, which is somewhat larger than the Douglas DC-7 and the Lockheed Super-G Constellation, will be used by the Royal Canadian Air Force for anti-submarine work over the coastal waters of Canada.

There are over 1500 metal bonded assemblies in the CL-28, many of which are of primary structural importance. They range in size from a few inches to those which are over thirty feet in length. Some of the problems we were faced with, because of this large range in sizes, will be described later in this paper.

Organizational Considerations

One of the first matters we had to consider when embarking upon this bonding program, was how to introduce into our production facilities, a process so radically different to anything we had used before. This was further complicated by the fact that we had a rather short-span engineering release and production schedule with which to contend. Co-ordinated decisions had to be made quickly and carried out effectively within our rather large organization. Until certain of these basic decisions had been made and we were well along in the experimental phase of production bonding, we considered that operating through our normal line organization would be too time-consuming, since there were so many other problems associated with the CL-28 program which had to be explored and settled.

Accordingly, it was decided to introduce bonding, as a production process, by means of a committee whose membership consisted of representatives of the various departments in our organization directly concerned with metal bonding. This committee, which was virtually autonomous, represented structures and design engineering, plant engineering, manufacturing engineering, the production department, quality control, and materials and process engineering. What this approach meant to us was that, within three weeks after the bonding department had been set up, we were able to produce bonded assemblies of specification quality. This elapsed time included that required for proving equipment and tools, as well as the training of production personnel who had had no previous experience in metal bonding.

Although we had done a certain amount of laboratory bonding of test specimens earlier, we soon learned that there is a large difference between laboratory and production procedures.

Selection of a Suitable Adhesive

We next had to decide upon the adhesive we should select for our use. There were several available in the United States and Canada, one of which was originally developed in the United Kingdom and which is being used there almost exclusively, with apparent success.

Amongst the adhesives available were those suitable for applications subject to the normal temperature range of −65°F. to +180°F., and those for the high temperature range of −65°F. to +500°F. Our requirements were for an adhesive suitable for use only in the normal temperature range. Also, at the time our decision had to be made, the high temperature adhesives available had not yet been adequately developed for practical use.

After visiting several airframe manufacturers in the United States and in the United Kingdom, all of whom were doing bonding under production condi-

Read at the 70th Annual General and Professional Meeting of The Engineering Institute of Canada, Montreal, May, 1956.

tions, we consolidated their reactions to the particular adhesives they were using, and selected as the best for our purpose FM-47 tape system adhesive[1]. This is a −65°F. to +180°F., adhesive covered by specification MIL-A-8331.

In addition to several others, our principal reason for selecting a tape-type adhesive, was our contention that a better and more consistent quality bond could be obtained than with a powder-type or a liquid-type adhesive.

FM-47 is a two-component material, consisting of a primer and a tape. The primer is composed of a partially polymerized or cured phenolic resin to which has been added a quantity of a vinyl resin. The tape, about 0.015 in. thick, consists of a loosely-woven Fiberglas cloth impregnated with a material similar in composition to the primer but with a very much higher solids content. The function of the glass cloth is that of a support for the adhesive. The cloth contributes very little, if anything, to the strength of the cured adhesive.

The presence of the vinyl resin in the formulation is to increase the ductility (and the peel strength) of the cured adhesive. Cured phenolic resins, by themselves, are extremely brittle. However, the presence of the vinyl resin lowers the shear modulus of the adhesive from approximately 1.5 million p.s.i., to about 0.75 million p.s.i.

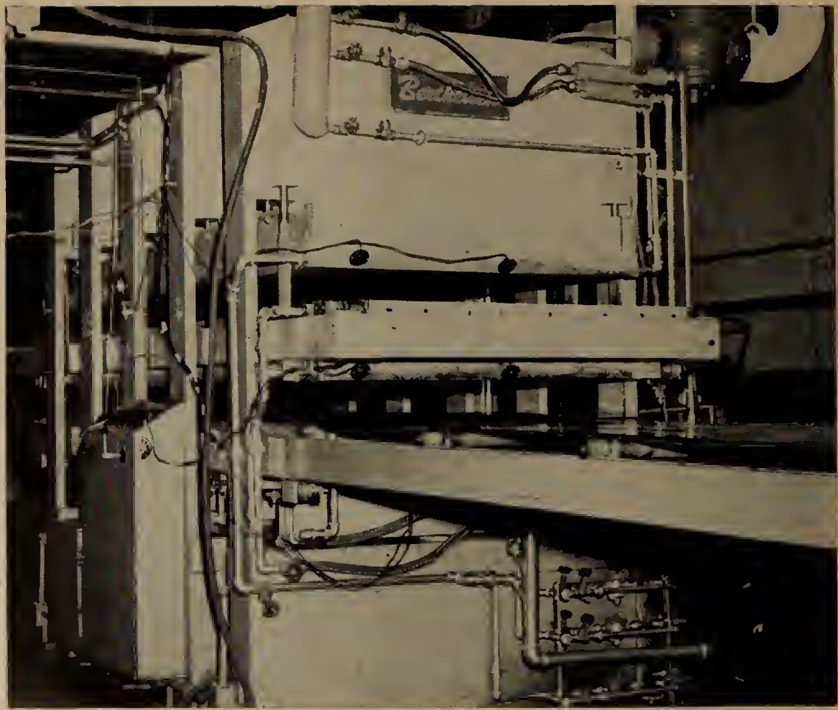


Fig. 1. General view of 5 ft. x 12 ft. platen press—two openings.

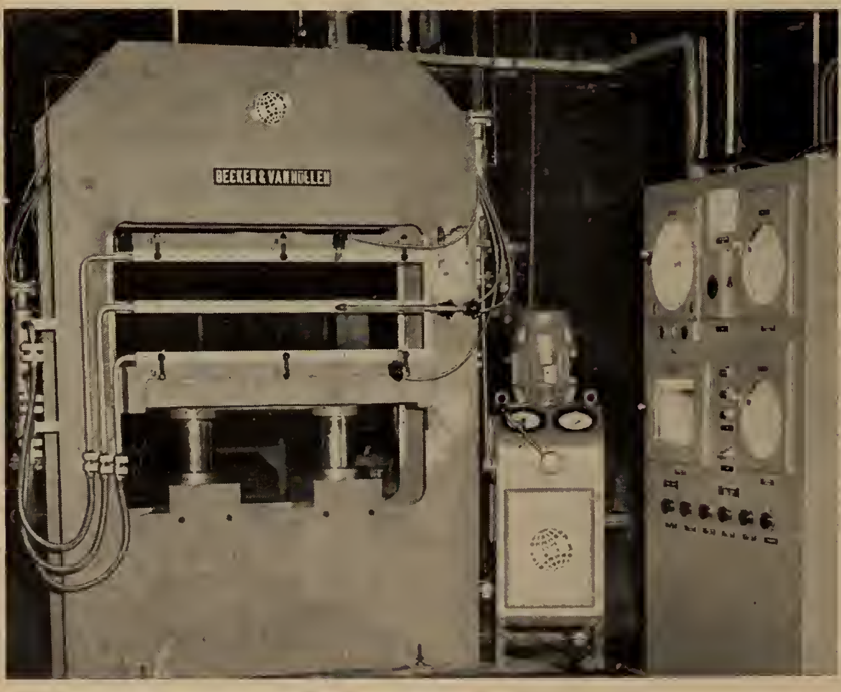
This adhesive, when properly used, will produce minimum shear strengths of 2500 pounds per square inch in aluminum alloy assemblies.

Selection of Equipment

The next phase of our program which had to be investigated was the selection of the equipment necessary for production bonding.

We had to plan for a rather limited rate of production and, since the assemblies to be bonded varied in size from those which are very small to those which are very large, we had to select equipment which would be versatile and at the same time require bonding tools which would be relatively inexpensive to make. We considered the "pants presser" type of tooling, the inflatable-diaphragm type and the integral pressure, and heating type, as well as many other similar types, to be uneconomical for our requirements.

Fig. 2. General view of 2 ft. x 4 ft. platen press—two openings.



Accordingly, one of the basic decisions we arrived at was that, in general, all flat parts would be bonded in platen presses, and all contoured parts in autoclaves. On this basis, most flat parts would not require any tooling whatsoever, while the tools required for autoclave bonding would be of the lightweight, inexpensive type made principally of sheet metal.

Two platen presses were purchased, each with two openings and platen sizes of 2 feet x 4 feet and 5 feet x 12 feet. The platens are heated by steam and cooled by water. Steam was selected in place of electrical resistance as the heating medium, because of the widespread reports we had received that the latter did not provide a fast heat-up time on an economical basis, nor did electricity provide as uniform a temperature distribution as did steam.

The pressure for platen press curing was selected at 200 pounds per square inch.

It was decided to purchase one autoclave only, having the working dimensions of 8 feet in diameter and 35 feet in length, so as to accommodate the largest part which had to be bonded. The maximum pressure for autoclave bonding was chosen to be 100 p.s.i., as higher pressures would involve a great deal of expense and time, and the safety hazards would be greatly increased.

Heat in the autoclave is obtained by means of a steam heat exchanger and a fan-type circulating system located inside the autoclave. Although some firms are believed to be still using wet-type autoclaves—that is, the live steam contacting the parts to be bonded—the trend for several years now has been toward dry units so as to obtain the desired flexibility of temperature and pressure. An arrangement is also provided to circulate cold water through the heat exchanger coils, for cooling the inside of the autoclave at the end of the curing cycle.

The curing temperature selected for both press and autoclave methods of bonding is 310±10°F. This selection was made so as to obtain the fastest curing time without tending to anneal or soften the aluminum alloy parts being bonded.

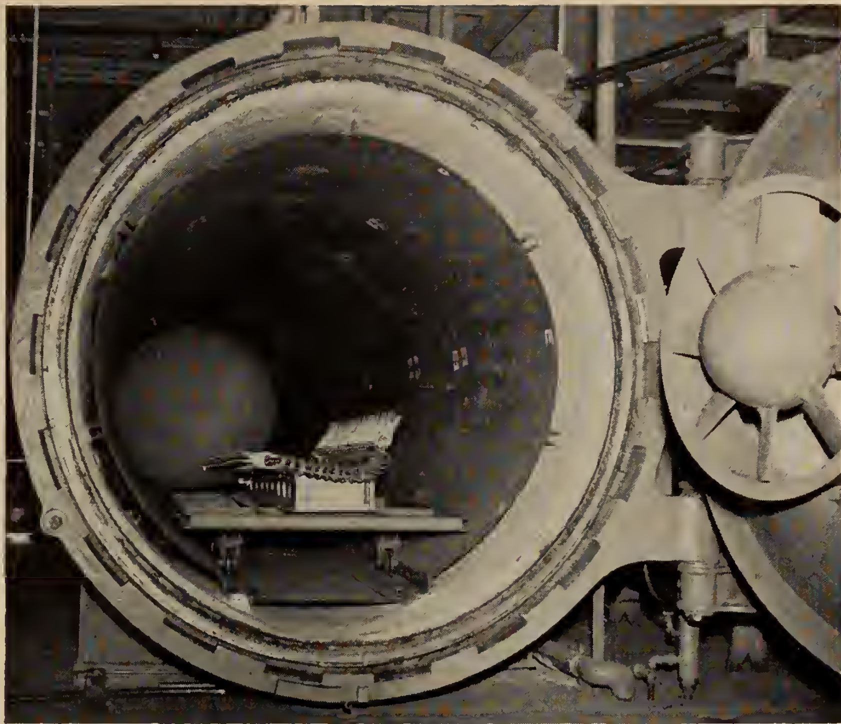


Fig. 3a. Autoclave door with air circulating fan and motor. Assembly in position ready for curing of the adhesive.

Bonding Tools

I would now like to describe briefly the general design of bonding tools selected.

As mentioned previously, our press bonding tools were held to a very small number, since when bonding a flat part to a flat part no tools are really necessary. For example, when bonding a flat spar web reinforcement to the web itself, the detail parts are placed between the platens of the press, separated on each side by a thin sheet of heat resistant rubber and a thin sheet of soft aluminum. We found the soft aluminum sheet to be necessary since, at a pressure of 200 pounds per square inch, the rubber flows, and the high friction developed between it and the parts being bonded creates a tendency for one of the parts being bonded to shift relative to the other—even when they are tack-rivetted together—the rivets being sheared.

The instances where tools are required for press bonding are for such items as corrugated assemblies, for example, where only certain areas of a detail part have to be bonded.

The tools which are used for autoclave bonding are made principally of aluminum sheet with the supporting structure made of thin aluminum plate. The sheet is contoured to the same shape as the assembly being bonded. This shape is supported by "ribs" fastened on to a base which, in turn, supports the whole bonding tool. Connections are provided for vacuum lines. I believe the simplicity of this type of tooling is self-evident.

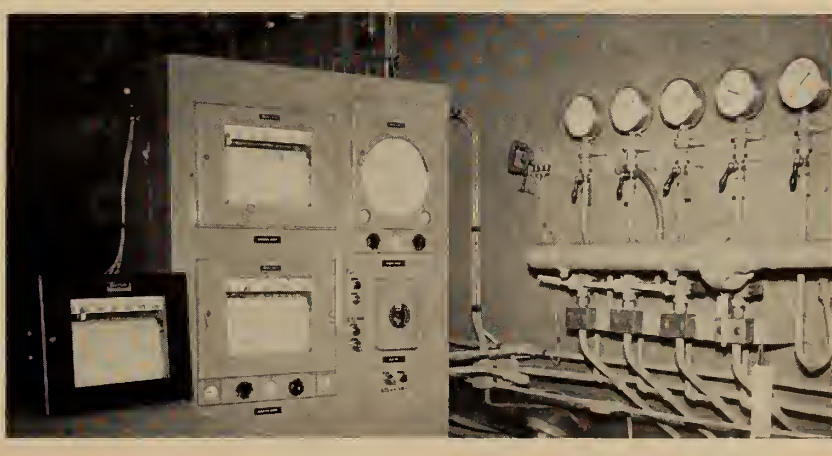
Bonding Pre-Treatment

I would now like to deal with the subject of the pre-treatment of aluminum alloy parts to be bonded, since this constitutes a very important phase of the process.

The first stage consists of removing the oil, grease and other soil from the surfaces to be bonded. This can be done in several ways using either or both vapour phase degreasing or alkaline solution degreasing methods. For reasons of economy and because it lends itself to "production line" methods, we selected the use of an alkaline solution. I will not go into the details of this phase of the pretreatment since it is a process in general use throughout the metal working industry.

The next stage of the process is the rinsing operation. We have found that the only way of ensur-

Fig. 3b. Autoclave instrumentation.



ing complete rinsing is by the use of spray rinse tanks instead of the ordinary immersion type. This consists of a conventional tank, adequately drained, with rows of spray nozzles running down the length and on each side of the tank.

Perhaps it should be emphasized at this point that cleanliness of the material to be bonded is of extreme importance throughout the whole process—more so, perhaps, than in any other process we are using.

The next stage in the pre-treatment is the etching of the aluminum, in a solution of sodium dichromate and sulphuric acid maintained at a temperature of 145°F. The time of immersion is 10 minutes.

Then follows a cold water spray rinse, in turn followed by blowing the parts dry with a jet of clean, dry compressed air. Strangely enough, the sodium dichromate-sulphuric acid solution is the only one found, so far, which will produce metal bonds with consistently high strength. It is strange, because this solution oxidizes and does not deoxidize the surface of the aluminum.

I would like, here, to discuss the theoretical aspects of the mechanism of metal bonding, since it is closely associated with the sodium dichromate-sulphuric acid etching of the material to be bonded.

Clad aluminum alloy sheet, when it is received from the mill and degreased, has a surface contact resistance in the range of 500 to 2500 microhms or perhaps even higher. A bond made on such a surface has low and inconsistent strength. Now, if this aluminum sheet is deoxidized in a reagent such as hydrofluosilicic acid, it will have a contact resistance in the range of zero to 10 microhms. A bond made with material so treated is also low and inconsistent in strength.

Then, again, when we treat this aluminum in a sodium dichromate and sulphuric acid solution and measure the contact resistance, we find the value to be in the range of approximately 500-700 microhms. Bonds made with material so treated have consistently high strengths. The question is "why"?

Firstly, of course, the sodium dichromate-sulphuric acid solution etches the surface of the aluminum and the microscopic "hills and valleys" so developed, not only increase appreciably the surface area of the material, but also develops a "keying" surface for the adhesive. However, this is generally considered to play only a minor role in the development of high strength bonds.

The oxide on the aluminum material as it is shipped to us by the mill is formed by natural or ordinary atmospheric exposure. It is a comparatively slow process. This oxide coating may be considered to be poorly adherent to the parent metal and non-uniform in properties and thickness. The oxide formed by the sodium dichromate-

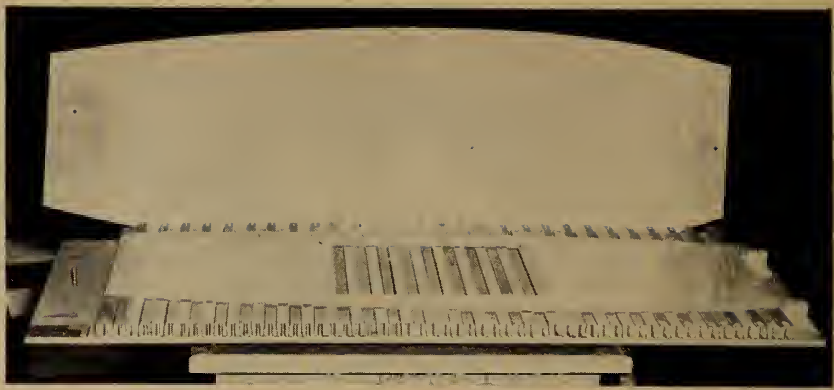
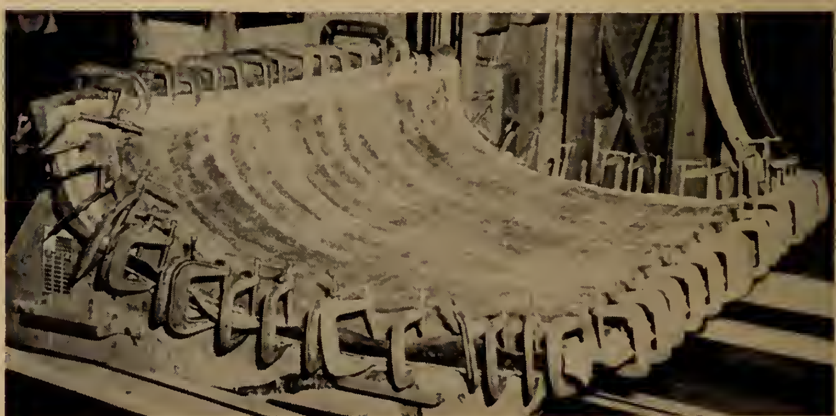



Fig. 4 and 5. Tooling for corrugation bonding.

Fig. 6. Autoclave bonding tool.

Fig. 7. Autoclave bonding tool.



sulphuric acid solution, on the other hand, is not only firmly adherent but is also uniform.

The major role in a good bond is played by polar molecules. The aluminum oxide molecule and its variations, which is firmly attached to the surface of the etched aluminum, is asymmetric and polar. That is, the electrical charge at one end is farther from the centre of the molecule than the electrical charge at the other end. Consequently, the neutralizing effect of one charge by the other is not as pronounced as in the case of a symmetrical molecule. That charge farthest from the centre of a polar molecule will have a high electrical affinity for another molecule, particularly of the polar type. In this case of metal bonding, the other molecule with polar characteristics is the adhesive.

One of the essential characteristics of a good adhesive is that it not only wets thoroughly or comes into intimate contact with the metal or the oxide of the metal being bonded before it is cured, but, after curing, it must be a molecule with polar characteristics. Adhesives like FM-47 have such characteristics and this wetting action and polar attraction between the molecules of the adhesive and that of the metal surface are chiefly responsible for the high strength bonds obtained.

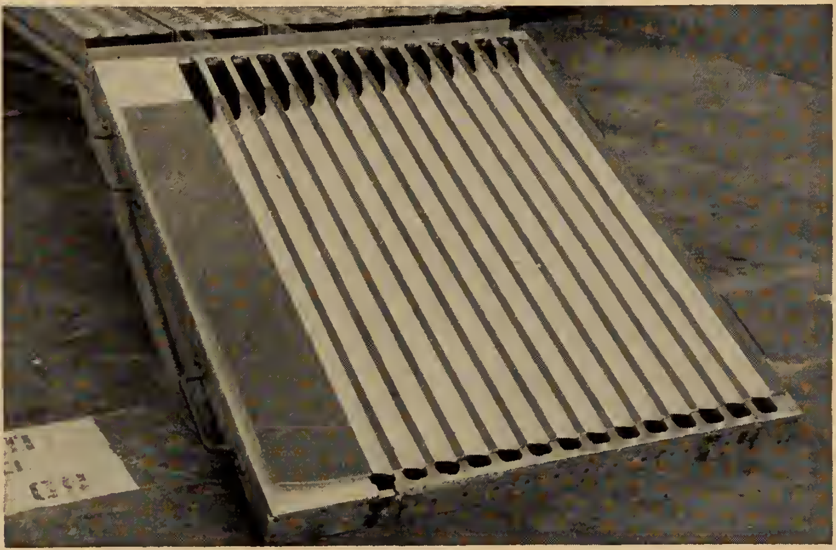


Fig. 8. General view of pre-treatment tanks.
Fig. 9. Adhesive in place.

Fit-Up of Parts To Be Bonded

One of the first and important operations to be carried out in bonding work, is to determine whether the parts to be bonded fit together properly, so that they achieve the necessary close contact during the curing operation. We have made it a general rule that ordinary hand pressure should bring the detail parts into good contact with one another—in all areas where bonding is to take place.

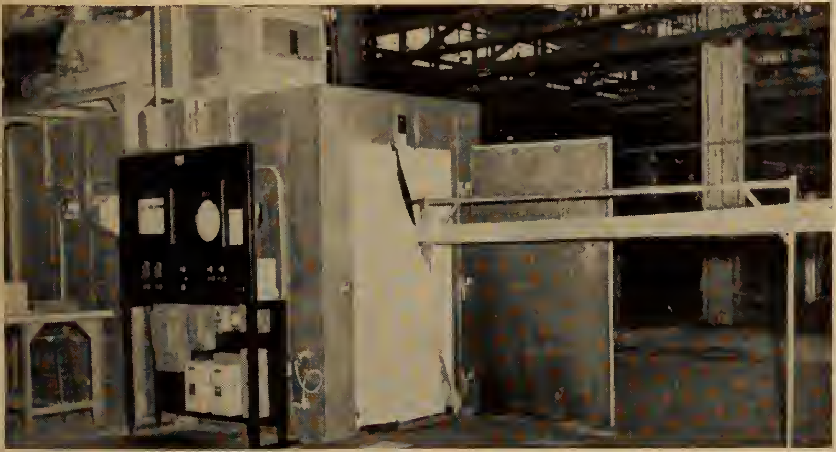
This requirement for good contact is sometimes difficult to achieve, particularly when one has to deal with complicated shapes such as contoured corrugations.

When the inspector concerned is in doubt as to whether a fit-up is adequate, he uses the dye transfer method for checking. This consists of applying, by brush, to one faying surface, a coating of die-maker's dye, fitting the parts together in the bonding tool and applying vacuum only. If the dye transfer to the other faying surface is complete, then, under normal curing pressure, the requirement for close contact will definitely be achieved.

After the fit-up has been checked, the detail parts are pre-treated in the manner described previously.

To add another note about cleanliness; after the parts are pre-treated, they are handled only by personnel wearing clean cotton gloves.

Fig. 10. General view of drying oven.



Application of Adhesive

The faying surfaces of the parts to be bonded are sprayed with adhesive primer to give a dry film thickness of 0.001-0.002 in. The adhesive tape is then applied to one faying surface only and rolled firmly into place using a hard rubber roller. The adhesive is then air-dried for two hours followed by force-drying for one hour at 225°F. This careful drying is essential so as to remove all traces of solvent from the adhesive, and avoid poor

Fig. 11. Press-cured bonded assembly.

bonds from being developed as a result of the solvent evaporating in the glue line during the curing operation.

Curing of the Adhesive

After the force-drying is completed, thermocouples, made from wire 0.005 in. in diameter, are attached to the adhesive tape in the significant areas so as to determine when the glue line reaches the required curing temperature. The parts are then nested together and placed in the bonding tools or directly on the press platen.

In the case of press curing, the heated platens, with the work in place, are brought together under very low pressure, about 5 p.s.i. The glue line is allowed to come up to 310°F., and to dwell at this temperature for 8 minutes. The press is then opened for 2 minutes.

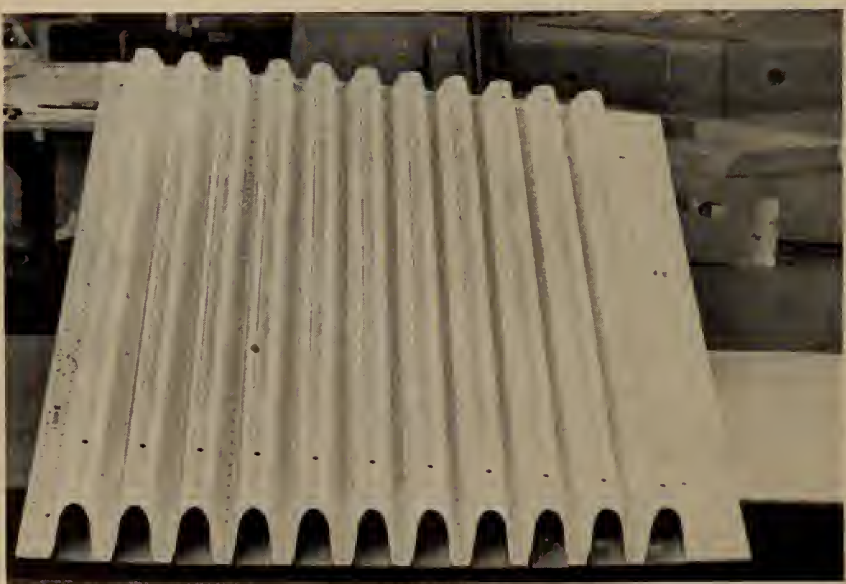
The purpose of this pre-cure is to start the polymerization of the phenolic resin. During this initial joining together of the molecules the by-product is water—which, under the existing temperature, is in the form of a vapour. Opening the press for the two-minute period allows this water vapour to escape and thereby diminishes the tendency for voids to develop in the glue line.

After this pre-cure stage, the press is closed to a bonding area contact pressure of 200 p.s.i., and the adhesive is finally cured at 310°F. for approximately 30 min.

After the 30-minute cure, with the 200 p.s.i., pressure maintained, the cooling system of the press is turned on. This is accomplished by flowing cold water through the hollow platens of the press, where the steam had previously circulated. When the glue line has reached approximately 180°F. the press is opened and the bonded parts are removed.

The purpose of cooling down to 180°F. while the assemblies are under pressure is that, at 310°F., the cured adhesive has comparatively low strength. Consequently, handling the parts at this temperature may allow one detail part to shift relative to the other. Also, if there is any tendency for springback of the parts to take place, a void could develop.

Fig. 12. Press-cured bonded assembly.



In autoclave bonding, much the same procedure is followed in curing as in the case of press bonding. The pre-cure as an individual stage is not carried out, since the continuously applied vacuum between the rubber blanket and the part draws off the water vapour evolved. The curing pressure used in the autoclave, as mentioned previously, is only 90-100 p.s.i.

Finish Treatment of Bonded Assemblies

FM-47 adhesive, after it is cured, is extremely stable chemically. In fact, we have been unable to find any reagent to dissolve it.

Because of this property, we are able to treat bonded assemblies for protection against corrosion, in the same manner as for assemblies joined together by any other method.

The treatment used consists of immersion in an alkaline cleaner followed by rinsing in water. Clad assemblies are then immersed for 5 minutes in a 5 per cent solution of chromic acid maintained at 130°F. Non-clad assemblies are treated by immersion to obtain one of the proprietary chemical conversion coatings such as Iridite 14-2 or Alodine 1200. The assemblies are then coated with zinc chromate primer in the usual manner.

Quality Control and Metal Bonding

One aspect of metal bonding which has not yet been covered and which is extremely important, is that of quality control.

Since, by present methods, a metal bonded assembly cannot be examined for good bonding by other than destructive methods, it is extremely important that each phase of the process is constantly and carefully controlled for quality.

This includes taking such precautions as testing each incoming shipment of adhesive, frequent chemical analysis of the pre-treatment solutions, checking carefully the fit-up of detail parts to be bonded, controlling accurately the curing temperature, pressure and time, enforcement of practices which ensure cleanliness of the parts being bonded, keeping flow times between various stages of the process to an absolute minimum, and finally the liberal use of shear test specimens which are processed along with each batch of production parts.

Quality control is probably more important in metal bonding than in any other process.

Inspection of Bonded Assemblies

The procedure used at present for the inspection of bonded assemblies is to tap them with a lightweight hammer having an aluminum alloy head. Voids will make themselves evident when a change in the noise caused by the tapping is heard. It must be admitted that this is a very unsatisfactory method, particularly since voids in heavy gauge materials are difficult to locate in this way.

Stanford Research Institute along with the Convair Division of General Dynamics, in Texas, have developed a more exact method of distinguishing between good and poor bonds. The equipment is basically the same as the ultrasonic equipment used for the detection of defects in metal, except that the bond testing equipment functions on the principle of measuring changes in mechanical impedance. Although we do not yet have such equipment in use in our facilties, I have had the opportunity of examining bonds by this method and it certainly gives a positive indication. The equipment is known as a Stub or a Stubz meter but is not yet commercially available.

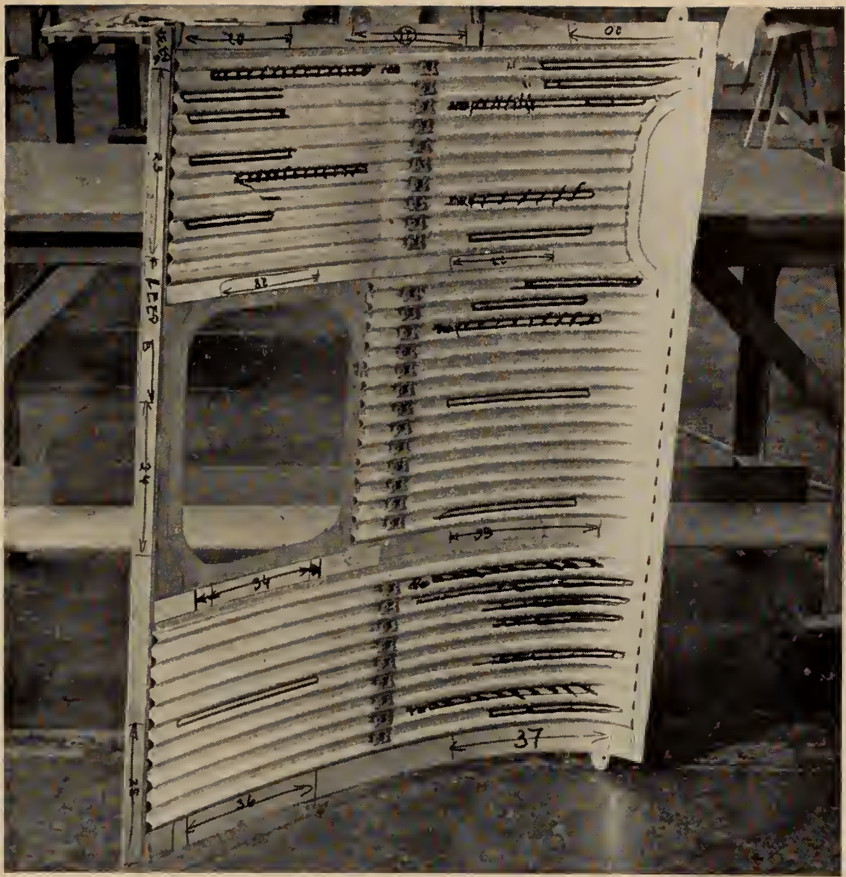


Fig. 13. Autoclave-cured bonded assembly.

Bonding of Metals Other Than Aluminum

Throughout this paper, the metal bonding of aluminum only has been discussed. Other metals such as magnesium alloy and stainless steel have been bonded successfully, although the shear strengths developed are generally not as high as those obtained with aluminum. Again, the whole problem is to treat the surfaces of these metals chemically so as to obtain a coating whose molecules are firmly adherent to the parent metal and also have polar characteristics.

CONCLUSION

In conclusion, some may wonder whether all this apparent trouble one has to go through to make properly bonded assemblies, is worth it or not—particularly in this day of automatic rivetting and resistance welding, which processes fit in closely with the current trend towards automation.

We have wondered about this too, until we discovered that going to joining methods, other than bonding, would have cost us approximately 1000 pounds in structural weight. On this basis, metal bonding becomes a necessity and not a process to be considered as a choice between it and some other joining method. Apart from the saving of weight, for certain critical assemblies, bonding will afford a much longer fatigue life than other methods of joining. Also, for high speed aircraft, bonding gives a smoother surface from aerodynamic considerations.

Also, apart from obtaining low weight, high strength and smoothness which the aircraft designer is constantly concerned with, there are certain applications where metal bonding proves itself to be more economical than other joining methods.

[1] Bloomingdale Rubber Company.

Fig. 14. Floor panel.

The Mackinac Bridge

How it was designed for aerodynamic stability

D. B. Steinman, M.E.I.C.
Consulting Engineer,
New York, N.Y.

The Mackinac Bridge, a suspension bridge 8,614 feet long with a main span of 3,800 feet, was designed to have exceptional aerodynamic stability. Wind-tunnel tests have proved that the designed high degree of stability against all forms of oscillation has been obtained. A perspective drawing of the bridge is shown at the head of this page.

•

The design of the $100 million Mackinac Bridge in Michigan, now under construction, with a main span of 3,800 feet and for which the writer is consultant, was predetermined in final form, without groping, cut-and-try experimentation or successive modifications of design to overcome aerodynamic instability. Now, extensive wind-tunnel tests have been completed on a large-scale dynamic model of the bridge; no modification of the original design has been found necessary or desirable. The wind-tunnel tests show conclusively that the Mackinac Bridge, as designed, has complete and absolute aerodynamic stability against all forms of oscillation — vertical, torsional, and coupled—in all modes at all wind velocities and all angles of attack. This goal has not before been attained nor approximated in any bridge section investigated.

With the destruction of the Tacoma Narrows Bridge in 1940 by cumulative oscillations in a mild gale, the engineering profession was awakened to the importance of considering the aerodynamic problem in bridge design. To resist these potential destructive forces, the more obvious, elementary methods ordinarily pursued tend to produce structures that are extravagant in cost and clumsy in proportions. In the case of the Mackinac Bridge, a different course was adopted. A bridge of ideal, assured aerodynamic safety has been secured without sacrificing either economy or graceful proportions. By scientific design, utilizing the new knowledge of suspension bridge aerodynamics, the Mackinac Bridge has been made the most stable suspension bridge, aerodynamically, that has ever been designed.

This result has been achieved, not by spending millions of dollars to build up the structure in weight and stiffness to resist the effects, but by scientific design to eliminate the cause of aerodynamic instability. The vertical and torsional aerodynamic forces tending to produce oscillations are not merely resisted; they are scientifically eliminated.

Read at the 70th Annual General and Professional Meeting of The Engineering Institute of Canada, Montreal, May, 1956.

FUNDAMENTAL PRINCIPLES

The fundamental principles of successful design are as follows:

1. The phenomena of aerodynamic instability are not mysterious, but can be solved by scientific analysis and then prevented. A science of bridge aerodynamics is a reality.

2. It is more scientific and more economical to eliminate the cause of aerodynamic instability by scientific design than to build up the structure, in weight and stiffness, to resist the effects of aerodynamic instability.

3. All bridge cross-sections do not behave alike aerodynamically. They may be differentiated and classified as aerodynamically stable and unstable sections, of different degrees of stability or instability, in the three different kinds of potential oscillation—vertical, torsional, and coupled.

4. The aerodynamic characteristics of any proposed bridge section are either already known or may be determined by simple model tests on a small-scale model. Expensive and time-consuming wind-tunnel tests on a full bridge model or on a large-scale oscillating section-model are not required in predetermining the design.

5. The aerodynamic behaviour of a bridge may be qualitatively and mathematically predicted from the lift and torque graphs recorded for different sections, or obtained for a new section from a small-scale static section-model in a small wind tunnel. The slopes of the graphs determine stability or instability. The curvature of the graphs determines limiting amplitudes.

6. The ideal bridge section, aerodynamically, is one that has zero slope of both the lift graph and the torque graph. Zero slope in both graphs denotes complete elimination of the lift forces and moments that produce aerodynamic oscillations, vertical, torsional, and coupled.

7. Bridges of assured aerodynamic stability may be economically secured by simple modifications of the usual bridge sections.

SIMPLE MODEL TESTS

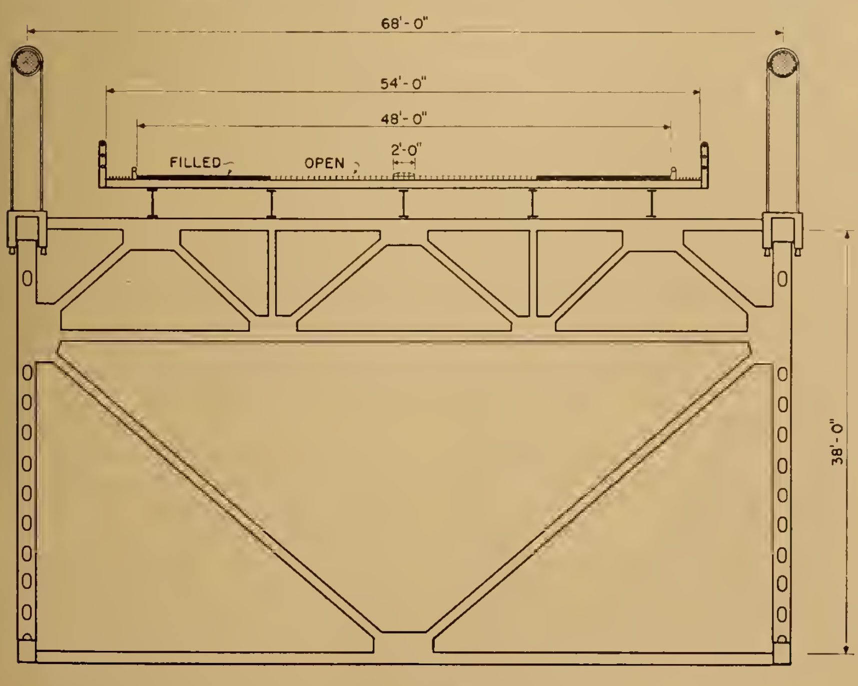
Based on fundamental conceptions of the aerodynamic forces and moments acting on a bridge section, simple modifications of the conventional bridge cross-section have been devised to eliminate the concentrations of differential pressure and the surfaces on which those pressure differences acted. These modified sections were easily and inexpensively tested and developed by means of simple, home-made office models, suspended from light springs and exposed to the breeze from an electric fan.

The results of these elementary tests, confirmed and refined by tests made on a small-scale non-oscillating section-model in a small wind tunnel, provided the basis for the design adopted for the Mackinac Bridge.

The confirmatory tests on a small-scale section-model of the Mackinac Bridge were made by Professor F. J. Maher at the Virginia Polytechnic Institute. The model, only 8½ inches wide and 15 inches long, was constructed to represent a 120-foot length of bridge to a scale of ⅛-inch to the foot, in accordance with the cross-section shown in Fig. 2. Open-grid sections of the deck and open railings were simulated in the model by use of wire screening. Graphs giving the variation of aerodynamic lift, drag, and moment with the angle of attack of the wind for this stationary section-model were plotted. These three graphs supplied the information to assure the aerodynamic stability of the bridge. The total cost of the model and the tests was only $500.

Those who do not understand the consistent simplicity of fundamental scientific principles have challenged this procedure by declaring that nothing can be learned from experiments on small scale models. These critics forget the history of scientific thought. Newton did not require an elaborate model of the universe in order to discover the universal law of gravitation; his mind grasped the fact that the forces acting on a falling object obeyed the same simple law as the forces acting on the largest planet. The most costly, elaborate research equipment may not be a substitute for the creative mind.

Fig. 2. Cross-section of the aerodynamically stable Mackinac Bridge.



DESIGN FEATURES

The essential features characterizing the design of the Mackinac Bridge for perfect aerodynamic stability are shown in the cross-section, Fig. 2.

The outstanding original feature contributing to high aerodynamic stability is the provision of wide open spaces between the stiffening trusses and the outer edges of the roadway. The trusses are spaced 68 feet apart and the roadway is only 48 feet wide, thus leaving open spaces 10 feet wide on each side, for the full length of the suspension bridge. These wide lateral openings are located where the maximum aerodynamic pressure differences would otherwise be concentrated; such pressure differences ordinarily produce the critical alternating vertical forces inducing and amplifying vertical oscillations, together with the maximum lever-arms for these vertical forces in inducing and amplifying torsional oscillations. These lateral openings serve a dual purpose:

1. They equalize the aerodynamic pressures above and below the deck in the critical areas adjacent to the stiffening trusses or girders, thereby cancelling the resultant alternating vertical forces.

2. They remove the area of solid deck on which these pressure differences would otherwise act. A pressure cannot exist and cannot produce a force without an area on which to act.

The alternating pressure differences ordinarily concentrated in these corners of a bridge cross-section not only create the biggest alternating forces causing cumulative amplification of vertical oscillations, but they also operate with maximum leverage to produce the alternating torques causing cumulative amplification of torsional oscillations.

For still further aerodynamic stability of the Mackinac design, the equivalent of a wide longitudinal opening is provided in the middle of the roadway (see Fig. 2). The two outer traffic lanes, each 12 feet wide, are made solid, and the two inner lanes and the centre mall (24 feet wide) are made of open-grid construction.

Model tests have shown that a design with open grid over the full width of the roadway does not produce aerodynamic stability. The solid deck, or a substantial part of it, is needed for damping by atmospheric resistance. The Mackinac Bridge cross-section provides the solution. The two solid roadway lanes, each 12 feet wide, supply the necessary atmospheric damping. Even in the two open lanes, a large measure of atmospheric damping is afforded by the friction of the airflow through the grid, with the velocity of this airflow augmented by the effect of the adjacent solid deck.

Wind-tunnel tests have confirmed the high aerodynamic stability of this design of cross-section.

An additional design feature introduced for the still further increase of the aerodynamic stability of the Mackinac Bridge is the use of open-web, trussed floorbeams (see Fig. 2), instead of the usual solid-web floorbeams. Aerodynamic oscillations of a bridge have usually started under the action of winds blowing at angles of approximately 45 degrees to the axis of the bridge. The component parallel to the bridge axis and acting on the transverse floorbeams and on the arched camber of the span, tends to start the oscillations; the component acting across the span then amplifies the initial oscillation if the cross-section has aerodynamic instability. The use of open floorbeams eliminates an important source for the initiation of oscillations by gusts and quartering winds. The aerodynamically stable cross-section eliminates the amplification of oscillations, whether originated by gusts or by the imperceptible vibrations due to traffic. Any initial vibration is quickly damped instead of being sustained and amplified.

STATIC LIFT GRAPH

The static lift graph is obtained by plotting the measured vertical lift force on a small section-model held stationary at various angles of attack in a wind tunnel.

For comparison and contrast, the static lift graphs for three significant bridge sections are shown in Fig. 3, superimposed and plotted to the same scale. The corresponding static torque graphs for the same three bridges are shown in Fig. 4. Taken from official records and published reports, the graphs for the Golden Gate Bridge were obtained in the wind tunnel at Stanford University, the graphs for the original (1940) Tacoma Narrows Bridge were obtained in the Guggenheim Aeronautic Laboratory of the California Institute of Technology, and the graphs for the Mackinac Bridge were obtained in the wind tunnel at the Virginia Polytechnic Institute.

The slope of the static lift graph represents the rate of increase of vertical lift with angle of attack. A small correction, the "drag correction", is made in the plotted graphs in order to take into account the fact that the model is inclined, instead of the wind direction, to provide the various small angles of attack.

The slope of the static lift graph is significant. A negative slope (lift decreasing with increasing angle of attack) would represent dangerous instability in vertical oscillations. A bridge section possessing this characteristic would be subject to cumulative amplification of vertical oscillations to catastrophic amplitudes.

A positive slope of the static lift graph identifies "stable sections," so designated to distinguish them from "catastrophically unstable" sections. This distinction is clear-cut in the case of narrow geometric sections, such as lenticular sections, with the depth exceeding the width. In bridge cross-sections, however, a "stable" section, that is, one with positive slope of the lift graph, is subject to limited aerodynamic oscillations in certain critical ranges of wind velocity. These aerodynamic oscillations usually occur at low velocities. Although they are not "catastrophic", these low-velocity oscillations are alarming, and tend to shorten the life of the bridge by fatigue. This is the type of oscillation, commonly known as "galloping", which characterized the Tacoma Narrows Bridge (1940) during the four months of its life.

In both cases, catastrophic instability (negative slope of lift graph) and limited instability (positive slope of life graph), the degree of instability is proportional to the slope of the lift graph. The steeper the slope, the greater is the rate of amplification of the oscillations. The rate of increase is logarithmic; the smallest tremor is automatically amplified a thousand fold to an amplitude of one or more feet in a few minutes.

Since the foregoing relationship applies to all lift graphs, of either positive or negative slope, the conclusion is clear:

The ideal bridge section is one that has zero slope of static lift graph.

In this respect, the goal sought in an ideal bridge section is quite different from that sought in wing sections for airplanes. "Flight stability" is something quite different from "aerodynamic stability". In the case of airfoil design, the objective sought is maximum lift, and the ideal airfoil is one that yields maximum ratio of vertical lift to horizontal drag. The idealized airfoil has a steep lift graph, with a slope of +6.28. The ideal bridge section should have a flat lift graph with a slope of zero.

The foregoing distinction is

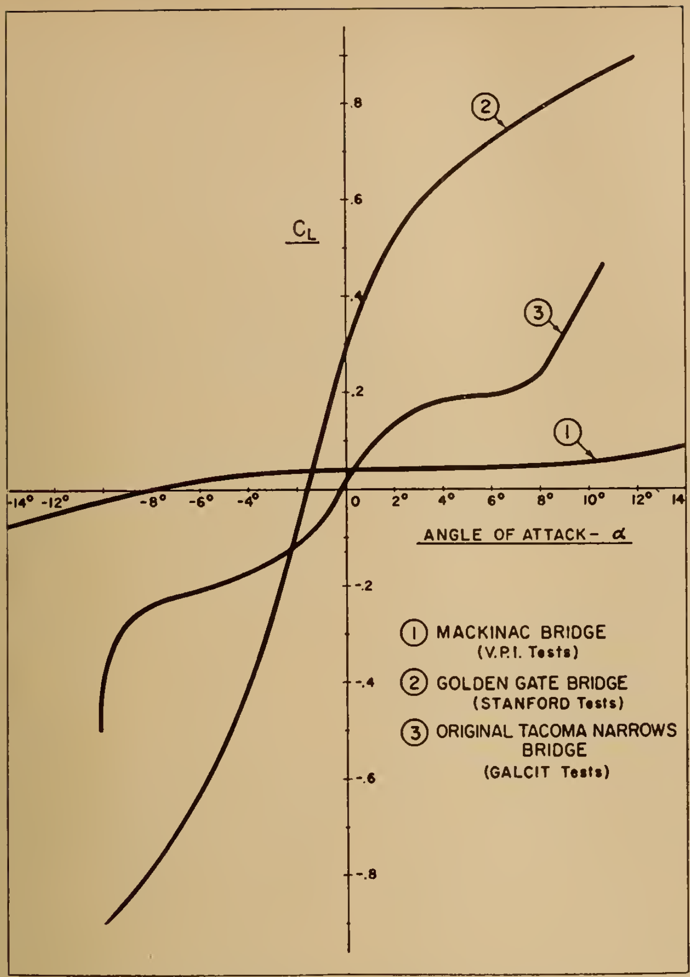


Fig. 3. Comparison of static lift graphs for three suspension bridges.

overlooked by those who seek to apply the formulas of conventionalized airfoil theory to bridge sections, since airfoil theory assumes that the section is an idealized airfoil of fixed characteristics, including steep slope of lift graph. Such misapplication of inappropriate theory and formulas fails to give due credit to the more stable bridge sections, scientifically designed, in which the slope of lift graph is greatly reduced or eliminated.

In Table I are listed the comparative slopes of the static lift graphs (corrected for drag) for some notable bridge sections; the idealized airfoil and the ideal bridge section are included for comparison.

Table I. Slope of Static Lift Graph

Golden Gate	+10.5
Idealized airfoil	+ 6.28
George Washington	+ 6.2
Tacoma (original)	+ 5.5
Bronx-Whitestone	+ 5.0
Mackinac (grid covered)	+ 1.9
Mackinac (grid open)	+ 0.03
Ideal bridge section	0

For the Mackinac Bridge as designed (see Fig. 3 and Table I) the slope of lift graph is +0.03, virtually zero. This degree of perfection has not before been approximated or attained. This remarkably flat slope of the Mackinac lift graph should be compared with the comparatively steep slopes of the lift graphs (+5.0 to +10.5) recorded for prior large suspension bridges, and with the steep slope (+6.28) for the idealized airfoil.

Using the slope of lift graph as a measure of vertical instability, Table I shows that the Mackinac Bridge, as designed, is 350 times safer than the Golden Gate Bridge against vertical oscillations or "galloping".

For completeness of presentation, Table I also includes the hypothetical case of the Mackinac Bridge with the grid in the middle of the roadway (24 feet of width) assumed completely covered, as by ice and snow. Even for this extreme assumed condition, the slope of lift graph has the unprecedentedly low value of +1.9, or five and a half times as safe as the corresponding figure (+10.5) for the Golden Gate Bridge. Moreover, for this assumed extreme condition, the ice and snow packed in the meshes of the grid and any ice and snow on the solid portions of the deck would greatly increase the structural damping, thereby offsetting the effect of the small increase in the slope of the lift graph.

The recently completed large-scale wind-tunnel tests on a model of the Mackinac Bridge in the specially built laboratory at the University of Washington confirm the fact that the Mackinac Bridge has complete and absolute aerodynamic stability against vertical oscillations at all wind velocities to infinity and at all angles of attack.

STATIC TORQUE GRAPH

For the static torque graph, as in the consideration of static lift graphs, the ideal slope is zero. Zero slope of torque graph means the complete absence of all forces and moments tending to induce and to amplify torsional (twisting) oscillations.

In the writer's formulas, the logarithmic increment (or rate of amplification) is found to be proportional to the slope of the static torque graphs. The complete mathematical analysis utilizes, in addition, a supplementary static torque graph obtained with a curved model of the cross section.

In addition to the steepness of the slope, its direction is of critical significance. A negative (downward) slope of torque graph identifies catastrophic torsional instability. This is the dangerous type of instability that was revealed in the torsional oscillations that destroyed the Tacoma Narrows Bridge.

A positive (upward) slope of torque graph identifies a so-called "stable section" in torsion, but such a stable section is also subject to potential aerodynamic oscillations in torsion. In this case the aerodynamic oscillations are non-catastrophic; they are of limited amplitude, from a few inches to several feet, and they occur at low wind velocities. Even such limited oscillations are troublesome and alarming and they weaken the structure by fatigue.

From the foregoing considerations, the conclusion is clear:

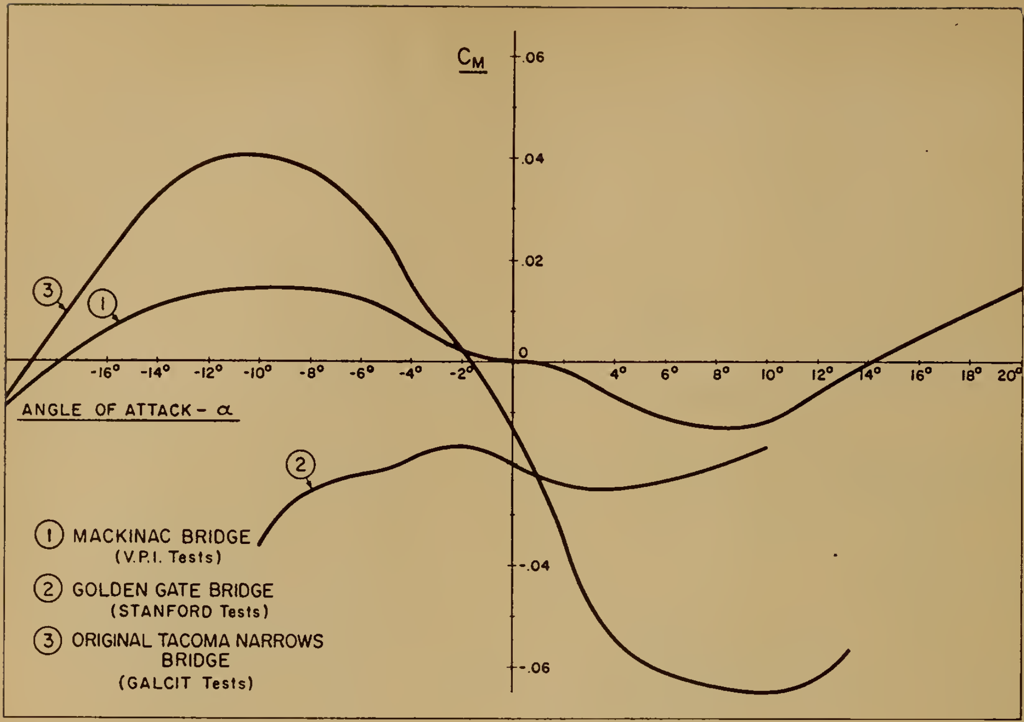


Fig. 4. Comparison of static torque graphs for three suspension bridges.

The ideal bridge section is one that has zero slope of static torque graph. This criterion is parallel to the corresponding conclusion with respect to slope of lift graph.

For comparison and contrast, the static torque graphs for three significant bridge sections are shown in Fig. 4, superimposed and plotted to the same scale. The three bridges represented are the original Tacoma Narrows Bridge, the Golden Gate Bridge and the Mackinac Bridge. This diagram shows clearly the steep negative slope of the torque graph for the Tacoma Narrows Bridge, representing the catastrophic torsional instability which destroyed that structure. In contrast, the diagram shows the flat torque graph for the Mackinac Bridge, indicating ideal torsional stability. Slopes are measured at the middle of the graph, corresponding to horizontal wind and the limited small inclinations of the wind.

In Table II are listed the comparative slopes of the static torque graphs for some notable bridge sections; the idealized airfoil and the ideal bridge section are included for comparison.

Of the sections listed in Table II, the idealized airfoil is the only one having a positive slope of torque graph. For bridge sections, a zero slope or a slight negative slope is preferable. If the lift graph and the torque graph both have a positive slope, the section is vulnerable to coupled oscillations, representing a dynamic combination of automatically synchronized vertical and torsional oscillations. In the case of airfoils (airplane wings and tail surfaces), such coupled oscillations, known as "flutter", are a source of danger and have repeatedly proved disastrous. That is why zero slope of lift and torque graphs, or a slight positive slope of lift graph combined with a slight negative slope of torque graph, represents the ideal for bridge sections, eliminating all possibility of vertical, torsional and coupled instability.

Table II. Slope of Static Torque Graphs

Tacoma (original)	—0.52
Bronx-Whitestone	—0.50
George Washington	—0.19
Golden Gate	—0.13
Mackinac (grid open)	—0.02
Mackinac (grid covered)	0
Ideal bridge section	0
Idealized airfoil	+1.57

Using the respective slopes listed in Table II as a measure of torsional instability, the tabulation shows that the Mackinac Bridge, as designed, is 26 times safer against torsional oscillations than the original Tacoma Narrows Bridge, 25 times safer than the Bronx-Whitestone Bridge, 9.5 times safer than the George Washington Bridge, and 6.5 times safer than the Golden Gate Bridge. For the hypothetical case of the grid completely covered, the foregoing ratios are actually improved, yielding an infinite ratio of superior torsional stability for the Mackinac section.

Combining the data of Tables I and II as a measure of safety against coupled oscillations, the Mackinac Bridge section, as designed, is 6.5 to 350 times safer than the Golden Gate Bridge, and 26 to 183 times safer than the Tacoma Narrows Bridge.

The graphs (Figs. 3 and 4) show how a section of assured aerodynamic stability was selected for the Mackinac Bridge. This simple procedure is the key to the safe, speedy, scientific design of future suspension bridges for assured aerodynamic stability.

The recently completed large-scale wind-tunnel tests on a model of the Mackinac Bridge in the special laboratory at the University of Washington confirm the fact that the Mackinac Bridge has complete and absolute stability against both torsional and coupled oscillations at all wind velocities to infinity and at all angles of attack.

DEPTH OF STIFFENING TRUSS

A suspension bridge ignorantly designed, or one otherwise unsafe aerodynamically, may be made safe by the crude and simple device of providing excessive depth of the stiffening girder or truss.

In 1945, the author of an engineer's handbook, though not a bridge engineer, included in his advertisement the claim that his handbook told how to design a suspension bridge so as to assure its safety against becoming a "Galloping Gertie". His prescription was very simple—to make the truss depth one-fortieth to one-sixtieth of the span. This prescription is technically correct, but it would represent a sacrifice of good engineering in order to cover ignorant design. For all but the shortest spans, it would represent extravagance and would yield needlessly heavy, awkward and ill-proportioned structures.

A more scientific formula has been derived by the writer. It gives the safe recommended depth of stiffening truss for various lengths of span, but adds the saving clause: "unless aerodynamic stability is otherwise assured".

By this formula, the required truss-depth for the 3,800-foot-span Mackinac Bridge, if it were unscientifically designed, would be 46 feet, or 1/82 of the span. But even this depth would be extravagant in cost and wasteful of steel.

For the Mackinac Bridge an ultra-conservative truss-depth of 38 feet was adopted, yielding a convenient ratio of 1/100 of the span. In view of the assured high aerodynamic stability of the design, a shallower truss-depth would have been entirely safe. In a suspension bridge, when correctly designed, the cost increases rapidly with increasing depth of stiffening truss. By reducing the depth from 46 feet to 38 feet, several million dollars were saved.

Because there are many who do not know or understand the fundamental principles of the aerodynamic problem and its solution, the design had to be ultra-conservative and to forego the additional cost-saving through any further reduction of truss depth. A barrage of uninformed criticism and attack had to be overcome. It was necessary to make certain sacrifices in order to retain the confidence of the public, the investors and the insurance companies. The ultra-conservative design was the price that had to be paid in order to sell the project.

DOUBLE LATERAL SYSTEM

As a further contribution to the assured ultra-aerodynamic safety of the Mackinac Bridge, a double system of lateral bracing was adopted. By providing two planes of horizontal bracing, at or near the planes of the top and bottom chords of the stiffening trusses, respectively, and extending over the full length of the suspension bridge, we secure the effect of a hollow rectangular section in torsion. The torsional stiffness of the structure is thereby greatly augmented, together with a corresponding high increase in the structural damping in torsion.

For the Mackinac Bridge, in the light of the scientific design of the cross-section to eliminate any trace of aerodynamic instability, the extra high measure of torsional resistance secured by providing a double lateral system was really not necessary. It was provided in order to be ultra-conservative, as an additional concession to public confidence.

By the addition of the extra plane of lateral bracing, the torsional rigidity of the Mackinac Bridge was increased seven-fold from 115,000 lb. to 832,000 lb. against one-segment oscillation (the main span assumed to deflect in a single segment); and nearly fourteen-fold from 160,000 lb. to 2,200,000 lb. against two-segment oscillation (the main span assumed to deflect in two segments, the mode that wrecked the Tacoma Narrows Bridge).

As a direct result of the manifold increase of torsional stiffness contributed by a double system of lateral bracing, the calculated frequency ratios (ratios of theoretical harmonic frequency in torsional oscillation to theoretical harmonic frequency in vertical oscillation) exceeded 3.5. These high (favourable) frequency ratios were unprecedented and exceeded the available range of the test equipment in the aerodynamic laboratory at the University of Washington. New modifications of the equipment had to be devised and installed before the Mackinac Bridge model could be tested.

The abnormally high calculated frequency ratios for the Mackinac Bridge, resulting from the provision of a double lateral system, constitute a further safeguard against any possibility of coupled oscillations. On account of the high frequency ratios, the wind velocity necessary for such coupled oscillations, even if they were possible, would be fantastically high.

TESTS CONFIRM STABILITY

Soon after the Mackinac Bridge bonds were sold and contractors were notified to proceed with the construction of the bridge, arrangements were concluded in March, 1954, for a thorough aerodynamic investigation by Professor F. B. Farquharson in the Suspension Bridge Laboratory at the University of Washington. The purpose of these additional tests was to secure impartial, authoritative confirmation of the high degree of aerodynamic stability achieved in the design of the bridge. These investigations, costing $15,000, were completed and the results recorded in Professor Farquharson's final report, dated May 20, 1955.

The model used for these wind-tunnel tests was a 1/50-scale section-model, 60¾ in. long, with details of shape reliably duplicated. (See Fig. 5.) The tests were made

Fig. 5. Dynamic model used in the wind-tunnel tests at the University of Washington. Accurately built to 1/50 scale, the model represents a 253-foot section of the Mackinac Bridge.

in a specially built open-jet wind tunnel with a wind-jet 12 feet long and 4 feet high.

The high aerodynamic stability of the Mackinac Bridge exceeded all prior experience in aerodynamic investigations. Professor Farquharson had to revise his test equipment when he found that this bridge had features of stability higher than had ever been previously investigated. In fact, some of the features of stability of the Mackinac Bridge, such as the very high frequency ratio of 3.5 and the high estimated damping of 0.10 for the iced condition were too high to be fully duplicated in the model.

When the model was tested for the normal operating condition of the structure, namely, with the grids in the central portion of the roadway and the sidewalks open, absolutely no motion developed at any angle of attack up to the extreme value of plus or minus 20° (the limits of the wind tunnel) and over the full range of velocities available. These tests were conducted under very low damping conditions (0.005) which would reveal the slightest trace of instability; the actual structural damping in the bridge will be ten to twenty times as high (0.05 to 0.10), emphasizing still more this tested confirmation of complete aerodynamic stability.

The wind-tunnel tests showed conclusively that the Mackinac Bridge, as designed, has complete and absolute stability against vertical, torsional and coupled oscillations at all wind velocities and all angles of attack.

Professor Farquharson also tested the Mackinac Bridge model with all roadway and sidewalk grids closed solid, to represent the hypothetical, abnormal condition of all openings completely closed by ice. For this condition the aerodynamic stability is found to be so nearly perfect that the difference is practically meaningless.

The Mackinac Bridge will have an exceptionally high value of structural damping, resisting any tendency to start oscillations. The high vertical rigidity and the still higher torsional stiffness contribute this high value of the structural damping. The magnitude of the structural damping factor, or logarithmic decrement, will certainly be at least 0.05. Professor Farquharson has estimated for the Mackinac Bridge a structural damping factor of approximately 0.08. For the abnormal condition of all deck openings completely closed by ice and snow, the action of the interlocked ice and the packed snow will contribute further to the structural damping, and for this condition the structural damping may be estimated as 0.10.

Table III

Bridge	Critical Wind Velocity
Bronx-Whitestone (after addition of stiffening trusses)	30 mph.
Golden Gate	40 "
George Washington	55 "
New Tacoma Narrows	76 "
Mackinac (with deck closed)	632 "
Mackinac (with deck open, as designed)	Infinite

For a minimum assumed value of 0.05 for the structural damping, the wind-tunnel tests for the bridge with the deck completely closed show complete and absolute stability against vertical and torsional oscillations at all wind velocities and complete and absolute stability against coupled oscillations at all wind velocities up to 524 miles per hour for the lowest mode of oscillations, 779 miles per hour for the next mode, and 800 miles per hour for the next higher mode.

For the higher and more probable estimated value of 0.10 for the structural damping, the wind-tunnel tests for the bridge with the deck completely closed, as by ice, show complete and absolute stability against vertical and torsional oscillations at all wind velocities and complete and absolute stability against coupled oscillations at all wind velocities up to 632 miles per hour for the lowest mode of oscillations, 942 miles per hour for the next mode of oscillations, and 966 miles per hour for the next higher mode of oscillations.

Accordingly, even under the worst abnormal conditions, the Mackinac Bridge is ultra-safe against any possibility of aerodynamic oscillations. The indicated critical velocities for the assumed abnormal conditions approach the supersonic range.

The highest wind velocity ever recorded in the vicinity of Mackinac is 78 miles per hour. The required "critical velocities" of 632, 942, and 966 miles per hour may be dismissed as fantastically impossible.

COMPARISON WITH OTHER BRIDGES

The outstanding aerodynamic stability achieved in the Mackinac Bridge is best shown by a comparison (Table III) with the critical velocities determined by similar wind-tunnel investigations for other notable suspension bridges.

For the prior long-span bridges, the critical wind velocities listed in the accompanying Table III are taken from published reports by Professor F. B. Farquharson in official bulletins (1954) of the University of Washington Engineering Experiment Station.

CONCLUSION

The Mackinac Bridge is one hundred per cent safe, aerodynamically, even under the most adverse conditions that may be expected to occur. It represents the achievement of a new goal of perfect aerodynamic stability, never before attained or approximated in any prior suspension bridge design.

A Progress Report on Canadian Atomic Power

I. N. MacKay, M.E.I.C.,

Manager, Engineering, Civilian Atomic Power Dept., Canadian General Electric Company Limited.

In the last few years the production of atomic power in Canada has come much closer to realization. The author discusses the main factors involved, gives an overall view of other programs, and deals particularly with the costs involved.

THREE YEARS AGO I had the opportunity of presenting to the annual meeting in Halifax some remarks concerning the possibility of atomic power in Canada. In these three years much has happened to bring atomic power closer to realization, and I would like to discuss some of the reasons for this. In particular, I would like to discuss some of the fields in which atomic power may soon find application, and also some of the technical developments which are likely to reduce the cost of atomic power to the range of conventional sources in many parts of this country.

In early 1954 a group was formed at Chalk River to study the design of a small demonstration power reactor. The group consisted of engineers and scientists from utilities, industry and Chalk River. The power range was specified between 10,000 and 20,000 kilowatts. The results of this study have been reported in the *Engineering Journal* in a paper* by Mr. H. A. Smith, of Ontario Hydro, who headed the study. As you already know, Atomic Energy of Canada Limited subsequently approached most of the principal manufacturing engineering firms in Canada and selected the Canadian General Electric Company Limited to carry out the design, and subsequently the construction of the N.P.D. power station. The Civilian Atomic Power Department of this company was formed in May 1955, with a staff of about two dozen engineers including about half a dozen from Atomic Energy of Canada Limited. During the first three weeks, a series of lectures was presented to the group by members of the Chalk River staff on various subjects associated with atomic power. The group spent most of the summer of 1955 reviewing the requirements for the N.P.D. reactor in detail and repeating many of the calculations originally carried out by Mr. Smith's group in order to familiarize themselves with the fundamental considerations of the design. During the fall, major alternatives were considered in detail; and a design which is believed to be substantially final is now progressing. Costs have been considered carefully throughout all stages of the design, and although there is as yet no cost estimate based on a final engineering design, we are in a far better position to assess the economics of this type of reactor than we were three years ago.

Let us first look at some of the power requirements in this country. The basic characteristics of atomic power plants as compared to conventional thermal power are the negligible cost of fuel transportation, the low but not negligible fuel cost, the relatively high capital cost, and the great economies attainable in large sizes. For these reasons we would expect atomic power to be used initially where hydro, natural gas, or other cheap power is not readily available. For a good many years to come it looks as though British Columbia, the Prairie Provinces, and Quebec Province will have cheap power available close to the large load centres. We can expect to see central station

*The Preliminary Design of NPD, December, 1955.

Read at the 70th Annual General and Professional Meeting of The Engineering Institute of Canada, Montreal, May 1956.

atomic power plants first in Ontario and the Maritimes.

Last January the Ontario Hydro-Electric Power Commission released some interesting figures concerning their expected power requirements over the next thirty years. Ontario consumes nearly two-fifths of the total electrical power consumed in Canada, and over the last three decades the increase has been at a rate of a little over 6½ per cent per year. However in Southern Ontario in the last five years the increase has been at a rate of 8½ per cent and last year the total load on the system increased by more than 14 per cent. By about 1965, almost all of the economically available hydro-electric power in the province will have been developed. Practically all further additions will be in the form of thermal power stations. The program assumes that by 1965 atomic power will carry base loads economically. Figure 1 illustrates approximately the expected growth of this system to 1980. You will see that the coal merchants need have no fears, but that those who manufacture waterwheel generator equipment would do well to turn their attention to much higher speed machinery. The atomic, or nuclear, power program calls for a 400,000 kilowatt station by 1965 and over 2½ million kilowatts of atomic power during the following five years. By that time the total thermal electric generation will have overtaken the hydro-electric capacity.

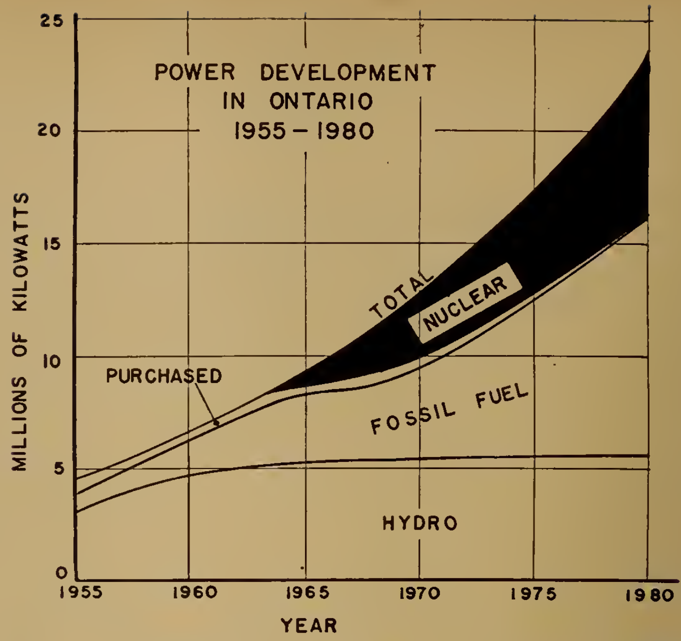


Fig. 1. Expected power development in Ontario, 1955-1980.

Growing power requirements in the Maritime Provinces call for smaller new blocks of power than in Ontario. These are smaller than the most economic atomic power unit sizes. However, due to the high fuel costs in this area, atomic power can be expected to compete in smaller units than the optimum. It would appear that the use of atomic power in the Maritimes will depend on the general rate of development there, but it could also directly affect this growth.

In addition to central station power use, there are a number of other opportunities in this country for the application of atomic power. These are based primarily on the negligible fuel transportation and storage costs. In remote communities where the cost of transportation of oil or coal is high, the cost of power may be from 15 to 35 mills per kilowatt-hour. An N.P.D. type of power plant can offer power close to the bottom end of this range. Another obvious use for atomic power is in naval ships, where it offers cruising ranges far beyond anything obtainable with conventional fuels. During its first year of operation, the U.S. Submarine Nautilus exceeded the previous record for distance travelled submerged by a submarine by a factor of more than ten. However, this type of power plant uses highly enriched fuel and is very expensive to operate. Its use in a surface ship would be difficult to justify. Although I have not gone into the question in any detail, I would doubt that power reactors could be used economically for the propulsion of naval ships of much under say 7,000 tons. By economic in this sense I refer to power plants where the operating costs would be acceptable considering the tactical advantages to be gained by their use.

The development work required to produce cheap and reliable central station atomic power plants is very largely applicable to the development of atomic power plants for other uses. With Canada's present man-power situation, it seems logical to proceed with the development of central station power plants first. This is, of course, being done and the N.P.D. reactor is intended to demonstrate the practicability of atomic power for large central stations. However, with only minor alterations, this design would provide economic power for an isolated community which is sufficiently stable to pay off the capital investment over a period of 20 years or more, with a reasonably stable load of at least 10,000 kilowatts.

A brief look at the programs of some other countries seems appropriate. Britain is undoubtedly the furthest advanced in producing commercial power reactors which will be economically attractive in that country. This is partly because their conventional fuel supply is dwindling and they can afford to pay relatively higher costs for atomic power. Their schedule calls for sixteen power reactors to be constructed by 1965 at a total cost of some $840,000,000 providing 1½ million to 2 million kilowatts. The first of these reactors is expected to be in operation this year. The first ten of these power plants are all of the same type, selected by the British Atomic Energy Authority, gas-cooled, graphite-moderated, probably using slightly enriched fuel available from the diffusion plant which was erected for military purposes. The used fuel from the reactors will contain significant quantities of plutonium. The U.S. have either under construction or in advanced engineering stages some two dozen atomic power plants of all types including those for ship propulsion. In all cases the U.S. reactors so far described publicly will use at least slightly enriched fuel. Table I shows the main features of power reactors now planned by private industrial groups in the United States. Russia expects to have two 50 Mw. reactors operating this year. Norway and France both have active atomic programs under way, and there is also a joint Dutch-Norwegian ship propulsion program.

ceivable that if the United States emphasis on enriched fuel creates a great demand for this, in the future we might prefer to sell enriched rather than natural uranium to users, and we might then erect a diffusion plant. However

Table I. Power Reactors Planned by Industry in U.S.

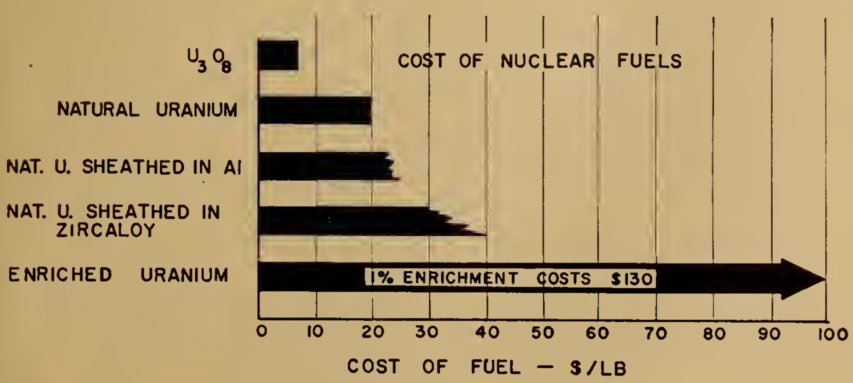
Owner	Builder	Power, Mw.	Type	Cost/kw.
1. Consolidated Edison Co. — Indian Point, N.Y.	Babcock and Wilcox Co.	236	Pressurized ordinary water	$230
2. Consumers Public Power District of Columbus, Neb.	North American Aviation Inc.	75	Sodium-cooled graphite	320
3. Detroit Edison Co. Group		100	Fast breeder	540
4. Commonwealth Edison Group	General Electric	180	Dual cycle boiling water	250
5. Yankee Atomic Electric Co.		100	Pressurized ordinary water	230

The three countries which have found it necessary to make the extremely heavy capital investment necessary to erect uranium enrichment plants are perhaps naturally using enriched uranium to fuel their power reactors. These countries are, of course, the United States, Great Britain and Russia. Although I have no information on the cost of production of U235 in the United States I do not believe that the use of enriched uranium will prove economical for central station power plants in the long run, unless a large part of the capital cost of the plants required to enrich the uranium can be charged to military expenses. I cannot imagine Canada spending very many hundreds of millions of dollars on an enrichment plant for military purposes. Therefore, unless we are to rely on imported fuel for our atomic power program, we must build our reactors to use natural uranium. As it turns out, this seems to us to be much the cheapest way of obtaining central station atomic power anyway. I suppose that it is conceivable that if the United States

if this day arrives, we can adjust our program to suit the circumstances.

Figure 2 illustrates diagramatically the relative costs of various forms of uranium fuel. The difference between the cost of U_3O_8 and of natural uranium metal is accounted for by the cost of proeessing the oxide to produce the metal. Low temperature reactors such as the N.R.U. and the N.R.X. at Chalk River use uranium metal sheathed in aluminum. The cost of this sheathing is in the order of $2 per lb. of uranium. High temperature power reactors in general use uranium sheathed in zircaloy or some other zirconium alloy. The cost of this sheathing is in the order of $10 to $20 per lb. of uranium; however as very few tons of uranium have actually been sheathed in zirconium to date, we can expect some reduction in the cost of this process. The cost of natural uranium enriched with about 1 per cent additional uranium 235 amounts to about $130 per lb., using U.S.A.E.C. prices. The P.W.R. reactor being built at Shippingport, Penn., for the Duquesne Light Company can be quoted as an example to illustrate the costs of slightly enriched fuel in a power reactor. This reactor uses between eleven and twelve tons of natural uranium plus 50 to 60 kilograms of uranium 235 in a nearly pure form. The cost of the natural uranium is in the order of $500,000, whereas that of the U235 is about three times this amount.

Fig. 2. Relative costs of various forms of uranium fuel.



A pound of U235 contained in natural uranium costs about one quarter as much as a pound of separated U235 at U.S.A.E.C. prices. Yet the former will release more energy in a reactor, and in doing so will produce upwards of three quarters of a pound of plutonium which may be had for the cost of chemical separation. However, it should be made clear that the use of enriched fuel gives the designer of the reactor much more freedom than the use of natural uranium, and may permit important economies in the capital costs of the reactor.

There are a number of ways in which the costs of natural uranium fuel may be reduced in the future. Although zircaloy is apparently the most suitable alloy for sheathing uranium for water-cooled power reactors at present, the Aluminum Company of Canada is cooperating actively with Atomic Energy of Canada Limited in the development of an alloy of aluminum and nickel which may be suitable and which would certainly reduce the cost of sheathing the fuel very greatly. Fused uranium oxide (UO_2) is currently being investigated as a substitute for uranium metal. This has several advantages including the fact that it is not acted upon chemically by the coolant in the case of sheath failure. Although its cost at present is not much different from that of metal, when large quantities are required it might be expected to cost less than the pure metal. When natural uranium is used in a heavy water reactor of the type that we are considering, for every hundred atoms of U235 contained in the natural uranium used up, something like eighty or more atoms of the otherwise inert U238 are converted into plutonium. Plutonium has properties somewhat similar to U235 and is capable of allowing the fuel to continue to be useful for a long time after all of the original U235 is consumed. Used fuel rods from reactors which operate on natural uranium contain considerable quantities of plutonium. This can be chemically separated relatively cheaply and may be used for small more or less transportable reactors where higher than normal fuel costs are acceptable. In a nuclear economy governed by military considerations, of course, plutonium has considerably higher value.

An intriguing possibility seems to lie in the use of thorium as a fuel. Thorium has properties somewhat corresponding to uranium 238, and is incapable in itself of supporting a chain reaction. However when it absorbs neutrons it produces uranium 233, which is better than either uranium 235 or 238 for fueling the kind of reactor about which we are talking. Theoretically at any rate a reactor fueled with a mixture of a small amount of uranium 233 and normal quantities of thorium would produce more uranium 233 from the thorium than is consumed. This should make possible very long irradiations from a set of fuel elements, perhaps ten times as long as from natural uranium. If proved practicable, this fuel might cost less than 1 mill per kilowatt-hour. This type of fuel could probably be used in heavy water reactor originally designed for the use of natural uranium without any other change. I understand from a prospector friend that there are large quantities of thorium associated with uranium deposits in Canada, but that extraction might be more costly than obtaining it from the Monazite sands in Brazil and India.

Figure 3 illustrates the effect of cost of fuel and also of the amount of energy which can be extracted from it in the reactor on the cost of the power from the station. Conditions are assumed to be approximately as they will be in the N.P.D. reactor. We know that we can obtain 3,000 megawatt-days per ton easily, we hope that we will be able to obtain 6,000 per ton out of the fuel for the N.P.D. reactor without chemical processing, and the graph suggests the economies that might be obtained with fuel such as I mentioned irradiated to perhaps 50,000 Mw. days per ton. Incidentally this latter figure is equivalent to more than two billion B.t.u. per pound. The heavy line at the top indicates approximately the corresponding

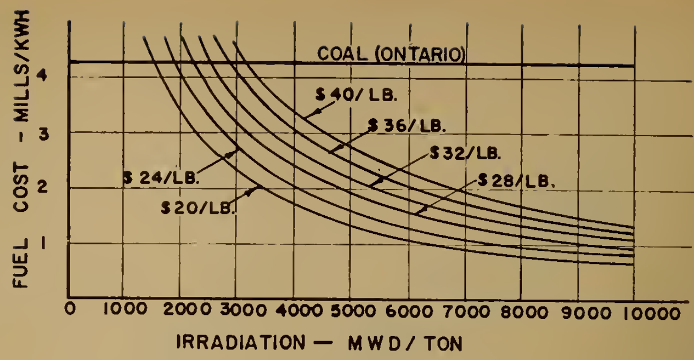


Fig. 3. Effect of the cost of fuel.

figure for the cost of coal laid down at a steam power station in say the Toronto district.

Figure 4 shows the relationship between capital and fuel costs to the total cost of power. We can see if say 6 mill power is acceptable and our fuel costs 4 mills per kilowatt-hour, then we can afford to invest only $150 per kilowatt in the plant. However if our fuel costs can be held down to say 1 mill, then we can afford a $350 investment and still obtain our 6 mill power. This diagram is calculated on the basis of capital costs being written off at the rate of 10 per cent per year. With this diagram, operating costs may be considered as part of fuel costs in order to obtain total power costs. Clearly fossil-fuelled power stations operate in the lower portion of this diagram, while atomic power plants operate in the left hand portion of the diagram.

Rapid rates of writing off capital expenditures are at present used to take advantage of the corporation tax structure. These should not be confused with the actual annual costs of equipment which can be expected to have a long useful life. In the case of atomic power plants, we are faced with relatively high capital costs, but considerably lower operating costs than coal-fired power plants. Technological advances may be expected to reduce the initial costs of future atomic power plants, but it is hardly conceivable that any development could render an atomic power plant, once built, uneconomical for continued operation. It will therefore be reasonable to write off such plants in the near future for costing purposes over 25 to 35 years. At the interest rates paid by Canadian public utilities, this amounts to no more than about 6 per cent per year.

Figure 5 is similar to Fig. 4, but using capital cost amortization at 6 per cent rather than 10 per

Fig. 4. Relationship between capital and fuel costs to the total cost of power.

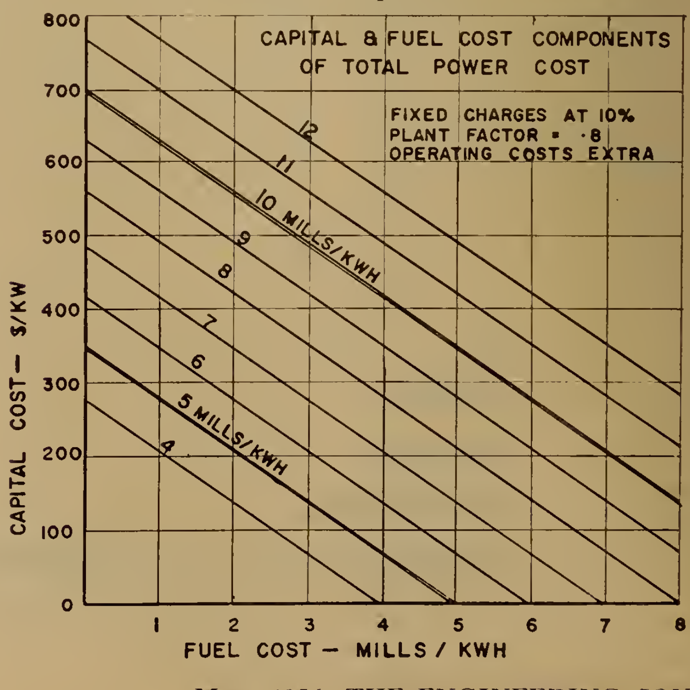


Table II. Costs for N.P.D. 20,000 Kilowatt Station

		Mills/kwh.
Capital Cost	— $750 per kilowatt installed written off at 10% per year based on 7,000 hours operation per year	10.7
Fuel	— $30 per lb. irradiated to 5,000 megawatt days per ton, overall thermal efficiency 22%	2.3
Operating Costs	— Staff (60 people at $6,000 per year to include housing subsidies, etc.); materials including heavy water make-up at $110,000 per year	3.4
	Total	16.4

cent. The effect on power costs in the examples previously quoted is obvious.

Reduction in the capital costs of any one particular kind of reactor will certainly come with experience in its design and manufacture. Particular types of reactors will almost certainly emerge as suiting certain kinds of applications better than other types of reactors. However, so far the conditions which reactors now under construction have been required to meet have varied so greatly that there seems to be no obvious pattern, at least in the United States. The N.P.D. reactor will provide valuable data on which cost reduction programs may be based and applied to large reactors of the pressurized heavy water type. An example is the use of low alloy steel piping and valves in the heavy water system. From data which we have available it appears that it is not necessary to use stainless steel piping and valves as has been the custom in the past, and that the corrosion products which may find their way into the heavy water system can be removed quite cheaply. When one considers that a sixteen-inch stainless steel gate valve may cost over $40,000, the savings are at least partly apparent. Again, it appears that it might be economical in future reactors to eliminate the very expensive pressure vessel and substitute containment of the pressurized coolant by aluminum pressure tubes operating at a little above room temperature; standard high strength aluminum alloys could be used for this purpose. Further experience with oxide fuel and long irradiations will indicate where savings may be made in instrumentation and cheaper arrangements for changing fuel. Increasing the size of the units is a very effective way of decreasing the capital cost per kilowatt. Increase in cost of an atomic power plant for given increase in power output is very much less than for a coal plant, and in general it appears that the bigger the units can be made the cheaper will be the power they produce.

It appears possible that recent developments in gas cooling may be applied to the cooling of the outer fuel elements of an N.P.D. type reactor to supply heat for superheating the steam. This would not only increase the cycle efficiency, but would reduce the cost of the turbine since this is now intended to operate on saturated steam.

After an initial period of experimentation, the cost of power from the N.P.D. station is expected to be in the neighbourhood of 17 mills per kilowatt-hour. This is made up as shown in Table II.

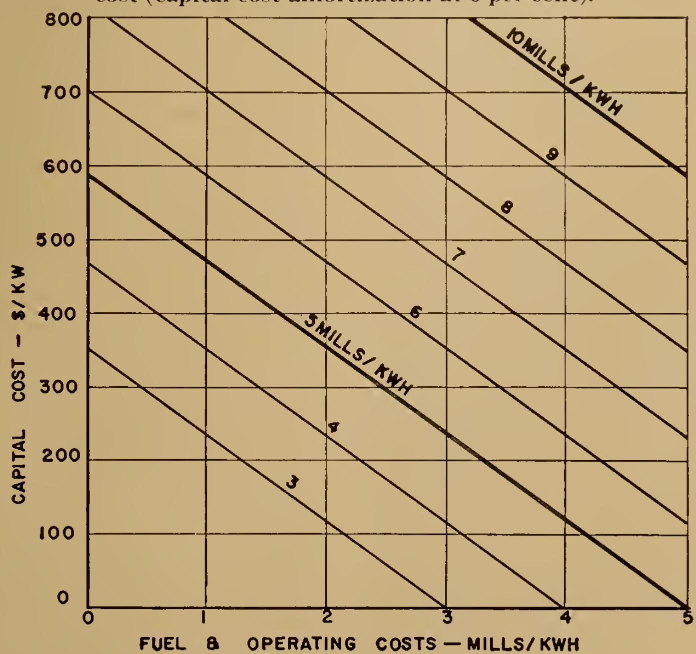
It is interesting to note how costs for a similar type of power station with a capability of 400,000 kilowatts might look. Such a station might have three units, the first of which could be ready for operation in 1962 or 1963. By virtue of the increased size of the units above, the capital cost could be expected to drop to about $350 per kilowatt. Technical developments in the next few years could reduce this figure. As previously suggested, it would be reasonable to write off such a station over say 30 years; the net cost to a publicly owned utility would be no more than 6 per cent per year. Fuel irradiated to 7,500 megawatt days per ton would reduce the fuel costs to 1.5 mills per kilowatt and there seem to be a number of ways in which this or a lower figure can be realized. A preliminary survey indicates that an operating staff of 160 people would be required, and that material costs might come to $700,000 annually. The costs would then be as shown in Table III.

Table III. Costs for 400,000 Kilowatt Station

		Mills/kwh.
Capital	— $350 per kilowatt written off at 6% per year	3.0
Fuel	— $30 per lb. irradiated to 7,500 megawatt days per ton	1.5
Operating Costs	— 160 people plus $700,000 per year	0.6
	Total	5.1

Since these costs assume virtually no technology which will not be proven by the time the N.P.D. power station has operated for a few months, we can conclude that economic atomic power from natural uranium is at hand. √

Fig. 5. Capital and fuel costs as components of total power cost (capital cost amortization at 6 per cent).



Some Aspects of Conservation and Wildlife Management

V. E. F. Solman,
Assistant Chief, Canadian Wildlife Service, Department of Northern Affairs and National Resources

A paper on wildlife may seem an unusual one for publication in the *Engineering Journal*, but we are sure that readers will enjoy this one. Many of them are hunters or fishermen, and a fair proportion of engineering works have very direct percussions on wildlife. As Dr. Solman points out, the conservationist makes use of many engineering techniques, a description of which is reserved for a possible future paper.

During man's long association with the wild creatures much has been learned about their habits. Indeed, such knowledge was vital to human survival before animals were domesticated, the better to serve man's needs.

The instincts of the hunter and fisherman are deeply ingrained in the human character. Although the need for food is no longer the main stimulus, hunting and fishing for recreation and relaxation are of increasing importance in this world of tension.

Although our knowledge of wildlife has been accumulating for centuries, it is only within the last few decades that it has become the basis for scientific wildlife management. Like many other branches of modern science, it has developed with amazing rapidity, and in consequence a large proportion of the biologists engaged in it are still young men. Some problems mentioned in ancient writings, such as predation, crop damage and "plagues" of wildlife species, are only now being subjected to intensive scientific research in the hope of finding solutions.

With the thought that members of the Institute may be interested in some of the problems and developments in wildlife management and its importance in human welfare, we discuss below a few modern ideas and discoveries regarding the subject.

Important factors in the field of wildlife management are public appreciation of the needs, public understanding of the methods and public demand for wise action. We cannot advance faster than public opinion permits, regardless of the speed or accuracy of our research.

As community leaders, engineers can perform an important public service by keeping informed of developments in renewable resource management and in endorsing and participating in wise management policies.

Many types of such management use engineering techniques. As advances are made in engineering development, wildlife management will use newer methods to do a more efficient job of water impoundment, fire control, reforestation, fish distribution and a host of other mechanized activities.

Recently fisheries research has been accelerated and rendered more accurate by the use of underwater television, the echo sounder, thermister temperature indication and more reliable and efficient outboard motors, to name only a few of the more obvious applications of modern engineering developments. The related field of terrestrial wildlife research has benefited during the same period, particularly from improvements in aircraft and helicopters and in the increased use of light-weight aluminum and fibreglass equipment of many kinds.

For many years attempts to remove animals detrimental to agricultural interests have been made in a variety of ways. One of the most popular means of achieving this end was through the payment of bounties for the head, hide or other parts of the noxious animal. The idea of paying bounties is a very old one and was brought to North America by the earliest colonists. The bounty system is based on the idea that if it is made financially worth-while, a person will exert himself to remove an animal which is causing him harm, even though it would be to his advantage to remove the animal without payment.

In some cases payment of bounty may increase the number of animals killed and help to achieve the desired purpose. In addition to this useful function, however, payment of bounty has often led to unwise, and indeed illegal practices. The unwise practices may involve the removal of animals from areas where they were doing no harm simply because they were easier to take there than in other areas, while at the same time animals were left in areas where they could continue to do harm because, in those areas, they were harder to take. The illegal practices encouraged by the bounty system include fraud and illegal transportation. Animals may be raised in captivity and offered for bounty; there may be falsification of the part of the animal offered for bounty; or old breeding animals may be left at large to continue reproduction while young are taken and offered for bounty. Animals taken in one area may be offered for bounty in a different area where higher bounty payments are made, even though the removal of the animals or parts thereof from one area to another contravenes transportation regulations. When animals under bounty have valuable pelts, bounty hunters may take them only when the pelts are prime, permitting them to carry on their harmful activities throughout the remainder of the year.

Under normal conditions only two young animals need to reach maturity and to replace their parents as breeding stock to maintain a stable population. The surplus, beyond this replacement number, is normally removed by disease, starvation, accidents and other factors. Paying bounty to remove animals which will not survive anyway has little or no effect on the population and is neither biologically nor economically justifiable.

Under a bounty system payments are made on all animals presented of the appropriate species. Many of these animals would be taken whether bounty were paid or not, but since a bounty is offered they are all presented for payment. If, in a given area, 500 wolves were taken each year before the introduction of a bounty system and it is desired to increase the removal of wolves by payment of bounty, the initial 500 each year must be paid for before the bounty serves any useful purpose in encouraging increased removal. Thus, with a $20.00 bounty, $10,020.00 would be the price paid for the first wolf effectively removed as a result of the bounty system. As the number of wolves taken under the bounty system increased the price per wolf would naturally decrease, but in any case the actual cost per wolf removed as a result of bounty payment would always be substantially higher than the bounty paid per animal.

When one considers the alternatives to a bounty system now available, it becomes immediately apparent why many game administrations have recently swung away from it. The most successful method of dealing with animals which may harm human interests, such as wolves, is to have them removed where and when necessary and in the required numbers by persons specially trained and experienced in the most effective and economical methods of removal.

In many areas poisons, such as 1080 or strychnine, can be used in meat baits set under carefully controlled conditions to take wolves or coyotes without danger to humans, domestic animals or valuable furbearers. Skilled hunters are used for control of some species. Often the work can be done at a cost per animal much lower than the bounty payment formerly offered, while at the same time removing only those individual animals which are important in causing losses. It should be realized that very many of Canada's bears, for example, do not cause damage of any consequence to human interests; a few of them, however, because of acquired tastes or undue proximity to settled areas, may do great harm to livestock, bee colonies or other property. An intelligent control program will aim at removing only the harmful animals, not at expending money and effort in pursuit of those which do not affect our economy. Employment of properly qualified predator control agents will ensure the carrying out of such a program.

The techniques for control of predators are now so well developed that it is quite possible to do too much as well as too little. Complete removal of all predators upsets the delicate equilibrium between predator and prey. For instance, when coyotes are eliminated from a certain area to reduce losses to sheep and antelope, a rapid increase in numbers of mice may result. In some places requests have been made by farmers for the cessation of coyote control so that these predators could again exert some pressure on mice.

In the Prairie Provinces the autumn of 1951 brought unfavourable harvest weather and early snow, and consequently much of the crop remained in the fields in swath through the winter. Mice lived

A Note to Branches Interested in Conservation

This paper outlines some of the interesting problems that confront the Canadian Wildlife Service. The Service has expressed its willingness to have its officers address any interested Branches of the Institute on the theme of conservation.

The staff of the Wildlife Service includes some 22 biologists, each of whom has training and experience slightly different from the other. In this way, Service speakers addressing any particular Branch would have a specialized knowledge of local conditions supplementing their overall experience. In addition to headquarters in Ottawa, offices are located at Aklavik, Yellowknife, Fort Smith, Vancouver, Banff, Edmonton, Saskatoon, Winnipeg, Kingston, Quebec, Sackville, and St. John's; a new office is to open at Whitehorse this summer.

Branches wishing to get a speaker on this subject are invited to get in touch with the Canadian Wildlife Service, Dept. of Northern Affairs and National Resources, Ottawa, Ont.

happily in the swath. In the spring when the swath dried out and was threshed by combines, mice were carried into the combines with the swath in such numbers that the machinery was plugged. Combines have two outlets, one for grain and the other for straw and chaff; but on that occasion, a third outlet for mice would have been appropriate! As far as we know, three-way combines capable of dealing with mice in quantities have not been developed.

After the crops which had served as winter mouse hotels were threshed in the spring, the dispossessed mice invaded farm buildings and granaries and even municipalities. Sometimes hundreds of mice would invade an empty granary, clean up the scattered grain in nooks and corners, and die of starvation, so that farmers had to shovel the bodies out to prepare the granaries for the next harvest. Small wonder if some farmers wished that the coyote control had not been quite so efficient, even though coyote reduction may have played only a small part in this unusual mouse plague!

There is some evidence that over-control of wolves in limited areas has been followed by the build-up of excessive populations of deer or caribou, with the result that these species have overgrazed their range and reduced its carrying capacity for years to come. Here, too much wolf control has resulted in the long run in a reduction, instead of an increase, in the numbers of deer.

To pursue this idea further, it should be realized that in a well-fed herd of deer the does have first a single fawn, then twins or triplets annually for the remainder of their productive lives. If less food is available the does may have only single fawns annually; if food is really scarce, they may have single fawns at two-year or longer intervals. Besides decreasing productivity, a reduced food supply will result in high winter losses of fawns, because they are smaller and cannot reach as high for browse as adults. We thus make the rather surprising discovery that removal of deer by predators or hunters, by keeping the population in proper balance with its food supply, results in high production and high fawn survival. Insufficient hunting or too intense predator control ultimately lowers production. The more deer killed, within limits, the more are available for future use. Some of the healthiest stands of deer are in park areas where there are also good sized wolf populations. In some cases, however, there are not quite enough large predators for the best big game production. Game animals then have to be removed from time to time to prevent over-utilization of range, with its accompanying damage to the flora, increase in erosion and loss of condition among the game animals.

Great concern is being caused at present by another phase of the conflict between wildlife and agricultural interests. Almost eighty per cent of the waterfowl which frequent North America are hatched and raised in Canada. Under the terms of the Migratory Birds Treaty between Canada and the United States, both governments are pledged to take necessary action to safeguard waterfowl so that they may be available for use and enjoyment by future generations. The major Canadian duck-producing area occupies parts of Saskatchewan, Alberta and Manitoba. These three provinces are also the "bread basket" of Canada and in some years contain more than fifty million acres under cultivation for the production of cereal grains.

Ducks and Grain

Many ducks normally feed on seeds. Certain species, particularly the mallard and the pintail, will feed on the seeds of cereal grains under suitable conditions.

Until recent years much of the harvesting of the cereal crops in the Prairie Provinces was done by cutting the grain, binding it into sheaves and placing these sheaves in stooks. After drying for a suitable time in the stook, the sheaves were threshed in the field or at some central location convenient for the storage of grain. Waterfowl do not normally land in fields of standing grain and are unable to do much damage to grain in stooks, even though they might wish to feed upon the seed. As labour costs have risen and as availability of farm labour has decreased, more complete mechanization of grain farming has become necessary. The combine was developed to eliminate the job of binding and stooking. In many areas, however, cutting the grain and threshing it in a continuous operation is not practicable. To overcome this difficulty the technique known as "swathing" was developed; in this technique the grain is cut leaving a high stubble, gathered together into narrow rows or "swaths" and left on top of the stubble. Wheat or other cereals treated in this manner dry and become ready for threshing much as when stooking was used, but with a great reduction in the cost and amount of labour involved. The ripening and drying of crops in swath prevents damage from the stem sawfly, which attacks only standing grain near maturity, and also prevents in large measure "wind shatter", which may occur when a standing crop is allowed to ripen completely before cutting. Once the swath is properly dried and ready for threshing, it is picked up by a combine and threshed in the field. Grain in the swath is not too much harmed by rain, since swaths will dry about as rapidly as stooks.

A disadvantage of swathing is that ducks and sandhill cranes may land on the swath, feed on a small amount of the grain, shell out a certain amount onto the ground and trample the swath down into the stubble where it cannot be picked up by the combine. This last type of damage is worst in wet weather, when the swath may be tramped down into the soil. Droppings accumulate on the swath and are carried through the combine with the grain and may make it unacceptable for storage in elevators.

The ducks which feed on swathed grain usually do not consume as much grain as is lost through their trampling. The grain which is shelled out and falls to the ground among the stubble cannot be gathered by any now-known agricultural operation. The mere loss of the grain on the ground, while often serious, is not the end of the difficulty. The grain which has fallen on the ground may easily take root during the following growing season and thus produce a volunteer crop in a field where there was no intention of growing grain during that year. In many prairie areas water supplies are insufficient for the growth of cereal crops each year, and the practice of leaving the land in summer-fallow in alternate years is common. A volunteer crop resulting from the trampling of ducks may be heavily seeded directly under the swath. Since the swaths are narrow and are spaced about 12 feet apart, the volunteer crop so produced may be extremely dense on narrow strips across the field. Even if it grows well such a crop is difficult to harvest. It may also offer difficulty in the further cultivation of the field, since the heavy seeding in a narrow strip may result in a dense, turf-like growth which may require special equipment to break up.

Local factors, including weather, affect the degree of crop damage by ducks. Certain areas in the Prairie

Provinces may have large duck populations without suffering much from their feeding in swathed fields. Other areas, with comparatively small waterfowl populations, may have more difficulty. Not all species of ducks have acquired that habit of feeding on cereal crops: mallards and pintails are the worst offenders.

In some areas the use of scarecrows of suitable types and at a suitable density has been effective in keeping ducks out of swathed crops. In other areas scarecrows, even when supplemented by the use of firearms, have not been completely successful either in keeping ducks out of swathed crops, or in driving them out of such crops when they had begun feeding in them.

Experience has indicated that, once the birds have become accustomed to flying from a resting area to a swathed field and feeding on the crop, it is difficult to break this habit. It is easier to discourage the first few ducks from entering such a field than to try to drive away the increasing numbers of ducks which will rapidly build up as the feeding pattern becomes established.

Control Methods

Much of the feeding activity is carried on after sunset and before sunrise. Control methods involving the use of searchlights, powerful noise-making machines, rockets and aerial bombs, and attempts to herd the birds away from cultivated areas with aircraft, have all been tried with limited success.

Ducks exhibit certain reactions when exposed to a beam from a radar transmitter. Experiments are being continued to see whether this type of reaction could be used to keep birds away from potential damage areas.

Limited studies have suggested that chemicals distasteful to birds might be used to discourage feeding. Tests of this method of control are in progress. Unfortunately, the senses of taste and smell are relatively poorly developed in birds, so the hope of success with a chemical repellent is not great. The use of grain as a source of human food offers a further difficulty in connection with the wide use of chemical repellents to control duck damage.

The source of the ducks which cause specific damage—that is whether they are locally-bred ducks or migrants—has been the subject of research during the past few years. Ducks are marked with coloured plastic neck bands in the areas where they are hatched and can then be identified wherever seen during field feeding. Conventional leg bands are also used, but then the ducks must be captured or killed to secure useful data on movements from the banding area. In some cases, birds which rest on a given water area may ignore the crops in adjoining fields and fly several miles to feed in other fields containing identical crops. In addition to this peculiarity of feeding, which is as yet not fully understood, there is the possibility that some of the damage done in the Prairie Provinces may be caused by ducks raised in other parts of the country, which may have travelled some hundreds of miles before reaching the damage area.

Other Solutions

Other approaches to the solution of this problem include the development, through plant breeding, of varieties of cereal grains which are resistant to attacks by the stem sawfly and other parasites and to wind shatter. Success along this line would furnish varieties which could be harvested by straight combine without the necessity of swathing. Elimination of swathing would greatly reduce duck damage.

Advances are being made in the technique of chemical dehydration of standing crops. This is accomplished by spraying the crops at a suitable stage of growth with a chemical which stops the translocation of water upward through the plant. The grain then dries out ready for straight combining earlier in the season than would normally be the ease. If the cost of this process can be sufficiently reduced, and if certain other present limitations can be overcome, it would be possible to use straight combining and, with the earlier ripening, to have the crop harvested before the majority of the ducks begin feeding in the fields.

There is much conjecture about the magnitude of the North American duck population and about the number of ducks killed each year. Birds which nest from the Arctic coast to the Central States and from the Atlantic to the Pacific are, of course, difficult to count accurately.

Each year summer surveys over the whole area, conducted in co-operation by biologists of the Canadian Wildlife Service, the provincial game agencies, the United States Fish and Wildlife Service, Ducks Unlimited (Canada) and other non-governmental agencies, sample all breeding areas and assess waterfowl populations and breeding conditions. Data so secured in recent years are comparable from year to year and show an upward trend in some species, despite more or less continuously liberalized hunting regulations. Accurate, comparative data are available for only a few years, so that comparisons with the early days of settlement are impossible. A series of wet years on the prairies, such as the past few, have always been followed by drought in the past; no doubt the duck populations have waxed and waned in response to water levels as long as they have concentrated on prairie nesting grounds.

It is almost axiomatic that before the present development of agriculture on more than fifty million prairie acres there were more ducks, because, in wet years at least, there were more breeding areas.

During and after the recent drought cycle in the 1930's many water areas were restored and new ones were created for agricultural purposes under the Prairie Farm Rehabilitation Act. Some of these were of direct benefit to waterfowl. Beginning in 1938 Ducks Unlimited (Canada), using dollars collected from United States duck hunters and with the co-operation of Canadian municipal, provincial and Federal agencies, restored and created many water areas specifically to benefit ducks and geese. With the return of wet years on the prairies the ducks increased as they have on similar past occasions, but during the next drought cycle the structures of the Prairie Farm Rehabilitation authority and Ducks Unlimited will retain water for ducks and help to compensate for the vast acreages of former good duck habitat now devoted to agriculture.

Opposing Interests

As long as some citizens want to see and hunt ducks and others are more interested in growing crops and putting needed food in hungry mouths, we will continue to have land drainage projects in aid of agriculture and water impoundment projects to aid ducks, often in an identical area at different times as local interests change, or in neighbouring areas at the same time.

Much attention is now being given to the idea of an upper limit to the number of ducks of certain species which can be allowed to breed in Canada and frequent the prairie agricultural lands before their southward migration. As the human population of North America increases, so in proportion do the duck hunters. The idea of imposing an upper limit on duck numbers brings the interests of the duck hunters into direct conflict with those of the agriculturists. The solution to this dilemma has not yet been achieved.

Fortunately for the future of the Canadian way of life, with its outdoor interests centering on wildlife, the apparent conflicts over land use are often solved by the gathering of more information.

Soil fertility is basic to all renewable resource development and use. Given a productive few inches of topsoil, many interests can be reconciled. Good agricultural practices protect the soil from erosion and maintain fertility. Waste grain and wise management of areas not in crop can sustain a population of game birds which will provide sport and food and, at the same time, aid in the constant battle against insect pests.

Good forest management promotes vigorous regeneration in cutover areas, which then become banquet tables for game of several kinds, to the joy of the hunter. Cottontail rabbits may multiply rapidly, provide good hunting and meat in the pot and also thin out a stand of jackpine at no cost to permit better growth of the remaining trees.

Big game can often live on cattle grazing areas without detriment to the use of the range by cattle because of different food preferences.

Management of Wildlife

In all these and many similar cases, wildlife must be as wisely managed as are the crops, trees and cattle. A population of elk can damage a poplar forest, denude a mountain slope, start soil erosion, eventually ruin a watershed and upset an economy based on river flow many miles away if not properly adjusted to the carrying capacity of the range. Almost any animal out of control can have similar disastrous effects on human economy. The rabbit introduced to Australia, free of its natural enemies and controls, is a classic example of wildlife on the rampage.

The explosive rate of population increase in most wildlife forms is often not fully realized. Three dozen pheasants were released on Pelee Island in Lake Erie in 1927. Seven years later, and annually since, a harvest of about 10,000 birds has been taken each hunting season. This sustained yield of about one pheasant per acre per year has now gone on for more than twenty years and shows no sign of reduction. All this sport and recreation takes place in addition to a very heavy agricultural development on a small island.

Most small wildlife species have a life expectancy of less than one year. With their high reproductive rates this is fortunate, or we would long since have been eaten off the earth or smothered under a blanket of mice or rabbits. Most wildlife species cannot be stockpiled. If they are not shot or trapped their numbers will be cut down by natural causes such as disease, accidents or starvation.

Even in large game such as white-tailed deer, with adequate soil fertility and deer numbers adjusted to food supplies, at least one third of the total number can be harvested each autumn on a continuous basis. For pheasants the harvestable surplus may exceed three-quarters of the late summer population. Because of these potentials, regulations governing the taking of wildlife by hunters or trappers need to be sufficiently flexible to permit an adequate harvest when the supply is available — it can't be saved for next year.

Lest this picture of high yield and quick replacement of numbers suggest a too utopian condition, it must be remembered that no area of the earth's surface can produce more than its basic soil fertility allows. Only a given number of cows can be pastured on a given field at the same time. To add more would damage the field or starve the cows. The same principle applies to all kinds of wildlife, including fish in a lake. The tendency to try to solve all angling troubles by adding fish from a hatchery often fails to achieve the desired results. Since the fish in a lake are less obvious than the cows in the field, overpopulation and food shortages are harder to detect without special studies.

The conflicts between wildlife and agriculture or other human activities have usually arisen, and will continue to arise, in increasing numbers, because of the increase in human population and the consequent utilization for the production of food and other human necessities of areas formerly occupied by wildlife.

Trans-Canada Highway Act

We record here the main points from a statement made in the House of Commons on the resolution to amend the Trans-Canada Highway Act.

The Trans-Canada Highway Act, which became law on December 10, 1949, was enacted to encourage and to assist in the construction of a continuous high standard highway following the shortest practical east-west route across Canada. The Act provides that the Federal Government may make contributions to a Provincial Government of 50 per cent of the construction costs of the highway over a period of seven years. The estimated cost of completing the highway in 1949 was $300 million and the amount voted by Parliament as the Federal Government share was $150 million.

The total length of the highway along the designated route in all ten Provinces is approximately 5000 miles. Quebec has not signed an Agreement under the statute and has not participated. The mileage in the nine participating Provinces, including Banff and Yoho National Parks, is 4580 miles.

For distances totalling approximately 2,850 miles, there is a paved highway, although to date the equivalent of only 1,600 has been constructed to the approved standard. Thus there remains approximately 1,545 miles of highway unpaved and there is 185 miles on which there is no highway of any kind.

The purpose of the Amendment is to seek authority to introduce a Bill to extend the period of construction, to provide additional funds and to alter the formula so as to enable the Federal Government to provide greater financial assistance in constructing select sections.

The Bill will seek authority for the Minister of Finance to pay a higher contribution for a portion of the highway in a Province not exceeding 10 per cent of the mileage. The Federal Government contribution for these gaps will be increased from 50 to 90 per cent of the cost of construction.

The Bill will also seek authority to extend the period for construction to December 31, 1960, and a further five months to wind up the accounting. The termination date for all contributions therefore will be set as May 31, 1961.

Authority will be sought in the Bill to increase the total amount of money authorized by Parliament for Federal contributions from $150 million to a maximum of $250 million.

DISCUSSION

Report on Investigation into the Failure of Two 100-Mw. Turbo-Generators

Sir Claude D. Gibb, C.B.E., D.Sc., M.E., F.R.S.
Chairman and Managing Director,
C. A. Parsons and Co. Ltd., England.

In the March, 1955, issue of The Engineering Journal there appeared the report of investigations into the failure of two generators at the Richard L. Hearn generating station, at Toronto. We now publish the full discussion of this paper, which aroused wide interest among engineers.

DISCUSSION IN LONDON

V. A. Pask, C.B.E., (*Member*), M.I.E.E., whose contribution was read by A. E. Hawkins, B.SC. (ENG.), A.M.I.E.E., observed that the author had rendered a signal service to both the manufacturing and utility industries in making available the results of his company's prolonged investigations in respect of the failures which had occurred to the alternator rotor end bells of two 100-Mw., 1,800-r.p.m. sets in Toronto during the previous April.

Immediately the accidents had occurred the author had notified the British Electricity Authority, other turbo-alternator manufacturers, and leading consulting engineers, adding that further information would be made available as it was obtained.

Following the preliminary examination made in Great Britain of a broken end bell from No. 1 Toronto machine, he himself had written, on behalf of the Authority, to all manufacturers, suggesting that the serious breakdowns, coupled with the fact that the Authority were contemplating machines of materially increased output capacity, indicated the advisability of the Authority and of the turbo-alternator manufacturing industry setting up a small committee to make a frank examination of the subject. He had stated that while there did not appear to be an immediate cause for undue anxiety in regard to B.E.A. plant, it would be prudent to take all reasonable steps to ensure that failures did not arise in Britain, and he had quoted the following proposals for discussion:

(1) That each firm should examine immediately the end bells of a 50- or 60-Mw. set, or sets, which had been in service for up to 20,000 hours; the examination to be in respect of both the metallurgical and mechanical condition of the steel.

(2) To consider the provision of hydraulic testing gear statically to load new end bell rough-turned forgings to some agreed percentage of the yield stress; also as an interim measure, the lowering of the yield stress from 50 to 45 tons per sq. in. on the 60-Mw. end bells in an endeavour to improve the ductility of the cold-worked material.

(3) The Authority to obtain from selected stations log sheets showing the hours in service, particularly in regard to the number of stops and starts, and how the hydrogen coolers had been operated during such periods with a view to determining the gas and metal temperatures in the vicinity of the rotor body and end bells during such thermo-cycling periods.

(4) That the Authority would consider the more widespread provision of rotor storage space having temperature and humidity control for protecting rotor end bells from possible stress corrosion conditions during the station construction period.

(5) Examination of details of the mechanical construction of the various designs of end bells and caps, having due regard to the stresses imposed by shrink fits, those caused by inertia of the end bell, and the internal pressure due to the centrifugal forces of the copper coils and supports.

Dr. C. Sykes had been invited to attend the proposed meetings.

At the first meeting of the manufacturers and the Authority held on 7th May 1954, the foregoing proposals had been generally agreed, with certain reservations in respect of the percentage of the yield stress to be imposed when hydraulically testing rough-machined forgings, and the lowering of the yield stress by 5 tons per sq. in. to 45 tons per sq. in. The Authority had agreed to return complete rotors from their stations to the manufacturers' works so that end bells could be removed for detailed examination and also re-assembled under controlled heating conditions, preferably by means of electrically heated jigs.

Dr. C. Sykes had agreed to act as chairman of a working panel, comprising metallurgists representing each manufacturer with the Authority's metallurgist as secretary, to assist and record the examinations of end bells which had been in service.

The preliminary examination of a representative number of end bells distributed amongst various

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The paper and discussion have been published in the Proceedings of the Institution of Mechanical Engineers, 1955, Vol. 169, No. 29.

manufacturers had indicated that with very few exceptions there had been no immediate cause for anxiety. Further examinations were proceeding as and when sets could be taken out of commission, the order being based on hours in service.

Progress had also been made in the evolution of hydraulic testing gear to suit individual designs, some equipped with strain-gauge apparatus to check the hoop and longitudinal stresses imposed. Acknowledgement for originating suitable hydraulic testing gear designs should be made to Sir George Nelson and his associates.

Information obtained from the Authority's generating stations indicate that 60-Mw. sets might be subjected to some 50-283 'starts' and 'stops' per annum, and the shutdown periods varied from 6 to 36 hours, or longer. Investigation had, however, proved that by a simple adjustment of the control valves associated with the dirty- and clean-water heat exchangers respectively, the recooled hydrogen-gas temperature might be raised to 80-85 deg. F. before shutdown; further, that that temperature would not drop by more than 3-5 deg. F. during even a 36-42-hour shutdown period on a normally lagged alternator casing. Those conditions could be realized at stations located in the fresh water reaches of a river in even the coldest winter period.

The Authority were providing additional air-conditioned storage accommodation at all sites where unavoidable delays in civil construction works might involve storage of an alternator rotor.

The details of mechanical construction naturally varied with different manufacturers, as also did the obstruction or shrink fit between rotor body, carrier ring, if used, and end bell. For about the same size rotor bodies that obstruction varied between different manufacturers in the ratio of 1/2, but material reductions in the heavier obstructions were now being adopted. Consideration was also being given to the methods of effectively 'shorting' the damper strips fitted under slot wedges, and also the provision of protective relays to safeguard large machines in the event of a possible system disturbance causing single phase working.

The B.E.A. were indeed greatly indebted to the author for carrying out the long series of repeated stress cyclic tests by hydraulic pressure upon rotor end bells. The tests so clearly demonstrated that a particular pattern of holes might so appreciably reduce the fatigue strength, owing to cracks developing at the work-hardened surface of the holes, that under repeated applications of a comparatively low stress they could be propagated rapidly as a brittle fracture.

That definitely established that holes, whether for ventilation or mechanical construction, and in fact, that any form of stress raiser caused by sudden changes in section, must be avoided.

At the time that the Authority had given consideration to the use of 100 to 120-Mw. sets requiring larger diameter rotors, a definite directive had been given to manufacturers that no ventilation holes were to be drilled through the bell. In fact, a recommendation had been made that they should also be avoided on the 60-Mw. frame. In the light of the research evidence now available that decision would appear to have been a wise measure.

True engineering progress could be achieved only by a balanced compromise between the materials used, design, manufacture, and operation methods. Many of the points raised in the paper had already been given close attention.

More effective production controls were being devised for use with existing and new materials for end bell construction, improved mechanical design to ensure more uniform stressing, together with the evolution of new ventilation systems to avoid either coil shortening or arch binding, and, lastly, operation engineers in the power stations had been advised to maintain minimum hydrogen-gas temperatures of between 80 and 85 deg. F.

V. J. Vickers, A.M.I.E.E. (Stafford), said that the two disasters with which the paper dealt appeared to be identical with the failure in July, 1950 of one of the end bells fitted to the rotor of a 60-Mw., 3,000-r.p.m. machine manufactured by his company. Details of the occurrence had not been published, but the information and conclusions had been made available at the time to the main manufacturers and users in Great Britain. Fortunately the incident had taken place in an overspeed test tunnel, during balancing operations at normal speed, and before the rotor had been taken up to overspeed. The rotor itself was a complete loss, but the tunnel, which was lined with timber to form a 3-foot cavity filled with sand, completely contained the wreckage, as would be seen from Fig. 27.

Figure 28 showed the point at which the larger piece of the fractured end-bell had pierced the timber lining, releasing the sand which had enveloped the rotor. The final condition of the rotor was shown in Fig. 29, after the remains of the winding had been removed. The end bell had broken into two pieces. He was concerned only with one of the fractures, since it was clear that the second had been the result of consequential damage.

Fig. 30 showed the larger piece with the primary fracture in front.

A close-up view of that fracture (Fig. 31) showed it to be generally brittle in nature and seemingly identical in character to that illustrated in Figs. 7, 8, 9.

Fig. 32 showed clearly how the fracture commenced at the surface of the hole approximately 1 inch radially outwards from the inner surface. Fig. 33 showed the pieces on either side of the fracture brought together, and Fig. 34 clearly indicated the absence of

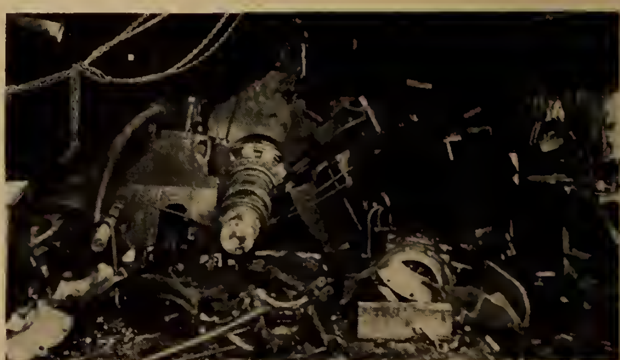


Fig. 27. General view of failure of 60 Mw. machine.

any appreciable general 'necking'. The author had said that in the immediate vicinity of the hole there was no appreciable deformation, but some 'necking' became evident as the crack extended away from it. Investigation had shown that the following were the principal factors which could contribute to a failure of that nature: first, the hole itself was a stress raiser and produced a high local concentration of stress. In addition, the work-hardening properties of that particular material, coupled possibly with a carelessly drilled hole, could produce ideal material properties for the initiation of a brittle fracture. The combined severity of those two effects would be greatly increased should such a hole coincide with a region of high residual forging stress, and also if the effects were coupled with cyclic stressing.

It was therefore abundantly clear that, while the holes might not be the complete explanation of the failure, they were a major factor. His company had therefore decided immediately to abandon the practice of drilling all end bells whether for ventilation or for other purposes. Furthermore, all machines of similar size in the course of manufacture or in service had been withdrawn. A number of smaller machines with end bells with physical properties characterized by an unduly small ratio between ultimate and yield strength had been withdrawn from service. At the same time, the policy had been adopted of not using any ring in which the ratio of yield to ultimate strength indicated inadequate capacity of the material to undergo further plastic deformation, although the ring in all respects came within the requirements of the ordering specification.

While he agreed with the author's estimate of the increase in average temperature rise of the rotor winding as the result of omitting the ventilation holes, he could not subscribe to his opinion that their retention was necessary in order to prevent coil distortion. In previously published information regarding the construction of the Toronto alternators it had been said that the coils had been wound using semi-hard silver bearing copper. It was now generally well known that the use of that material would give an ample

Fig. 28. Damage to timber lining.

margin of safety at the slightly higher temperatures resulting from the omission of the holes, particularly because the increase in temperature would be largely localized in the end turns and would not, in any case, result in a substantial increase in stress in the copper in the slots, where the forces giving rise to the stresses leading to deformation were most significant.

The investigations into the failure of the 60-mw. rotor referred to showed, as the author had remarked, that the holes *per se* were not sufficient to account for the failure, and support for that view was given by the fact that other identical rotors had already been proceeding ever since, and it had become evident at a very early stage that in any one ring very wide variations could exist in physical properties and, in particular, in the residual forging stresses arising from the method of cold working over a mandrel. That had led to the introduction in 1950 of hydrostatic testing of every forging before it was passed for use.

Fig. 35 showed the equipment set up with clock gauges to register the expansions occurring under pressure. The purpose in adopting that procedure had been twofold: first, as a further precaution, in conjunction with ultrasonic examination before and after test, to prove that the forgings were sound. That test had shown a forging defect which had not been noticed by the machinist. The second was a means of producing more uniform properties throughout the rings. For that purpose it had always been the practice of his company to produce a maximum hoop stress in the rings equivalent to 95 per cent of the lowest value yield stress obtained on any of the acceptance tests, which figure was considerably higher than that mentioned by the author. Some non-uniform permanent set invariably resulted, indicating that there had been a redistribution in stress, or that there were some areas having lower than average strength which received the necessary additional working.

Experimental results confirmed that stretching by means of internally applied pressure greatly improved the uniformity of residual forging stress distribution. There could be little doubt that any method of forging which ensured uniform working of all the material in the ring, in contrast to the step-by-step method used with the Toronto rings, and also for the rings on the 60-Mw. rotor which failed in 1950, would produce a much more uniform distribution of those stresses. One ring possessing an undesirably high ratio of yield to ultimate strength had fractured explosively while undergoing hydrostatic test.

In addition to the two major factors mentioned above, he agreed that no doubt a number of minor effects came into play. One such effect, not mentioned, might arise from the construction used, shown in Fig. 1. Experience had shown that such a construction, in which the end bell was supported at two positions on the shaft, the deflexions of which were different, had led to fretting, and in extreme cases to fatigue cracking. Fig. 36 illustrated those effects.

Fig. 37 showed that cracking had occurred over the pole where there was a sudden and significant change in section of the rotor body due to the presence of a ventilation duct. It might not be without significance that, on the evidence of Fig. 11, both fractures in service appeared to have run to points on the lip at equal, but small, distances from the pole

Fig. 29. Final condition of rotor.

centre. If those points coincided with the edge of a ventilation duct, or of the first winding slot, then a further point of locally raised stress, coupled with a small cyclic variation due to the rotation of the rotor, was introduced along a section already weakened by the three holes in line.

The author had not, as the result of his investigations to date, been able to attribute those failures to any definite causes, but he himself was interested to see and to hear that he regarded the presence of holes, particularly in material susceptible to work-hardening during drilling, and the effect of cycling and similar effects, as being major factors, which agreed with his company's conclusions.

Harry West (*Member*), M.I.E.E., said that a catastrophe of such magnitude reflected not only on the manufacturing company, but also on British industry as a whole, and critical remarks had been directed at British equipment. Had there not been a number of recent failures of Amcrican-built equipment of similar size the criticism could have reached considerable proportions.

One was faced with the fact that a material which was fairly well understood and which had an ultimate strength of about 57 tons per sq. in., and a yield point of some 50 tons per sq. in., had failed under most peculiar circumstances; yet, according to Table IV, the undrilled rings had withstood a stress of approximately 50 tons per sq. in. The drilled rings had been subjected under hydraulic test to a mean hoop stress of something between 35 and 43 tons per sq. in. and had failed.

It could be shown that the stress pattern rising when a ring was drilled was such that the surface stress could reach theoretically some three times the normal hoop stress. Therefore, it was clear that rings did fail at a low hoop stress when it was possible to have high stress on the surface of the holes, and also where material had been work-hardened and has therefore lost most of its ductility. The material would be in a suitable state for a crack to start, and once it had started the failure of the ring would follow.

The author had given the figures for working stress in the Toronto ring as 19¼ tons per sq. in., and at the nose of the bell, where it was shrunk on to the rotor body, as 26 tons per sq. in. The author did not say whether the shrink stress of 26 tons per sq. in. was that at stationary or at running conditions. In a ring of that size he would use a stress of about 20 tons per sq. in. hoop stress and a shrink stress, cold, of 16 tons per sq. in. The rings had failed at the low hoop stress because, as could be seen from Table V, under cyclic stress the failure occurred at about 27.6 tons per sq. in. in the ring. The surface stress at the holes was possibly twice or more than that, and was, he thought, an explanation of the failure.

In 1928 his company had adopted the design shown in Fig. 38. The ring was completely free from holes, notches, or any forms of stress. At the same time an attempt had been made to maintain, as far as possible, a uniform section. Since 1928 some 800 rings had been in service successfully.

Fig. 1 indicated that stresses could arise from the deflexion of the shaft. Fig 38 showed that his company had adopted a mounting of the ring on the end plate which was itself mounted on a member completely free from the shaft. That system solved the problem of shaft deflexion.

Fig. 39 illustrated the complete copper damper across the surface of the windings.

As a result of that experience his company had been able to show that their first 37-inch rotor which had been put into operation in 1935 had a hoop stress of about 20 tons per sq. in. and a shrink stress, cold, of about 16 tons per sq. in.

It was interesting that the rings had been installed in a station where, for the previous ten years, there had been two-shift working. Therefore, the rings had withstood the type of cycling which the Toronto machines had had, upward of 6,000 times, but of course they had not been hydrogen cooled but air cooled.

At the time of the Toronto failures he had visited one of the largest French manufacturers and the largest Swiss manufacturer, and had found that they had

Fig. 30. Larger piece of end bell showing primary fracture.

Fig. 31. Close-up, showing brittle nature of fracture.

adopted a ring very similar in shape to that adopted by his company with complete success. In fact the ring material specification was similar to that which his company were using. They had found that under the hydraulic test a solid ring gave a stress diagram very similar to that which could be obtained from a reasonably selective sample. He had been interested to find that the Swiss manufacturer had actually rotated a ring at high speed in order to create a very high stress, had measured the stress-strain diagram and had found the behaviour of the ring to be identical with the piece of ring material which his company had previously tested. When failures took place there was a great deal of nervousness in connexion with the materials and designs, but he himself thought that one could take heart from the fact that solid rings had behaved very well in service.

Mr. Vickers had raised a point concerning the ratio between yield point and ultimate tensile stress. In the first 37-inch rings used by his own company the ultimate tensile strengths of two samples were 65.5 and 65.1 tons per sq. in., and the yield point in the first instance was 58.2 tons per sq. in., and in the second 55.9 tons per sq. in. In view of the fact that machine sizes were increasing, and that stresses were likely to increase, it was very important to have from the manufacturers a steel which would meet the new conditions and, in fact, he believed that results with the original steel indicated that it would be safe to increase the ultimate stress and the yield point.

Professor G. W. Austin, O.B.E., M.A., M.SC. (Cambridge), said that he was not clear whether both the end bells that had failed were from the same cast of metal. In Table I was indicated one cast of metal which covered both machines.

Secondly, on the question of working on and preparing the rings, he asked whether high-temperature treatment had been carried out. Frequently, material of that description was heated to a high temperature and then quenched, and he asked whether that had happened in the present instance.

Thirdly, in regard to the very striking comment (p. 215) that the yield point of the material had been raised from 35 tons per sq. in. to 50 tons per sq. in., that was a great increase in strength. He thought, rather as earlier speakers had done, that the ductility was being exhausted. If the yield point closely approached the ultimate strength it was possible only to count on 2 or 3 per cent ductility. The rest was surely a reduction in area. The same material was used yet a very great increase had been made in the yield strength solely by cold working.

In regard to the author's reference to brittle fracture, he thought that the author had compared the present failure with the brittle fracture of mild steel. With low alloy steels there was another brittle phenomenon known as tempered brittleness, and it was possible to see in the failed material a network reminiscent of austenitic network. With tempered brittle metal the grain boundary was the weak point, and by suitable treatment it had been possible to avoid that brittleness and susceptibility to it. In the same way, by treatment and alloying, it should be possible to remove the grain boundary weakness in the end bells.

One was apt to ignore toughness and that was why he thought that the retaining of adequate ductility and the possible introduction of the notch bar test would constitute a safeguard. He would prefer a softer, tougher material to a material which had been worked to an extremely high tensile strength and was at the limit of its ductility.

Dr. Charles Sykes (*Member*), F.R.S., said that the end bells under consideration had been manufactured by his company, so that they attached great importance to the investigation. In Appendix I, attention was drawn to the differences between the properties of the end bells as defined on the test certificates and the properties actually determined from test-pieces cut from the end bells. An alteration was necessary in interpreting the curves. The acceptance figures were based on the flick yield, which was roughly 2-3 tons higher than the 0.5 per cent proof stress. Therefore the full lines in the three Figs. 21, 22, 23, should be moved towards the horizontal axis by that amount. That im-

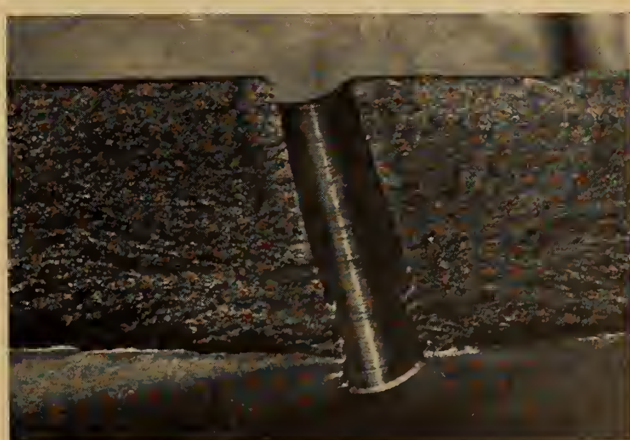


Fig. 32. Commencement of fracture.

proved the correlation. The main reason for the differences in elongation and reduction of area was associated with the fact that during the production of the rings both prior and during the cold working, some carbide precipitation took place and the degree of such precipitation was less at the ends of the rings from which the test material was taken than it was in the middle of the rings.

He would answer Professor Austin's point by saying that the material had been treated at 1,050 deg. C. prior to cold working. Subsequent to the Toronto failures his own firm had speeded up the cooling arrangements and had made them much more uniform, with the result that they had reduced the precipitation at the grain boundaries and had obtained better Izod values. At the same time, variation in ductility of the ring had been reduced.

Mechanical test figures were now available for No. 1 turbo-generator end cap which had failed after 76 cycles. It had failed at holes 39 and 39*a*. Tests had been made on the material between the two holes and the results were very similar but slightly superior to those recorded in Table IX for No. 4 machine, the exciter end. In considering the various possibilities contributing to the failures the internal stress set up in the immediate vicinity of the hole owing to the drilling should be included. While the internal stress system would be very local the stresses themselves might be very high.

Table VIII recorded a series of internal stress measurements and, while he thought that they tended to exaggerate the position, in the end rings they were variable from point to point. His firm had carried out a number of tests on rings which had been hydraulically tested in the manner described by Mr. Vickers, and the tests confirmed that that substantially evened up the internal stresses.

The forgemaster would be extremely satisfied if he could produce a type of non-magnetic material which could be hardened by heat treatment without cold working it. The cold working operation was difficult, and a good deal of time and thought has been expended on the problem of finding a heat-treatable steel. About two years previously his firm thought that they had found the solution. They had produced full-size rings with the appropriate mechanical properties and yield point, but had had to abandon the material because it had been found that the heat treatment left it in a condition in which it was much more susceptible to stress corrosion than the material at present being used. Experimental work was, of course, still going on to try to produce a material which surmounted the cold working difficulty.

The cyclic tests had emphasized the importance of the fatigue properties of end bell materials, and his firm had in hand an extensive series of fatigue tests. As the author had pointed out, under the results of Wohler fatigue tests the fatigue limit was about 21 tons per sq. in., and the ratio of the fatigue limit to the ultimate tensile strength was about 0.35 compared with 0.46 for heat-treated magnetic steels. The Wohler fatigue limit of the non-magnetic material was, however, practically the same whether the material was soft, having a yield point of 25 tons per sq. in., or whether it was cold-worked to 50 tons per sq. in. It seemed that the fatigue ratio decreased with the degree of cold working.

Mention had been made of the larger units now being contemplated, where presumably the working stress on end bells would be increased. At the same time it appeared that, owing to the very great increase in the efficiency of the cooling arrangements on those alternators, temperature fluctuations between the end bell and the rotor would probably increase during change of load. The importance of the temperature fluctuations was brought out very clearly in Figs. 25 and 26. Therefore, from the point of view of the steel maker, it appeared that shrink stresses would increase and the fluctuating stresses around shrink stresses would also increase. In view of that, he thought that the data recorded in the paper indicated that all forms of notch should be eliminated and that the shrink fit stress should be kept as low as possible in order to provide the maximum margin of safety against various types of fatigue load which would occur in service. There was an additional very important reason for keeping the shrink fit stress low. There was evidence that when stress corrosion took place it occurred when the end bells were stationary, when condensation could occur. The rate of stress corrosion probably varied exponentially with the stress, and the stress when the rotor was stationary was, of course, the shrink stress, so that it was desirable to keep it as low as possible.

L. E. Benson (Manchester), said that he had concluded on reading the paper that the ventilating holes were the major cause of disaster, also that without ventilating holes the rings would have had quite a generous margin of safety.

It was not, perhaps, realized how serious the weakening effect of the drilled hole could be in austenitic steel. The weakening effect could arise in three ways — by stress concentration, by strain hardening effect which limited the ductility of the material and, possibly, by local heating during drilling operations which, if severe, could leave the surface material in a state of initial tension when cooled.

In regard to the strain hardening effect, drilling in austenitic steel was a most difficult operation, and it was almost certain to be accompanied by severe distortion as shown, for example, in Fig. 13*b*, and by the severe strain hardening as indicated by the recorded hardness figure of up to 650 V.P.N.

Fig. 40 indicated how severe was the degree of hardening, and showed a plot of Vickers hardness against reduction in area. The points had been obtained from tensile test pieces which had been stretched, and if the graph were extrapolated up to the region of 600-650 V.P.N. it was seen that that represented a strain corresponding to a reduction in area of 90 per cent or more. At that figure the elastic limit would be very close to the ultimate tensile strength. There would be substantially no accommodation for stress concentration effects, and with a nominal working stress of, say, 20 tons per sq. in. it would be possible to have a cyclic stress locally at a hole of from nil to 60 tons per sq. in. Under those conditions it was not surprising that the material should fail.

Furthermore, in material that had been so drastically treated so much ductility had been used up that if the hole were made to deform by yielding of the material around the hole, then the material must crack. The conditions at the hole surface could be still further aggravated by roughness due to machining, and by the heat effect of drilling already mentioned.

In the absence of cold working the ability of the material to withstand repeated loadings even involving plastic strain was reasonably good. Results of fatigue tests hardly represented service conditions, but some results his firm had obtained experimentally were perhaps a better indication.

Fig. 41 showed the results of what were, in effect, fatigue tests carried out in slow bending on bar specimens of ⅝-inch by ⅜-inch section. The tests had not been carried out to simulate the effect of holes but to obtain information on the characteristics of the material. The test pieces had been strained from zero to a positive amount as shown, in tension. There was some scatter amongst the results but the general grouping of the points indicated that for 20,000 applications, which was probably as much as any coil binding ring would be likely to receive in service, the material was capable of withstanding strains above 0.5 per cent which, in the absence of serious stress concentration effects, would appear to provide an ample margin of safety. By the same token one should not expect the Parsons' ring, now being tested (without holes), to fail.

Fig. 42 showed the form of the test piece employed.

The material used for the tests had been provided by T. Firth and John Brown, Ltd. It had all been from the same cast and had been cold worked by different amounts to give the different mechanical properties indicated in Fig. 41.

Fig. 33. Pieces after fracture.

It was desirable that strain hardening effects on machining should be minimized, not only so far as the surface inside holes was concerned, but also on the outer and inner surfaces. His firm had therefore standardized finish machining conditions, i.e. tool type, shape, speed, feed, and so on. He did not claim that they had necessarily obtained the best possible conditions, but it was desirable not to have uncontrolled variations in machining with material that was so difficult to machine, or so easily work-hardened.

Apart from stress concentration effects it might be helpful to mention that his firm had evidence that machine finish, and in particular strain hardening, might affect the susceptibility of the material to stress corrosion cracking. The evidence was that with their own stress corrosion tests his firm did not obtain cracking under conditions which they understood other workers would regard as dangerous. For instance, even micro-examination at 100 diameters had not shown cracking on specimens tested at 30 tons per sq. in. in wet air and carbon dioxide for 500 hours, or at 20 tons per sq. in. in sea water for 2,000 hours. He did not suggest that machining was the answer to the stress corrosion problem, but it was important to recognize that surface condition could be a controlling factor in deciding whether or not cracking occurred or how far it occurred.

Fig. 34. Shows absence of appreciable "necking".

J. T. Moore, B.SC. (*Member*), M.I.E.E., said that he had been intimately connected with the investigations following the failure of the 37-inch diameter non-magnetic end bell referred to by Mr. Vickers, and would like to emphasize the remarkable similarity between that failure and those described by the author. Not only were the end bells of the same material, but they had also been manufactured at about the same time.

The extensive investigations following the bursting of the 37-inch end bell in 1950 showed that, while holes in the end bells had probably been not the sole cause of the failure, they had undoubtedly largely contributed when used in the particular cold-worked material, especially when the ratio of yield to ultimate tensile strength was high.

Not only had all identical end bells in service been replaced, i.e. identical dimensionally to the end bell which had failed at Rugby, but end bells in service of smaller diameter had also been replaced which, having ventilation holes drilled in them, were made of material with an unduly high ratio of yield to ultimate strength. The danger of the combination of holes drilled in end bells and a high ratio of yield to ultimate strength was confirmed by most, if not all, of the material acceptance test figures given in the paper for the different sets of end bells.

In Table I the ratio of yield to ultimate strength for the end bells for No. 1 machine was not excessively high, 89 and 86.7 per cent, for No. 2 machine 87.6 per cent and the rather high figure of 92.2 per cent, No. 3 machine 98.9 per cent (probably a rogue although indicative of unequal properties) (96.1, 93.1), and 88.4 per cent, but for No. 4 machine the ratios were both high, 91.4 and 93.4 per cent. He would have expected as a result of the experience in 1950 that the end bells on No. 4 machine with drilled holes would have been very liable to brittle fracture, and that was confirmed by the results on No. 4 end bells which the author had described.

In regard to Table IV, and the results of the hydraulic testing of the 37-inch end bells, the ratio of yield to ultimate strength on the two drilled end bells given was over 90 per cent (90.4 and 93.5) and both had failed at the holes at a not unduly high stress. On the other hand, the results on the two undrilled 37-inch end bells (with ratios of 91.4 and 94.7) would appear to show that, when undrilled, the ratio of yield to ultimate did not exercise the same importance. Nevertheless, he thought that any surface score or blemish could make such an end bell a potential danger.

From the results given in the paper and from the very similar results obtained by Mr. Vickers' company after their 37-inch end bell had failed in 1950, it would appear to be advisable to consider the replacement of any drilled end bells in service where, from the original test results the ratio of yield to ultimate strength was high. He knew that the author had had a most careful review made of all drilled non-magnetic end bells in service, and asked whether he could indicate what he considered to be the maximum acceptable ratio of yield to ultimate strength for drilled non-magnetic end bells of 37 inches diameter and less. He also wondered what was the similar maximum ratio accepted by Mr. Vickers' firm; it would be useful to have that information.

With cold-worked non-magnetic material for use in end bells the ratio of yield to ultimate strength was of vital importance, and he suggested that the various parties concerned in Great Britain, both manufacturers and users, should establish a national standard for the maximum acceptable ratio of yield to ultimate strength. All were most anxious to assist in every way in re-establishing full confidence in Britain's products and if national standards could be established for non-magnetic end-bell material, it would go a long way towards that object, and could be the forerunner of corresponding international standards.

On the assumption that an acceptable ratio of yield to ultimate was established, and that holes were not in future drilled in non-magnetic end bells of any size so that the question of the finish on the holes would not arise, a pressure test on the lines described by the author and by Mr. Vickers would seem advisable as being the only means of finding the occasional 'rogue' end bell. An end bell so tested to a reasonably high stress, and retaining its roundness without sign of failure under such a test, could be accepted with confidence, but if the end bell should go appreciably out of round under the test as a result of very unequal distribution of residual stresses, it should then be considered suspect and rejected.

As a further safeguard after machining, non-magnetic end-bells (undrilled of course) should be subjected to low-temperature annealing to remove, as far as possible, surface stresses without impairing the main properties of the material. He would welcome the views of specialists on the question of low-temperature annealing after machining.

F. Shakeshaft, O.B.E., A.M.I.E.E. (London), said that in presenting the results of a thorough investigation associated with the breakdown of the Toronto alternators, the author had made a valuable contribution at a time when large increases of plant output capacity were still in the development stage in Britain, and mainly in the manufacturing stage in the United States.

With the evolution of new cooling systems for both the rotor and stator windings, alternator output capacities of 200 Mw. were contemplated with rotor bodies of about 180-185 inches in length and around 40-42 inches diameter. As some 60-Mw. hydrogen-cooled sets had been built with rotor dimensions of about 190 inches body length, and 37 inches diameter for hydrogen pressure of 0.5 lb. per sq. in., it would be clear that the new 200-Mw. rotors were substantially the same in length, and only 8-14 per cent bigger in diameter than 60-Mw. rotors. The production of suitable rotor bodies should therefore impose no outstanding problem to the forgemaster as the increased stress level should require little or no change in metallurgical properties of the steel.

The dimensions of end bells for output capacities of 60 or 200 mw. were also very similar, the latter being only some 8-14 per cent larger in diameter. Opinions differed, however, as to the yield and ultimate strength required of the material from which the 200-Mw. alternator rings were made.

The favoured ratio between the yield and ultimate strength of materials was about 85 per cent, but the consensus of opinion was that the existing yield strength of 50 tons per sq. in. should be increased by some 10-14 per cent, i.e. to 55-57 tons per sq. in., or in about the same ratio as the increase in diameter of the end bell. That might involve a major change in the alloy used for the forgings.

A new alloy containing 18 per cent mangnese and 3 per cent chrome was being tried out on the Continent, but as little experience had so far been gained of its behaviour in practice some continental alternator engineers had named it a 'young' steel and awaited further results. It was not their intention to use the new alloy for 37-inch diameter rotors, but to adhere to an alloy similar to that now used in Great Britain.

He suggested that the problem was not one of simply designing for an increase of 8-14 per cent in rotational stresses computed under uniform temperature conditions, but of designing to avoid under service conditions, dangerous increase in compound stresses caused by temperature differences between rotor body and end bell. That problem must also be solved when aiming to achieve around 3 1/3 times the electrical output from a rotor of only some 20-30 per cent increased volume.

The experience already gained from semi-direct cooling of the winding in the rotor slots, together with the evidence made available in the paper, indicated that additional metallurgical and heat transmission research work was needed; further, that an exhaustive investigation into the mechanical design details should also be made before the fifty new large capacity alternators entered the manufacturing stage.

The application of semi-direct cooling to the rotor body winding had already shown the importance of adjusting the hydrogen flow through individual bars to avoid uneven cooling of the rotor body. If uneven cooling occurred it resulted in the bending of the rotor body and consequent heavy mechanical vibration.

Temperature differentials between the rotor body and the end bell might induce excessive combined hoop and bending stresses in the end bell. Examination of Fig. 26 showed that while the mean hoop stress in the end bell required to balance the forces imposed by the inertia of the bell and the centrifugal action of the end windings was 19¼ tons per sq. in., the maximum stress at the point of shrink fit between end bell and rotor body was about 32½ tons per sq. in. under the temperature differential quoted. That stress gave a factor of safety of around 1.5 only at normal speed on a yield stress of 50 tons per sq. in.

That raised important design matters. First, he wondered whether it would be wiser to shrink the end bell on both the rotor body and the carrier ring; secondly, whether it would be wiser to support the carrier ring on a separate sleeve either secured to the end of the rotor body or from a shaft seating adjacent to the body. One manufacturer in Great Britain and another in the United States had had satisfactory results with shrink fits as low as two-thirds of that now used when supporting the bell from the rotor body alone. That type of construction stressed the end bell more uniformly under stationary and uniform temperature conditions, and gave rise to smaller variations in stress with differential temperatures caused by service operating conditions.

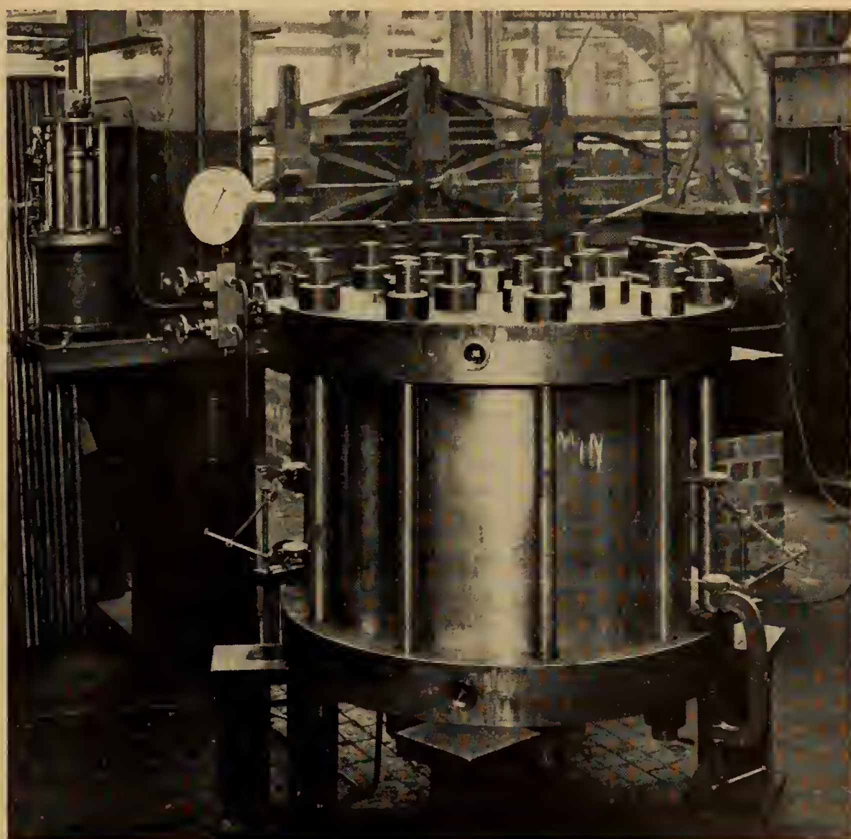
L. W. James, M.A., A.M.I.E.E. (London), said that whilst the paper dealt mainly with mechanical and metallurgical matters, there were a number of references to electrical items with which he proposed to deal.

The author had referred to the use of magnetic end-rings in place of non-magnetic rings which were more usual in Britain. One major effect in addition to those mentioned which had arisen in the past with magnetic rings had been a relatively large increase in the short-circuit stray losses particularly with full pitch and two-thirds pitch windings, giving reduced efficiencies and increased heating. Recent figures had, however, indicated that the increase with the modern involute coil of about 80 per cent pitch appeared to be very much smaller, and he asked the author for information on that effect on the Toronto machines.

In the paper the effect of holes drilled in the end rings was given as from 7 to 15 deg. C. reduction in rotor temperature and was stated to be an outstandingly helpful way of reducing temperature rise and overcoming copper distortion. It appeared, however, that for a given average temperature rise as normally measured, the actual temperature of the coil in the centre of the rotor body would be very much higher than the well-cooled end portions, and he would therefore expect that type of cooling to give, for the same average temperature rise, much more risk of copper shortening than the more normal type of rotor with a well ventilated body and slots. The new design of direct-cooled rotor was very much better from that point of view and should give a more even temperature.

The author had stated that the rotor body had a very much greater heat capacity, and therefore could follow the load changes only slowly, whereas the end bells would respond rapidly being cooled directly by the cold inlet gas. It appeared that, with a very well cooled ring as indicated, separated from the hot windings by means of fairly thick insulation, and joined to the hot body only by a relatively thin lip, the load temperatures would not be very much above the no-load temperatures, since very little heat was induced in the ring itself. He asked the author for approximate

Fig. 35. Measurements of expansions occurring under pressure.



figures for the temperature rise of the ventilated ring on load. It appeared that the use of the new direct-cooled winding with undrilled end rings would result in the rotor body and the rings having temperatures very much closer together than on the old design.

In regard to the effects of single-phase loading, while it had been fairly rare in the past to experience trouble in air-cooled machines, on most occasions when heavy unbalanced loading had occurred smoke, or the smell of hot insulation around the machine, had given warning before serious damage had taken place. It was not possible to notice in that way overheating effects of the type occurring under unbalanced loads with totally enclosed hydrogen-cooled machines and it was necessary to rely on some more accurate method for detecting unbalance. In addition, the present-day use of large numbers of main circuit breakers not having the three phases mechanically interlinked had increased the risk of single-phase loading.

Some eighteen months previously it had been agreed that all large hydrogen-cooled generators being installed on the British system should be protected against unbalanced loading by a suitable negative phase sequence relay, arranged to trip the machine off after a time delay depending on the degree of unbalance. An alarm would also be given as soon as the unbalanced loading reached such a value that there was risk of damage to the machine, so that the operators would have warning that the protection would trip the machine if no action were taken to reduce the unbalanced loading.

On the question of fire, he would be interested to know whether there had been any indication of explosion of carbon-dioxide bottles.

Dr. H. E. Davies (London) said that it would be shown that the presence of holes of relatively small size in comparison with the main section of a metallic material could give rise to a system of triaxial stresses at the holes, which could result in failure of the material by brittle fracture. The stress system at the holes was such as to inhibit plastic flow of the metal at those points, with the result that fracture took place with little or no deformation. The description and illustrations of the failure of the end bells on the Toronto machines presented evidence which indicated beyond reasonable doubt that that had been the method by which they failed.

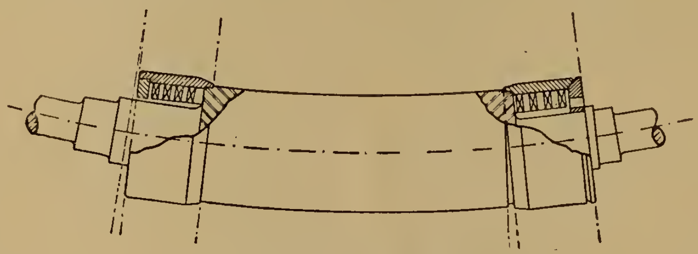


Fig. 36. Effects of rotor deflection.

Left: End bell fastened to rotor body only. No bending of end bell and no relative movement between end bell and body.

Right: End bell fastened to rotor shaft, resulting in bending of end bell and relative movement between end bell and: rotor body; windings; end cover.

Work hardening of the material, especially locally at the areas of stress concentration, also inhibited plastic flow, and increased the tendency to brittle fracture, but the stress concentration due to the presence of the holes and the fact that the material itself was cold worked throughout its mass would tend to override any tendency for fracture to commence in a hard hole as against a relatively soft one, as had been observed in one or two of the author's tests when bursting rings.

The fact that the stress conditions at the actual time of failure of the No. 2 machine end bell had not been so onerous as for the No. 1 machine end bell at its failure, should not be taken as evidence against a similar mode of failure in each case. Even brittle fracture did not necessarily propagate from initiation to final rupture in one instant under service conditions, as was evident from the number of holes showing cracks in some of the burst end bells, so that the conditions at ultimate rupture might not necessarily be so important as the previous history which initiated the crack. Presumably those conditions would be the same for both machines. The effect of that was illustrated by the cyclic tests on the end bells where failure had occurred at a stress not greatly exceeding the working stress, whereas in the static hydraulic testing failure occurred at a much higher stress value.

It seemed that the author's explanation for the overspeeding of the Venezuela end bells without mishap as being due to their much thinner section was reasonable. It had been illustrated for mild steel, under conditions propitious to its formation, that brittle fracture never occurred below a certain thickness. On the other hand it always occurred above a certain thickness, size effect being, therefore, an important factor.

Susceptibility to brittle fracture was also a property of the material itself, and he asked the author whether he had carried out tests, similar to those conducted on mild steel, which would indicate the propensity of this non-magnetic steel to brittle failure.

It seems extremely likely that in that design of end bell for a 100-Mw. machine, the limit of dimensions for the material had been passed when failure by brittle fracture would be almost certain to occur, and when it could be propagated by suitable stress raisers.

Although no indications had been forthcoming in the investigation to indicate that stress corrosion had played a part in the failure of the end bells, nevertheless that type of cracking had been uppermost in his mind when he had first heard of the disaster, since the susceptibilities of that quality of steel to that type of cracking had been amply demonstrated in the past. The British Electricity Authority, together with manufacturers, had taken active steps to examine as many end bells as possible for that type of cracking. Some seventy-four end bells had so far been examined, ten of which had exhibited stress corrosion cracking of varying degrees of intensity, some sufficient to cause rejection of the bells as being unsuitable for further service.

It was, perhaps, unfortunate that it was necessary to rely on cold working, with the resultant internal stresses in the material, to obtain the necessary mechanical properties of end-bell steel, since that condition made it more susceptible both to stress corrosion and to brittle fracture.

A. W. C. Hirst, B.SC. (Eng.) *(Member,)* M.I.E.E., said that the author and his associates had been wise in not jumping to what had been regarded by some as the obvious conclusion that the failure of the Toronto end bells was due solely to the presence of ventilating holes. The consequence was that, in casting round for other contributory factors, they had obtained a great deal of information which would be most valuable to designers who had not had similar experience, and who might now be able to avoid it.

It was suggested that if holes were used the surfaces should be carefully ground and honed, the implication being that that would substantially increase the stress at which failure would take place. He wondered whether any comparative tests had been carried out on end bells with holes treated in that way, and if so, with what results.

The problem was largely a metallurgical one, and in the present case depended very much on the amount of cold work that could be got into the material in the forging process. As with all forgings, the larger they were the more difficult they were to produce and it was hardly justifiable to compare the performance of the 7,500-kw. Venezuela end bells with the 5-foot diameter bells at Toronto.

He suggested that a series of tests on end bells of varying diameter, but otherwise generally similar in design, might yield valuable results. It was even possible that the necessary figures were already available piecemeal to individual manufacturers and steel makers, and by suitable co-ordination could be put together to form a complete picture.

He was pleased to hear the author state so categorically, in presenting his paper, that the accident was in no way due to the presence of hydrogen in the machine. On the morning following the accident the Canadian daily press had carried front-page headlines referring to a hydrogen explosion in the Toronto Power Station, and it so happened that on the reverse side of the same page there had been a picture of the Bikini atomic bomb explosion. That no doubt had given rise to an unfortunate association of ideas in the lay mind. Even today, in some quarters, there were misgivings as to the safety of the use of hydrogen for the cooling of turbo-generators and the sooner the hydrogen explosion bogey was laid, the better.

Dr. R. W. Bailey, WH.SC. *(President)*, F.R.S., said that the paper and the discussion should serve the following objects:

(1) They should ascertain the facts of the failures, nominating those most concerned, and of major significance.

(2) They should ascertain whether, and if so, what, alterations in design, materials, and manufacture would have made the conditions sufficiently less onerous as to have prevented failure.

(3) They should ascertain whether by utilizing the information disclosed, freedom from a recurrence of such a failure in future would be assured.

In varying degrees the three objects are achieved, either directly, indirectly, or derivable from the investigations and information reported, and therefore the paper rendered a valuable service to the engineering profession and to the industry.

It was possible, of course, to answer (2) and to ignore the remainder by saying that there was every reason to believe that had ventilation holes not been used the failure would not have occurred, which was virtually the conclusion reached by the investigation, but if that were done much important light upon the failure would thereby have been missed, including a satisfying explanation of it, especially in view of the author's declaration that 'previous experience and design by the same maker using end bells of similar materials, drilled with ventilation holes had been completely free from failure of the kind described in the paper'. Doubtless that fact made it difficult to unravel from apparently conflicting evidence a satisfying explanation of the failures, which on the evidence of the builder's clean record should not have occurred.

In his view the most significant feature of the failures was the fact that the fractures had been of the brittle kind. That would not imply that the material was other than normally ductile or indeed different from normal high quality material in any way, as, of course, had been amply confirmed by the many material tests made and referred to in the paper. The fact that the fractures had been of the 'brittle' kind sufficiently accounted for the catastrophic character of the breakdown and for the fact that it could occur under no more than working stresses, indeed at even lower than working stress if the conditions for setting in motion a brittle fracture were present. That heav-

Fig. 37. Cracking over pole at change of section.

ily cold-worked non-magnetic end bell steel could fail by brittle fracture was demonstrated sufficiently by the fact of the Toronto failures. But engineers and metallurgists did not possess, as a rule, an adequate appreciation of the significance of that kind of fracture which, when it occurred, caused bewilderment and alarm because usually behaviour appeared to be unrelated to the normally understood properties of the material. It was for that reason, and also for a better understanding of what occurred that he proposed to draw attention briefly to the subject.

In Fig. 43 the general stress f could be chosen so low as to be unable to support the propagation of a brittle fracture and the part would remain intact. Unfortunately, however, the threshold value of stress capable of supporting the propagation of a brittle fracture, if a ferritic steel might be taken as a guide (e.g. carbon steel), the threshold value of stress of the cold-worked end bell steel would be less than the allowable working stress in simple tension, indeed probably not more than two-thirds of the stress allowed in simple tension or for the end bell steel, say, 12.5 tons per sq. in. Thus, given the features which could initiate a brittle fracture, the destruction of an end bell under its own working stress, if as low as 12.5 tons per sq. in., would be feasible. That was analogous with the disturbing failures, by brittle fracture, of welded structures such as welded storage reservoirs and ships.

In order to remove at the outset 'fog' which might be introduced by drilled holes and cloud vision, one should be clear about the part played by the ventilation holes. It was common knowledge with engineers that elastic theory demonstrated that the stress concentration due to a small circular hole on a part under simple tension was 3, or the stress at the surface of the hole at the ends of its diameter perpendicular to the direction of the stress would be three times the stress without the hole. Or, with a tensile stress of 19 tons per sq. in.—the stress in the end bells—the stress at the hole would be 57 tons per sq. in. for elastic behaviour. The proportional limit of the steel was about 40 tons per sq. in., or 17 tons per sq. in. below the maximum stress at the hole, if the material were elastic. The elastic strain that would accompany a stress of 17 tons per sq. in. would be 17/13,000 = 0.0013. If it were assumed that plastic strain were all of that—actually it would be less—the increase in stress due to the cold work involved would be found by the stress concentration due to the hole to be 0.021, or the corresponding increase in hardness would be 0.1 Brinell. The figures for Brinell hardness at the holes given in the paper varied widely, the highest being 657. The normal hardness for the tensile strength would be around 300, and the values given by the paper were in the range 280-340. Thus the drilling had brought about a maximum increase of 357 Brinell, which compared with less than 1 which could be accounted for by the stress concentration effect of the hole. Clearly the influence of stress concentration of the holes upon hardness was negligible compared with that arising by cold work such as by drilling.

Fig. 43 showed a member in tension (it might be an end bell), containing a feature assumed capable of setting off a brittle crack when the stress f in the segment was of a sufficiently high value. When that happened a crack would shoot across the member at lightning speed (3,000-4,000 ft. per sec.) completely fracturing the part. The characteristics of the crack were revealed by the marking at the surface of the fracture, i.e. the chevron markings which were the orthogonals of the fracture front as it travelled. Those were shown in Fig. 43 for a plain member and for one drilled with two holes.

Clearly, what mattered was the feature which could set the brittle fracture on its course, because everything was over and disaster brought in a fraction of a second in a structure of normal high quality material. The feature which had brought disaster to the Toronto end bells was the drilled ventilation holes, not, in his view, by their action in causing the well-known stress concentration of a small circular hole of 3/1, but as a consequence of the increased cold working of the material imposed by the drilling of the holes.

The concentration factor of 3/1 would, of course, apply also to the strain equally with stress, but because of the high degree of deformation or cold working of the surface ductility was so lacking that under the strain concentrated by the hole, cracking of the worked skin would probably occur.

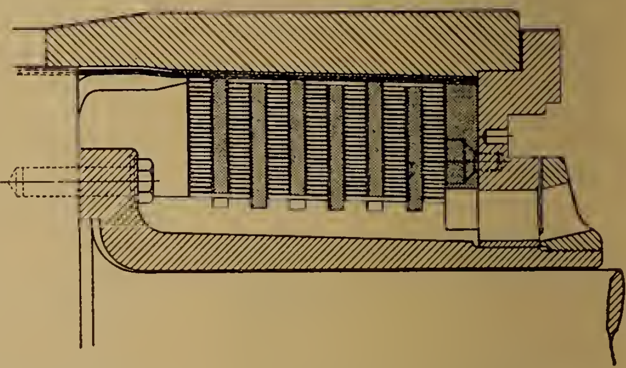


Fig. 38. Rotor end windings, end rings, and end ring support extension sleeve.

It had been amply demonstrated that a cold-worked surface, e.g. a hammered or peened surface of mild steel, for example, was a more effective source of a crack able to set off a brittle fracture in a part under stress. There had at one time been a great deal of trouble due to the fracture of anchor chains on being dropped on to decks. Heavy anchor chains, perhaps with a link diameter of 3 inches, had broken in two. Investigations made at the N.P.L. had shown that the hardened skin of the chains was capable of setting off brittle fracture, and that it was a potential source of cracking capable of setting off brittle fracture. A similar phenomenon might be expected with the drilled holes and the cracking of the surface skin would be equally suspected of being able to set off a brittle fracture. As so many holes had been drilled without resulting in disaster, one might well inquire the reason. He was inclined to think that the reason was the small depth of the hardened layer, another reason he believed was that the cracks of the skin had probably very sharp ends,

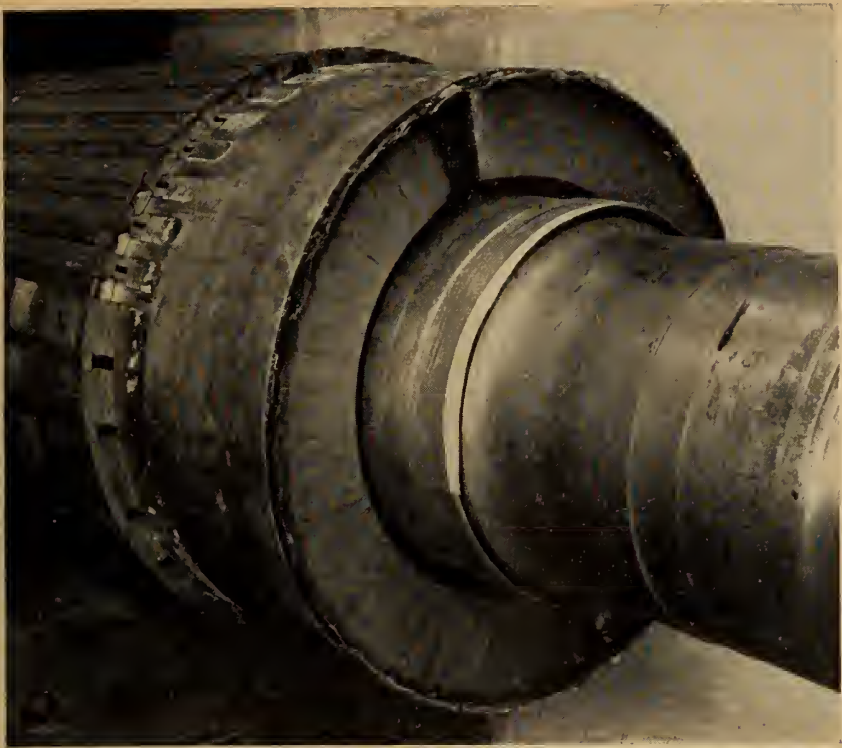


Fig. 39. Complete copper damper across surface of windings.

but if blunted failure would proceed gradually as found by the author.

With so many triggers, which might have become, with some alteration, able to set up a brittle fracture, it would seem that no significance should be attached to the fact that two rings failed in the same station.

So far he had commented upon object (1) and had nominated the work-hardened skin of the drilled hole to be, in his view, the cause of brittle fracture being initiated under the working stresses.

In regard to (2), his reading of the evidence led him to the view that any change in material would be a gamble, as insufficient was known about brittle fracture to make a change with any confidence; it was possible that all steels of the high physical properties required and of the dimensions needed would fail by brittle fracture. He would, therefore, prefer to stick to the materials known, and correct for their greatest weakness, whether or not the design involved drilled holes.

It was a well-recognized principle of the cold working of metals that the higher the degree of cold work the more rapidly softening could be effected by thermal action. Therefore, thermal treatment after machining, whether rings were drilled or not, could be made selective, softening the surface layers which had been most heavily cold worked.

COMMUNICATIONS

D. W. Puttick, (*Graduate*), G.I.E.E., wrote that he was interested in the laboratory tests carried out in order to ascertain the strength of the end bells, and asked whether they had been intended as a comparison between end-bell strength or to simulate the working conditions.

The following comments were made with the realization that what was theoretically desirable might have been found to be impossible in practice owing to the difficulty of sealing all leaks, which was essential for high-pressure testing with small-capacity pumps.

The restraints on the end bell on the generator did not appear to be exactly simulated by the hydraulic test conditions. Figures 1 and 2 showed that the end bell was constrained from moving outwards at one end by the support ring and the other end was free to move outwards under the effect of centrifugal load. In the test apparatus of Fig. 15 it would appear that both ends of the end bell were similarly constrained, both being free to move outwards. As the length of the centre piece was specified as exceeding the end bell by 0.004 inch, it would appear that the end bell was not restrained axially as it did not look possible for the end plate to distort that amount owing to the pulling down action of the outer ring of the studs. In other words, the end bell should be floating (to the extent of 0.004 inch) between the two thick blanking plates. It seemed curious, therefore, that the bursting of the end bell had caused a crack in the end plate and at the exact point of the end bell failure. He asked whether it was considered that the momentary opening out of the end bell caused it to hit the outer ring of studs which had broken the plate.

He asked how the end bell ventilating holes had been blanked. Theoretically the correct method would be a piston in the hole which would not restrain the end bell from moving outwards, being attached to the cast-iron centre piece as shown in Fig. 44*a*. Small blanking plates on inside and outside of the end bell strapped through the hole, Fig. 44*b*, would perhaps be easiest for solving leakage difficulties at 10,000 lb. per sq. in. but it was possible that the failures would not be obtained at the correct stress.

In regard to the results of the tests on the end bell he asked how the stress had been measured, or rather whether the stress had been measured by strain gauges, or by calculating them from the hydraulic pressure applied.

H. W. Puttick, (*Member*), M.I.E.E., wrote that the author had referred to the resemblance to brittle fracture on the failed end bells, and later he had referred to the thinner end bells of the Venezuela turbo-generator which had withstood successfully a serious overspeed.

He asked whether it would not be feasible to manufacture an end bell of composite material, i.e., say, a forging of 2 inches thickness of non-magnetic steel, with a shrunk-on ring of 1-inch thick magnetic steel. That would have better electrical characteristics than an end bell of magnetic steel, and would also have a much higher factor of safety than an end bell of non-magnetic steel.

R. C. Golding, M.E.I.C. (Toronto) observed that on p. 225 it was stated that the desire to have no possible chance of end bell movement when the unit was taken to overspeed to test the emergency governor, governed the design ruling that the end bell shrink should just loosen at 10 per cent above normal speed with the rotor end-bell at operating temperature. In Table II, however, it was stated that overspeed tests at 25 cycles went up to 13 per cent above normal speed. He asked whether that meant that under past conditions the bell had often lifted, and whether the new decision to decrease the shrink so that the bell would lift at 5 per cent overspeed, will worsen the position.

According to the author's statements his firm had many such end bells running on 60-Mw. machines, of 37 inches diameter, at similar stresses. However, those machines ran, he believed, at 3,000 or 3,600 r.p.m. Even with the smaller diameter, he wondered whether those smaller bells were stressed very much higher than the Toronto bells, taking into account the square law referring to speed.

H. G. McHaffie (Toronto) said that the paper summarized a notable investigation following on two regrettable mishaps. Unfortunately, however, it did not appear to have uncovered any items of metallurgical knowledge not previously familiar to those intimately associated with the turbo-generator industry. The investigation did remove all suspicion from the quality of the material used in the manufacture of the retaining rings.

His firm had used rings of this type for over twenty-seven years and in that period approximately 250 machines had been fitted with rings of that type, i.e. 500 or so non-magnetic rings were in successful service.

One solitary failure, definitely established as due to stress corrosion, had been experienced on a small, low-steamed machine which had been stored for an extended period in a salt-laden, humid atmosphere.

However, a selection of machines which had seen extended commercial service, had had their rings examined at the request of the purchasers and no traces of stress corrosion or of any incipient flaw of any description had been found. The rings had been re-assembled without modification or treatment of any description and were still in commercial service.

The material used was similar in composition to that described by the author but was not cold-worked to the same degree. Three grades had been used according to the working stress of the machine concerned. The specified properties of the grades were shown in Table A.

It would be observed that the specified ratio yield point/ultimate tensile strength in the case of grade I (as used on the largest two-pole machines) was lower than the specified ratio of 0.877 given in the paper.

Similarly the average test figure deduced from Table I showed that the ratio yield point/ultimate tensile strength for the Toronto rings was 0.912 and the corresponding figure obtained from test on grade I rings, supplied to his company, was 0.84.

Corresponding test figures for grades II and III were 0.79 and 0.73 respectively. They were convinced that the increased ductility more than offset any reduction in safety factor resulting from reduced ultimate tensile strength.

Similarly they had always avoided the drilling of radial holes in rings and other species of stress raiser. Perforated rings had never been used by the company.

They considered that the practice of supporting the ring at two points was faulty as the flexure of the shaft introduced an alternating stress. They had had a certain amount of vibration difficulty with doubly supported magnetic rings about thirty-five years previously and since then rings had been supported from the rotor body only.

His company believed that some increased difference in rate of change of temperature as between body and rings might result from the use of hydrogen as a coolant, but they could not believe that that could be sufficient to contribute to the failure.

They did, however, agree with the author that protection against unbalanced electrical loading was particularly necessary with hydrogen-cooled machines.

He regarded the results in Table IV to be most significant. It would be observed that all the undrilled rings had expanded without cracking whereas the drilled rings had either cracked or fractured.

Table A

	Ultimate tensile strength, tons per sq. in.	Yield point, tons per sq. in.	Elongation, per cent	Reduction in area, per cent	Ratio yield point/ ultimate tensile strength
Grade I	50	40	30	35	0.8
Grade II	48	35	35	40	0.73
Grade III	45	30	35	40	0.667

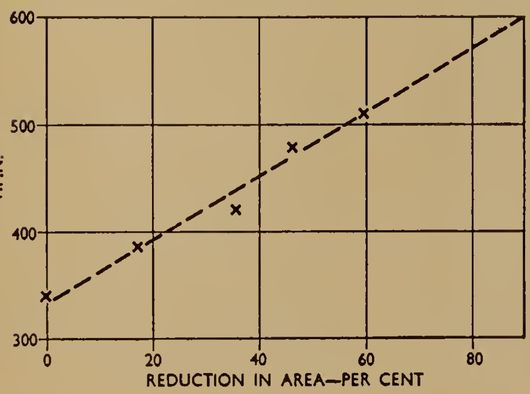


Fig. 40. Hardness versus reduction in area on tensile test. Non-magnetic steel units, ultimate tensile 55-60 tons per sq. in.

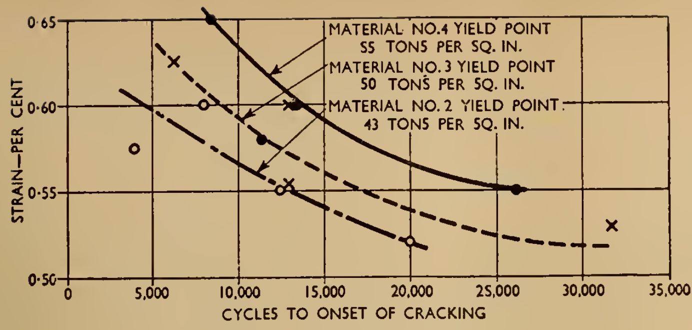


Fig. 41. Results of repeated strain tests.

A. S. Tuttle (Toronto) asked how the surface of the replacement ring was finished, and its chemical composition, having in mind the effect of surface treatment on fatigue resistance.

He also asked to what extent the electrical efficiency had been lowered by replacement of the non-magnetic ring by a magnetic alloy.

F. G. Watson (St. Catharines, Ont.) said that the paper was particularly interesting because the two failures with which it dealt appeared to be identical with the failure in July 1950 of one of the end bells fitted to the rotor of a 60-Mw., 3,000-r.p.m. machine manufactured by his company.

Details of the occurrence had not been previously published, but the information and the conclusions had been made available at the time to other British manufacturers and to users of such plant. Fortunately, the incident had taken place in an overspeed test tunnel and while the rotor was a total loss the fractured end bell parts had been recovered from the tunnel lining for examination and analysis.

The end bell fracture had proved to be generally brittle in nature commencing at the surface of a ventilating hole.

It seemed clear that while the ventilating holes might not be the complete explanation of the failure they had been a major factor. They therefore had abandoned the practice of drilling all end bells whether for ventilation or other purposes. Furthermore, all similar machines either in course of manufacture or in service having end bells with properties proved on their acceptance tests similar to those of the forging which failed had been refitted with undrilled end bells.

At the same time the policy had been adopted of keeping the ratio of yield point to ultimate strength low to permit plastic deformation.

He agreed that the omission of ventilating holes would increase rotor winding temperature, but did not subscribe to the opinion that their retention was necessary in order to prevent coil distortion. In this view the use of semi-hard silver bearing copper gave an ample margin of safety at the slightly higher temperature which, in any case, would be largely localized at the end turns.

It was acknowledged that the holes produced local stress concentrations and that, coupled with the work hardening that can and did occur when drilling, produced ideal conditions for the initiation of a brittle fracture. The danger was greatly increased should such a hole coincide with a region of high residual forging stress.

He also agreed that the ventilating holes in themselves were not sufficient to account for the failure, as the examination of many typical end bells showed wide variations in physical properties and residual forging stresses arising from the cold working of the material in the course of production.

That led his firm to introduce in 1950 a hydrostatic testing rig and subsequently every end bell has been subjected to test. With the test rig it was their practice to create a maximum hoop stress in the end bells equivalent to 95 per cent of the lowest value of the yield, taken from test pieces. Tests showed that consequent stretching improved the distribution of the residual forging stresses.

In addition to the two major factors mentioned, a secondary contributory cause could be the method of supporting the end bell at two points involving shrinking on both the rotor body and the shaft. Their experience had shown that such a construction in which the end bell was supported at two positions the deflexions of which were different, led to fretting and, in extreme cases, to fatigue cracking.

It was interesting that the author regarded the presence of holes and residual forging stresses as being major factors, as that was the conclusion arrived at by his company in 1950.

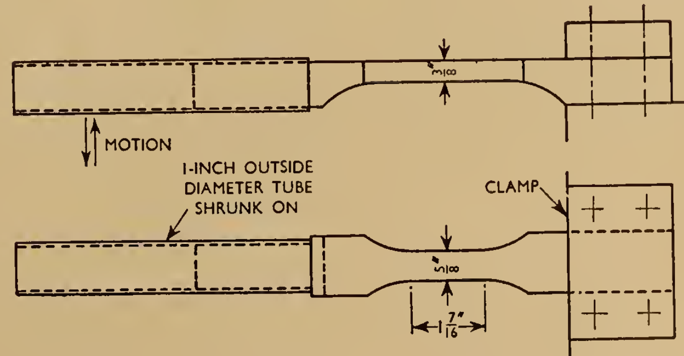
Vote of Thanks to Sir Claude Gibb

H. Fealdman, M.E.I.C., in proposing a vote of thanks to the author for his paper, said:

In rising to move this vote of thanks to Sir Claude on behalf of the Toronto Branch of the Engineering Institute of Canada, I must confess to a feeling of great pleasure mingled with a sense of humility in the presence of such a great engineer.

It does not fall to many of us during our lifetime to be present on an occasion when engineering history is made, but I am certainly of the opinion and so, I believe, is every single person in the audience, that tonight is one of those very memorable occasions.

Fig. 42. Form of test piece used.



Engineering progress can only be made on occasions such as the present, where an original mishap has caused a great deal of engineering talent and time to be concentrated on the solution of a particularly difficult problem, by the complete publication of all the relevant facts and conclusions.

In very many cases in the past this publication has not taken place, and the knowledge so obtained remains the secret of a select few. I have to congratulate Sir Claude on the full and frank treatment that he and his company have given to the subject we have heard discussed this evening. It is certain that this paper will long be a model upon which students and research workers in all branches of engineering can base their investigations and reporting.

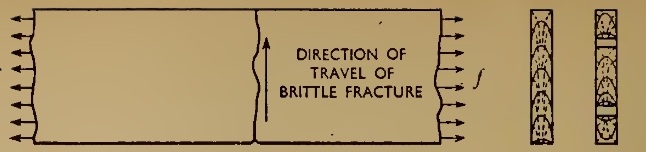


Fig. 43. Effect of general stress *f*.

I personally, have been quite fascinated by the process of deduction that was carried out prior to the solution of this problem, a process of which Miss Agatha Christie would have been quite proud. I am sure that had the effervescent M. Hercule Poirot had been here himself this evening, he would have been the first to lead the applause which, surely, has never been more merited.

I wish to extend the thanks of the Branch through Sir Claude to the very large team of engineers, scientists, and mathematicians who laboured so long and so hard to perform the work described in the paper. In conclusion I wish to thank Sir Claude specifically, not only for his work and inspiration to the team, but for the immense amount of trouble he has gone to in coming here to deliver the paper to us and for the very clear and simple manner in which the presentation was made.

I feel certain that every single person in the hall will join with me in according Sir Claude a very hearty vote of thanks.

REPLY BY THE AUTHOR

Sir Claude Gibb, in reply, wrote that as many similar points had been raised by several contributors to the discussion, it would be preferable to submit remarks extending the information given in the paper rather than to reply individually. He would, however, pay tribute to Mr. Pask and his colleagues for their interest, assistance, and forbearance in making rotors available for examination and test after long periods in service, thus to extend the scope and value of the investigation.

Had he himself considered, or the evidence led to the belief, that ventilating holes were the prime cause of the failures, the paper would never have been written and the industry would have continued in ignorance of the small margins of safety under which rotors were operating until further disasters had been experienced. It was true to state that as the result of the investigations and the researches consequent upon them, changes in forging technique, in design and in manufacture had enabled the industry to proceed with complete confidence in the manufacture and operation of generators of outputs appreciably greater than double that of the generators which had failed.

Researches into the material and methods of manufacture of end bells had continued as a matter of urgency and would continue for a considerable time. One outstanding result had been the improvement in the notched bar toughness of austenitic non-magnetic end bell material of identical composition from between 20 and 70 ft. lb. Izod at the time of the failures, to 80-120 ft. lb. at the present time.

A large number of end bells of identical composition to those of Toronto which had been in service for long periods under similar operating stresses and conditions had now been withdrawn for rigorous examination and testing. In no case had anything been found which had given the slightest cause for nervousness regarding their continued suitability for service over an indefinite period. Since the end bells had had to be replaced to enable destructive testing to be made, the replacements had been of similar non-magnetic material, but without ventilating holes.

In a cyclic pressure test carried out since the paper was presented, an undrilled non-magnetic end bell forged by a modified technique but of the same size and similar properties to the Toronto end bells had withstood, without detectable effect or damage, 1,000 cycles of a range of stress from zero to 40 tons per sq. in. At the oil pressure corresponding to a mean hoop stress of 40 tons per sq. in. seal failure had occurred after approximately every six cycles, necessitating the stripping down of the heavy bolting and flange plates and making testing so slow that the testing had been discontinued after 1,000 stress cycles. A similar end bell but drilled as the original Toronto bells, had been subjected to hydraulic pressure producing a mean hoop stress of 47.6 tons per sq. in., at which load continued stretching of the bell caused the oil seals to fail. The pressure test had been repeated after renewing the seals, and again at a mean hoop stress of 47.6 tons, expansion of the bell had caused the seals to fail without fracture of the end bell. The yield point of that bell, as shown by the acceptance tests, had been 43.5 tons per sq. in. When these test results were compared with those given in the paper for the original end bells, the advance in the quality of bells owing to changed forging techniques resulting from those investigations would be apparent and comforting to operating engineers.

Several contributors had referred to the high ratio of yield point to ultimate strength in the Toronto end bells and expressed a preference for a lower ratio. It was obvious that all designers would prefer that ratio not to exceed, say, 0.85, but the end bell had certain functions to perform while the forgemaster must have a margin on specified minimum yield point figures and for cold worked austenitic alloys that margin had long been agreed as 7 tons. Hence, when working to the specification of 50 tons per sq. in. minimum yield point, and allowing the forgemaster's tolerance, the ratio of yield point to ultimate strength could vary between 0.877 and 0.934. The latter figure was not of itself dangerous but it did indicate an increased susceptibility to brittle fracture. Furthermore, the tests taken from widely differing places in a particular end bell showed the values of yield/ultimate ratio to vary from 0.876 to 0.964. Thus acceptance tests had not necessarily been representative of the properties of a bell as a whole.

Austenitic steels were not in general susceptible to brittle fracture, but to obtain desired physical properties in end bells, the high carbon content and the conditions realized in processing resulted in the formation of a definite boundary envelope of carbide which provided a ready path for brittle fracture. Thus with the material available and the method of forging adopted up to the time of the Toronto failures, the possibility of failure has been present in many machines and only the absence of the 'triggering' combination of several factors had avoided trouble.

Whilst ventilating holes were one source of stress raiser, there were, of course, many others, and a particularly dangerous one would be a recess at the shrunk nose of the end bell which, unless the shrink was to be removed at speed, was likely to be the plane of maximum stress in the bell.

The discussion had shown the differences of experience or opinion between designers. Mr. McHaffie liked a low ratio of yield point to ultimate tensile strength, whilst his colleague Mr. West would appear to be satisfied with ratios

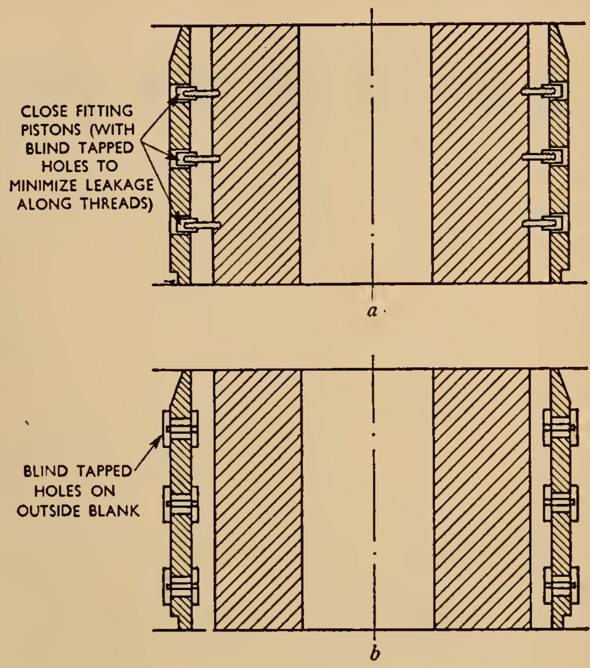


Fig. 44. Methods of blanking end bell ventilating holes.

higher than those in the Toronto rings. Those differences in the considered opinions of designers were, of course, based upon experiences, satisfactory or otherwise, of their current and past designs. His own experience would lead him to expect stress corrosion to develop between the copper damper and the end bell in the design shown in Fig. 39, but obviously Mr. West had so far not detected such an effect.

The Toronto rotors were four-pole, 1,800 r.p.m., and therefore very stiff shafts with almost uniform deflexion. No trace of fretting corrosion had been present under the nose of the cap and, as the Toronto nose had not had a stress raising recess, the cracking shown in Fig. 37 would not take place. The report referred to by Mr. Vickers and Mr. Watson was, it is believed, dated June, 1954—some three months after the Toronto failures.

Professor Austin had asked whether the two end bells which failed had been from the same cast of metal. It had now been established that they had not been from the same cast. Tensile specimens from the end bells showed more uniform extension and less necking than specimens of heat-treated alloy steel, hence the elongation figures obtained during tensile tests were a true measure of ductility. There was no other established method of obtaining high yield points in large non-magnetic forgings than by cold work.

A wide variety of alternative alloys had been tested or used for non-magnetic end bells, but all had one or more serious disadvantages, amongst them often being a marked susceptibility to stress corrosion.

No claim was made in the paper that a reduction of temperature rise of the rotor windings by the use of ventilation holes in the end bells, or by other methods, was the only way of preventing coil distortion, but it was one important factor. The use of hard drawn silver bearing copper was another important factor but it had not been established that it alone would be completely effective.

The wide interest shown in the report, both in the London and the Toronto presentations, was adequate recompense to him and his colleagues for its preparation. An advance in the science and the art of generator design and manufacture had resulted from the failures.

He wished to thank the contributors to the discussion, and particularly Dr. R. W. Bailey for his advice and assistance as well as for his valuable contribution. √

ABSTRACTS . . .

OF RECENTLY PUBLISHED ENGINEERING LITERATURE

APPLIED SOLAR ENERGY

Air Conditioning, Heating and Ventilating, v. 52, n. 12, December 1955, p. 73.

Solar energy is being harnessed directly today for heating, cooling, and for motive and electric power. A report on the World Symposium held last month in Arizona, with abstracts of those papers of interest to heating and air conditioning engineers, is presented in two parts of which this is the first.

The preliminary conference on the scientific basis of solar energy conversion was organized to permit scientists to meet and exchange ideas in advance of the World Symposium in Phoenix. Papers at the conference were in general beyond the scope of this presentation, but will be published in proceedings of the Association of Applied Solar Energy.

Dr. Farrington Daniels of the University of Wisconsin, introducing his discussion of basic principles and problems, said he thought this conference might give as much international impetus to solar power as the recent Geneva conference did to atomic energy. Dr. Daniels envisions solar power and atomic power as developing together and atomic power handling heavy loads in urban areas while solar power supplies the smaller unitary demand typical in rural areas.

At present, he said, the conversion of solar energy into usable forms costs more than conventional power sources. New technology and new ideas will be required before solar energy is widely available on a competitive basis.

Henry B. Sargent, president of the Association for Applied Solar Energy, described how the idea for the association was conceived as a result of conversations between himself and Dr. Daniels some two years ago. It seemed desirable, said Mr. Sargent, to have an association which could form a vehicle, not only to encourage further scientific and engineering work in connection with solar energy, but which could serve as a means of presenting to industry and business accurate information on the present state of the art. Accordingly, on March 17, 1954, Mr. Sargent met with a group of men from industry, agriculture, finance, and education who agreed that additional steps should be taken to meet the problem of greatly increased world requirements for energy.

A staff paper presented by J. E. Hobson, director of the Stanford Research Institute, explored the economic possibilities of solar energy. In the not too distant future, said Dr. Hobson, we will be confronted by an imminent, ominous shortage of the fossil fuels and other energy sources packaged and stored for us through action of the sun. Men of this generation must prepare today for this coming crisis.

Direct use of energy from the sun offers immediate, specific economic opportunities. Some have already been developed. Engines have been operated with solar power; water has been lifted by solar powered pumps; solar furnaces have produced exceedingly high temperatures; solar ovens can cook our basic foods; houses have been heated by solar devices. Solar cooling and direct solar electricity are physical if not economic facts of life today.

The economic advantages of large producing units do not apply to solar energy devices, because the major cost factor is in the area of the collector. That area must be doubled to double the capacity. Ordinarily the net gain from doubling the size may not be sufficient to overcome the additional operating difficulties. We may never build solar power plants with a capacity of 100,000 kilowatts, but we may well build 10,000 plants, each with a ten kilowatt capacity.

There does not seem to be an economic potential now for solar house heating in most of our eighteen selected cities, said Dr. Hobson. However, solar house heating is more economical where the cold season is long and the weather clear, since longer heating means a higher use factor. There are many locations, especially in the mountains, where solar space heating can be utilized economically today.

For a panel discussion on solar house heating, Dr. Maria Telkes of New York University reviewed research projects which have been conducted with solar heat collectors. Development and use of low cost heat storage materials is essential for the economical solution of solar heating, Dr. Telkes said.

A solar Engineering Exhibit, concurrent with the Symposium, is described in this month's News pages. Next month, the balance of abstracted papers, covering solar power, heating, cooling, water heaters, and mechanical, chemical and electrical converters will be published.

FLUID COKE — NEWEST STEAM PLANT FUEL

By F. H. Stracke and F. H. Schiffer
Power, v. 99, n. 12, December 1955, p. 102.

The power industry is showing much interest today in test burnings of a new fuel known as fluid coke. This article reviews the program of Esso Research and Engineering Company in its studies to determine the adaptability of fluid coke for steam generation, including full-scale combustion tests recently finished at the Essex Station of Public Service Electric and Gas Company.

For many years there has been a continuous increase in worldwide consumption of gasoline, heating oil, jet fuels and other light petroleum products. While the market for heavy fuel oil has increased, the rise has not been as rapid as for light products. In addition, there has been a trend toward processing heavier crudes.

About two years ago Esso became active in a project to determine ways and means of best using this new product. Because refiners who adopted the fluid coking process would be faced with the problem of moving large volumes of carbonaceous material new to the industry, a long-term development program was established. Early studies showed the material was useful as a fuel, primarily for steam generation. So we had to learn how it could best be used.

At that time the total supply of fluid coke in the world was about ten tons, from pilot-plant operations. We realized that the usual volume-burning cut-and-try technique, so familiar to the fuel industry, would not apply in this instance. So our second problem was developing this material as a fuel while having little of it to work with.

A 4-part program was established. (1) Theoretical combustion calculations were made. (2) Laboratory-scale tests were the second part of the program. (3) Pilot plant tests were proposed should lab tests bear out the calculations. (4) Last step was to make full scale tests.

These tests showed that electrostatic precipitators will function properly when handling fluid coke. Other large-scale tests indicated mechanical precipitators are somewhat more efficient handling fluid coke refuse than when handling fly ash.

Much additional information, yet to be procured, cannot be obtained until a steady supply of fluid coke is available. Based on these tests, however, Public Service has contracted for the entire output — about 170 tons per day — from the fluid-coking unit recently completed at Esso Standard Oil Company's Baltimore refinery.

Based on the laboratory and full-scale test programs, it can be said that the power industry now has a fourth fuel — fluid coke — which can economically compete with coal, gas and oil.

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RESCUING DOWNTOWN AND ITS TRANSIT

By Philip M. Talbott, Woodward & Lathrop Co., Washington, in December 8th issue of *Public Utilities Fortnightly.*

Following a 9,000 mile trip through the U.S. and Canada, visiting fifteen major cities, the author contends there is nothing wrong with downtown sections of principal cities that cannot be corrected by joint action of leading citizens who have an interest in downtown areas.

It is not his opinion that downtown America is doomed. However, the problem of downtown vitalization is not merely a matter of dressing up our main streets and the buildings and stores that line our thoroughfares — it is far more than that. The problem can be solved through unified and vigorous action, properly executed.

Action should have these immediate objectives: (1) Organization of small groups of business men and civic leaders to establish a program with sole objective of an economically, culturally and socially strong downtown district. (2) Development of a program based on elimination of slum sections, better traffic conditions, rapid mass transportation, private capital for construction to vitalize the area, and promotion to bring people downtown.

No set program would fit every city. A program should be mapped out which will be effective for each particular city. Suburban developments cannot be ignored. Suburban shopping centres offer an opportunity for additional business competing more with each other than with the greatest shopping centre of all — downtown.

Many blighted downtown centres have deteriorated buildings which are the property of absentee owners. Committees should urge executors of such estates to encourage modernization. Downtown is everybody's business, everybody's responsibility. There is a job in downtown vitalization for everyone interested in his community.

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WAR AND PEACE IN LABOUR RELATIONS

By Robert N. McMurray, *Harvard Business Review,* November/December, 1955.

Current labour philosophies are 'fair weather' programs. The time has come when management must set up a preventive labour relations policy to maintain the balance of power between company and unions.

The plan for labour peace through balanced bargaining power which is offered in this article is in no sense a panacea and it is not for the tender minded nor the doctrinaire. In fact, a number of companies cannot use it at all, either because of lack of sincerity or because of lack of forceful leadership. On the other hand, it may be helpful to those companies that do genuinely desire to help their people and have the kind of executive who can maintain the respect of both the union and the workers.

There is a need and place for labour unions. In large corporations some form of collective bargaining is a must: individual bargaining is impossible. But just because unions are here to stay is no reason not to try to place a check on the power and arrogance of some of them.

We must face the fact that labour peace in the sense of absolute freedom from conflict is neither possible nor desirable. The answer lies in keeping the conflict within reasonable bounds. This is best accomplished by maintaining a balance of power between management and the union.

This can be done if the business is headed by strong and emotionally healthy men capable of participative leadership. Labour problems require the same executive strength and competence as do all other aspects of business, and are not susceptive to any special quick tricks or 'gimmicks'.

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TRAINING OF ENGINEERS

By Dr. E. A. Allcut, Prof. of Mechanical Engineering, University of Toronto
Modern Power and Engineering, v. 49, n. 12, December 1955, p. 52.

The problem of the shortage of engineers in Canada is an important one, because our civilization is becoming increasingly dependent on engineering and engineers — indeed our chances of survival may well depend on them. Most engineering degree courses of any repute are of four years' duration and the question therefore arises: "Could these courses be reduced to three years, or could the length of the academic year be increased, without sacrificing anything essential?"

All in all, the present four-year course appears to be of the right length. If it had not been so, we should have changed it long ago, particularly during the post-war years, when we were swamped with students. A shorter course would have been a godsend at that time.

Suggestions have been made and seriously considered, from time to time, that the length of the academic session should be increased but, for several reasons, these have not been adopted. The most important consequence would be the reduction of earning power by the students during the summer months. At the University of Toronto (and other institutions) the practical experience gained during the summer is considered to be an essential part of their training.

Lengthening of the sessions might make it impossible to get or retain adequate staffs, particularly in times like these, when they could easily leave and go into industrial work on more lucrative terms. Another factor in Canada is the prevalence of high temperatures during the summer months, which makes it almost impossible to work in laboratories that normally have relatively high temperatures and humidities.

Evening classes also have been considered, but unless budgets and staffs are greatly increased, these cannot be carried on to any useful extent.

If it be conceded that a minimum of four years is required to give suitable preparation for an engineering career, and that there is no reasonable prospect of increasing the length of the session to any appreciable extent, the problem boils down to the necessity of training a greater number of students with the buildings and facilities that may be available in the near future. We are also face to face with the practicability of reducing the failure rates in the engineering courses.

It must be assumed that there is no desire on anybody's part to reduce educational standards for the purpose of obtaining an increased "throughput". Apart from any other consideration, this panacea would be opposed by the Professional Engineering Associations as well as by the universities. I believe that both of these conditions could be met by the institution of junior engineering colleges, into which all engineering undergraduates would go for the first two years of their courses.

Those not chosen for the university course could continue in the junior college and, on graduation, could receive diplomas or certificates entitling them to practice in certain aspects of engineering work. This procedure would assuredly reduce the failure rate in the university, perhaps to a remarkable extent.

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INSTRUMENTATION OF A 14-IN. EXPERIMENTAL ROLLING MILL

The Engineer, v. 200, n. 521, December 9, 1955, p. 846.

This paper describes the comprehensive instrumentation on the new 14 in. experimental rolling mill in the British Iron and Steel Research Association (B.I.S.R.A.) Sheffield Laboratories. Roll force on each side of the mill, front and back tensions and strip gauge, using the B.I.S.R.A. gaugemeter principle, are continuously indicated on high-speed servo-operated potentiometric indicators fitted with large pointers and dials. The whole instrumentation scheme is designed and laid out as a model system for industrial mills of this class. Facilities are provided for experiments with various systems of automatic gauge control. A simple system of on/off control of the existing a.c. screw motors according to the gauge deviation has been successfully operated with a tolerance of only $+0.0005$in. Facilities are also provided for switching to automatic tension control based on measured tensions as an alternative to the present method of control of coiler-motor current with correction for radius of build-up.

The system of measurement and display of roll loads, strip tension and strip gauge described in the paper has shown itself very satisfactory in service and has served as a useful model upon which industrial instrumentation schemes might be based. The rationalisation of the electronic units and the choice of a potentiometric system of display have helped greatly in getting this comprehensive scheme quickly into service.

Experiments so far carried out with a simple system of automatic gauge control by on/off control of the screw motors, using the gauge error indicator to initiate the control action, have shown that this system has considerable promise for use on some industrial mills.

$15-MILLION POWER STATION IN B.C.

From news release of British Columbia Power Commission and Canadian General Electric Company, April, 1956.

The world's largest concentration of gas turbines for the generation of electric power will be placed in operation on Vancouver Island in 1957.

The British Columbia Power Commission announced it has placed an order on Canadian General Electric Company for four gas turbine-generator units with a power capacity of 100,000 horsepower.

Site of the power station likely will be in the central section of the east coast of the island, according to Power Commission general manager Lee Briggs. Total cost of the station will be in the order of $13,000,000 to $15,000,000, depending upon final design details, location and length of related transmission facilities.

Though the initial installation will be gas turbine units fired by heavy-type oil, provision is being made for future expansion, if and when required, with steam turbine units using either coal or other fuel.

The order received by C.G.E. includes two 19,750 kw simple cycle, single shaft units, and two 18,000 kw regenerative cycle, single shaft gas turbines. The units are rated at 50° F. inlet temperature at an altitude of 200 feet above sea level.

The units will be built by the General Electric Company's Gas Turbine Department in Schenectady, N.Y.

Turbines will have tip speeds of 910 mph, and the average speed of air traveling through the turbine's compressor will be 314 miles per hour.

Each gas turbine will drive a 3,600 rpm, three phase, 13,800 volt generator which will produce 25,600 kva. of electric power at 60 cycles.

The gas turbine is essentially an internal combustion engine which directly transforms energy contained in fuel into usable mechanical energy at the coupling. However, instead of having a reciprocating motion similar to the usual internal combustion engine, the gas turbine has a rotary motion with continuous firing. The gas turbine assembly contains a shaft driven axial flow compressor which furnishes compressed air for the working medium. This compressed air is heated to the required turbine inlet temperature by burning fuel in a system of combustion chambers. The hot compressed gas from the combustion system then expands through the turbine buckets to develop rotary power to drive the air compressor and to supply shaft horsepower to drive the generator. After expanding through the turbine buckets, the gas at reduced temperature and pressure is exhausted either to the atmosphere or to a heat exchanger depending upon the cycle.

The station will be capable of furnishing enough electricity to adequately satisfy the average yearly needs of 190,000 persons. The use of the plant in large part is to "firm up" power from the Commission's hydro plants so that its Vancouver Island customers will not be threatened by "brown-outs" from time to time as load growth expands.

• • •

ASWAN HIGH DAM

A staff article in *The Engineering News Record*, issue of February 9, 1956, p. 44.

Egypt's proposed Nile river project, of current international concern, becomes increasingly interesting with this release of preliminary design details. Its maximum height, 361 feet; length, 3.1 miles; base thickness, 4,276 feet; volume of fill, 54.93 million cubic yards; reservoir capacity, 105 million acre feet; reservoir, 300 miles long, and holding four times as much water as Lake Mead.

Discussed for decades, it has been under serious investigation since 1952. In 1954 a Board of Consultants studied proposed design and construction, making recommendations now being incorporated in the final design. The estimated cost of construction is $1.3 billion. It will take ten years to build.

A construction timetable would shape up as follows: First four years, four diversion tunnels and cofferdams to Elev. 365. Fifth and sixth year would take it up to Elevation 395, including drainage ditches, grout curtains, upstream blanket and excavation of powerhouse cavern. Another four years would complete it to elevation 643 and see installation of eight hydraulic power units.

• • •

A TECHNICAL LEVIATHAN

Editorial in *Engineering*, v. 181, n. 4694, January 13, 1956, p. 33.

The opening of the Iron Curtain to specialist visitors from the West has enabled a number of people to catch a glimpse of the advances in scientific and technical education which have been taking place in Russia since the war.

The present rate of production of professional engineers and technicians in Russia, which to-day amounts to about 350,000 a year, can be compared with the numbers taking degrees and National Certificates and Diplomas in this country, which amount to about 21,000. When account is taken of the relative populations the Russian figure is over four times our own. Even if the production of university-standard graduates in all faculties continues at only the present rate, in 15 years' time there will be one graduate for every 40 of the Russian population — a staggering achievement.

Standards are certainly comparable with those in other industrial countries; while the numbers themselves, of professionals and technicians together, are comparable with those in the United States.

The question left in one's mind, after digesting the startling information provided by the report, is whether the accelerating development which it discloses must not lead to the creation of a Leviathan state impelled by blind technical progression towards world domination or its own destruction.

He would be a bold man who would say that he was certain that the Russians, if they were ever to outgrow their philosophical and political authoritarianism, would not be found to have reached that goal more successfully than ourselves.

Abstract of the report referred to: —SOVIET PROFESSIONAL MANPOWER, by Nicholas DeWitt, National Science Foundation, U.S. Government Printing Office, Washington, D.C., U.S.A. $1.25, appears on page 40 of the same issue.

Month To Month

JAN. | FEB. | MARCH | APRIL | MAY | JUNE | JULY | AUG. | SEPT. | OCT. | NOV. | DEC.

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

Comparison of Salaries

Not long ago a survey of salaries of professional workers was made and issued as a confidential document. One copy has been filed with the Institute. It is full of very interesting information but in view of the confidential nature it is not possible to publish it. However, here are a few paragraphs which appear on one of the pages.

Doubtless engineers right across Canada will be interested in these observations.

"Observations"

"Canadian industry in 1955 pays its professional employees at approximately the same level as did American industry in 1952 (using for comparison figures from the Los Alamos Scientific Laboratory 1952 National Survey of Professional Salaries).

"In all countries plant operators are paid more than laboratory workers at the same level of education and with the same years of experience.

"When related to purchasing power the average Canadian salaries may not be very much greater than the British but there is no doubt that, on this basis, American rates are considerably better than either Canadian or British, especially when total lifetime earning power is considered.

"British doctors of philosophy have no advantage in starting salary over bachelors and masters. This differs from both American and Canadian practices.

"Scientists and engineers in British industry double their starting salaries in 12 years, in Canadian industry in 16 years and in American industry in 17½ + years despite the much higher level at which Americans begin.

"It is also obvious that the percentage of older people in British industry is greater than in either Canada or the United States."

Cover Picture

Launching of the new "Empress of Britain" at the Fairfield shipyard, Govan, Scotland, in June, 1955. She made her first transatlantic crossing in April and attracted considerable public interest during her stay in Montreal.

Shortages, Shortages

Recently on picking up an old number of the *Ontario Medical Review*, it was interesting to see that the medical profession also have their share of shortages.

There is therein an article which states that the report of the Ontario Health Survey Committee, which dealt with "Medical Manpower in Ontario", contained many recommendations with regard to finding new personnel for the profession.

Herewith is a quotation from the report:—

"Under the section dealing with 'Hospital Facilities and Services' the Committee recommended:

> Measures to provide training for additional hospital personnel to meet the following shortages existing at the time (1948) of this survey, i.e. — 22 pathologists, 25 radiologists, 99 laboratory technicians, 209 radiographers, 35 laboratory radiographer technicians, 176 dietitians, 91 pharmacists, 94 physiotherapists, 36 occupational therapists, 52 combined occupational-therapists, 128 medical record librarians.

"Under the 'Mental Facilities and Services' section of the Report, the Committee recommended:

> That the universities of Ontario be granted sufficient funds to train psychiatrists and other professional personnel to relieve the present shortage and to make possible the recommended mental health programme. Annual cost of this training is estimated at $500,000;
>
> That 54 psychiatrists be added to the staffs of existing mental hospitals to meet immediate needs, and that an increased number of psychologists, social workers, occupational therapists and physiotherapists be employed as they become available;
>
> That in order to make possible

the early implementation of various of these recommendations, despite the acute shortage of psychiatrists, an effort be made to employ on a part-time basis in the public service psychiatrists who are engaged in private practice."

that Canadian mill production of structural shapes and reinforcing bars be increased to overcome the serious supply problem.

There is still scope for further amendments to the NHA whereby home ownership can be extended. Moreover, many of our existing houses are substandard. As population grows and standards rise, many units will have to be improved or replaced.

Greater activity in re-housing and multiple-unit buildings will involve important policy decisions, and gives additional weight to past CCA recommendations that an advisory housing committee should be formed to provide the various groups concerned with a medium through which to co-ordinate and present their views to CMHC officials.

The increased volume of house building has been accompanied by the entry into the market of some with no experience in the building of houses and little in the way of financial resources. It is important that these aspects be borne in mind before granting them credit. Once work has commenced it should be adequately inspected to assure protection to the owner, the lender, CMHC and the reputable builders.

Pipeline Progress Reported

This *Journal* contains the first article in a new series, on "Canadian Pipeline Projects", in which we will report the progress of important pipeline developments in Canada.

The first article, on page 651, is a review of the discovery and use of Canadian natural gas, and the story of the part played by the Westcoast Transmission Company and Trans Canada Pipelines in recent years. The Westcoast Transmission Company will be transporting gas from the Peace River gas field, where the estimated reserves are 3.5 to 4.5 trillion cu. ft., and will be associated with the Pacific Northwest Pipeline Company, to serve northwestern United States. The Trans Canada Pipelines propose lines going east as far as Montreal from the southern Alberta fields, where the reserves are estimated at 15.5 to 20 trillion cu. ft. Though there is much negotiation to be done yet on this larger program, there may be news of the commencement of the western leg of the project in 1956.

Obviously these are matters of great interest to the Canadian economy and to Canadian engineers. The *Journal's* plan to follow and report our major engineering developments calls for this new series, which we hope our readers will enjoy.

Correction

Some notes on the career of the president-elect, V. A. McKillop were published on page 473 of the April issue. In the interest of accuracy it should be reported that the degree received by Mr. McKillop in 1924 was that of B.A.Sc., and not that of B.Sc., as stated.

CCA Brief to Federal Government

A submission from the Canadian Construction Association was presented to the Federal Government on February 28, 1956. Signed by CCA President A. Turner-Bone, and S. D. C. Chutter, the Association's general manager, this submission presented the statement of policy and resolutions adopted at its annual meeting. An abstract of the text follows:

A year ago hope was expressed that the volume of construction in 1955 would reach $5 billion. Preliminary estimates indicate that this figure was exceeded by a margin that more than compensated for the increased dollar total due to a 2 per cent average rise in basic construction costs. The physical annual volume of work has roughly doubled during the decade since the end of World War II.

The annual increase in the volume of construction during the entire post-war period has constituted one of the most powerful stabilizing influences in our overall economy . . . So much of the Canadian economy relies on the construction program that any sizable reduction in the amount of building activity would not only affect adversely the industry itself but also our general economy throughout the country.

Indirect action by the government influences the commencement of an even greater volume of "private works". For example, roughly half of our new houses are being financed through the National Housing Act. This amounts to about 15 per cent of the volume of construction. Losses on NHA loans have been negligible. Similarly, the federal rates set for income tax, depreciation and interest charges greatly influence capital investment decisions by private individuals, corporations and other bodies. Government policies concerning the volumes of immigration and trade also affect the volume of construction.

The prospects for 1956 are for a new record volume of construction under conditions of exceedingly keen competition. The industry's capacity has expanded so as to take care of the heavier demands. Supplies of several products — notably steel — have, however, been unable to keep pace with current demands. . . . In view of our large iron deposits and the increasing market for steel products, it is especially desirable

Highways

Despite record roadbuilding programs undertaken by the provincial governments in recent years, the backlog of road requirements has steadily increased. The benefits ensuing from investment in well-planned and well-built roads are great. Although the outlay may be large, it will bring many dividends in the form of increased economic activity and revenues resulting from development and expansion.

It is therefore again recommended that federal grants be made available to provinces for use on Canada's main highway network, and that an auxiliary joint program be carried out with regard to international connections, new access roads to undeveloped areas, approaches to national parks, railway-highway grade separations, etc.

All sections of the Association once again endorsed a policy statement advocating the "co-ordination and centralization of responsibility and control of construction projects under a general contractor". A joint meeting was held in 1955 between a CCA delegation and senior officials of Defence Construction Ltd. and the Department of Public Works to discuss tendering and contract procedures. The subjects discussed are generally applicable to all federal departments and agencies administering construction contracts.

For example, all federal agencies but CMHC require tenders to be submitted to their Ottawa office and a serious problem exists with regard to tenders arriving after the stated closing time due to delays. It is accordingly recommended that a point be designated in each province for the delivery of sealed tenders.

In a clause common to all federal tendering documents it is stated the government does not guarantee information furnished concerning subsurface conditions, and that all bidders must examine the site and make their own appraisal. It is strongly recommended that the Canadian government amend its policy by improving the calibre of and accepting responsibility for the subsurface information included in its specifications.

On private projects, subcontractors and suppliers have protection under the terms of Mechanics' Lien Acts in the event that a general contractor goes bankrupt. It is not possible, however, to take lien action against federal government property and many subcontractors and suppliers have suffered financial losses following the failure of a general contractor. It is requested that protection be provided to such firms.

Other resolutions urged that only the lowest tenderer be invited to re-bid except in the event of a major revision in plans and specifications, in which case the three lowest tenderers may re-bid; that the practice of retaining a portion of a holdback as a performance guarantee past the time limit set by Mechanics' Lien Acts requirements be eliminated; and that sole authorities be designated for both the design and supervision of construction wherever practicable.

In addition, the "Statement of Policy" reiterated long-established recommendations that unit prices on lump sum building projects should be restricted to excavation, concrete, formwork and reinforcing and that tenders should be called and opened in public except in the "secret" or emergency categories.

The Association appreciates the privilege of representation at the opening of tenders at all federal departments and at some federal agencies. Central Mortgage and Housing Corporation, Defence Construction Ltd., the Federal District Commission and the St. Lawrence Seaway Authority, however, do not conduct regular public tender openings. It is most important that the relative standing of the bids be made known without delay . . . The public tender opening principle for public projects has been long-established and adherence to it is an indication that tenders will be considered on an equitable basis.

Wintertime Construction

The Association greatly appreciates the action of the federal cabinet in issuing a directive to all federal departments and agencies requiring them to time their construction projects so as to provide the maximum amount of wintertime employment . . . It has also been encouraged by the support given by other national organizations for wintertime construction and employment. Eight national bodies representing business, designers and labour are participating with the CCA in a joint committee to publicize the feasibility and benefits of wintertime construction.

The subject is of widespread interest to the public and it is believed much has been accomplished in overcoming the belief, erroneously held by many, that work carried out in the winter months is either of inferior quality or excessive in cost or both. Further efforts by all to continue this educational and promotional campaign are recommended.

Labour Relations

The Association believes that periodic meetings of management and labour representatives can assist in improving industrial relations, and it is hoped that the National Joint Conference Board of the Construction Industry, which met over a period of years under the auspices of the Department of Labour, may once again function. Now that the TLC has agreed to amalgamate with the CCL, it may be that it will also be agreeable to sit down with the Catholic Syndicates (CCCL) on the National Joint Conference Board, thereby giving representation on a national basis to construction trade unions.

The Association has increased its staff with a view to stepping up its activities in apprenticeship promotion work. Training for engineering and management positions in the industry also should be carried out on a much larger scale to meet the industry's needs.

Immigration

It is strongly recommended that the facilities of the Department of Citizenship and Immigration be used to the utmost to encourage an orderly program of selective immigration on a larger scale than in 1955.

Federal Sales Tax

The Association has already made representations advocating the removal of the federal sales tax from the many building materials still subject to tax. These representations were supported by subsequent briefs from not only a number of specialized trade associations but also the Canadian Tax Foundation and the Canadian Manufacturers Association. There is widespread recognition of the desirability of removing the problems facing builders and tax officials alike resulting from a complex tax and a complex industry.

It is hoped, therefore, that the next federal budget will incorporate amendments whereby structural steel, plumbing and heating materials, lumber, roofing materials and other materials now only conditionally or partially exempted, will be given full exemption. It is also hoped that the placing of a number of electrical apparatus items, nails and staples, air conditioning equipment, acoustical materials and construction equipment and tools with the exempted group will receive favourable consideration. It is believed that the refund procedures recommended in connection with materials used on provincial government and public hospital projects would greatly reduce the present paper work.

Foreign Project Insurance

It has become apparent that there are opportunities for Canadian contractors to tender on overseas construction projects. It is recommended that the Export Credits Insurance Act be amended to provide insurance against non-payment on services in order that Canadian contractors may participate in overseas contracts.

Special Tariff Arrangements, Construction Equipment

Canadian contractors and manufacturers and suppliers of construction equipment are adversely affected by the special tariff arrangements concerning equipment not available in this country in that they are more advantageous to the foreign firms. While these concessions may have been desirable during World War II, it is believed that the necessity for them no longer exists.

Work on the Westcoast-Transmission Co. Ltd., gas pipeline. The crossing of the Coquihalla River, near Hope, B.C.

Canadian Pipeline Projects

Commencing with this issue, it is the *Journal's* intention to review the news and progress of the projects for piping Alberta natural gas westward to Vancouver and the Pacific states, and eastward to serve Canada's central provinces.

Two major Canadian projects, together involving an expenditure approaching $1¼ billion for transportation of natural gas from Alberta by pipeline to outside markets, are now nearing the construction stage.

Since outside of Alberta and Southwestern Ontario natural gas is little known by Canadians as a fuel, to acquaint those elsewhere in Canada with the natural gas industry the following brief history and background is presented.

History

Canadian natural gas was exported to Buffalo and Detroit as early as the 'nineties' from Ontario fields in Dawn and Welland Counties. In 1900 it was discovered in commercial quantities at Medicine Hat, Alberta. Calgary, Lethbridge and nearby towns have heated with gas for 45 years. Edmonton and surrounding areas have had it 30 years.

Growth in production in Canada has expanded more than threefold over the past decade to 163 billion cubic feet per year in 1955. About 85 per cent of this volume is used in Alberta, 10 per cent in Ontario and 3 per cent in Saskatchewan with small quantities in New Brunswick and the N.W.T. This total production would be equivalent in heating value to some 6½ million tons of good grade coal annually.

Today supplying slightly more than 5 per cent of Canada's energy requirements, by 1975 our gas production may increase a further fivefold, and by then would probably be supplying some 13 per cent of the nation's energy. That this is possible is seen by comparing the growth of production in United States, where gas furnished 13 per cent of that nation's energy in 1938 and 23 per cent in 1952.

Since 1947 discoveries in Alberta alone have increased gas reserves fourfold, and reserves in Western Canada are today conservatively estimated at 20 trillion cubic feet and optimistically at 25 trillion cubic feet, with a heating value equal to some 800 million tons of coal. Reserves are thus increasing far faster than production, while south of the international boundary supplies have been depleted from a 30-year supply in 1938 to a 23-year supply in 1952. Since little incentive to drill for gas in Canada has existed so far, few doubt that gas export will vastly spur further discoveries.

Many Pipeline Companies Sought Charters

Ever since discoveries of vast oil pools in Alberta in 1947, such as Leduc, Redwater, and later Bonnie Glen, Golden Spike and others, with their accompanying gas reserves, and of the huge Pincher Creek wet-gas field in 1947, a flood of competing pipeline companies have sought charters from Parliament to carry Alberta's natural gas to export markets outside the province. Pincher Creek field, with enough gas reserves to supply Toronto city for 80 years, plus enough propane to fuel 66,000 farm homes for 20 years and sulphur to furnish half Canada's present consumption, was first favoured for supplying the nearby north Pacific states market.

Early pipeline applicants sought to pipe southern Alberta gas to Winnipeg, and through the mountains by various routes to supply north Pacific states and Vancouver. As discoveries followed in northern Alberta and northern British Columbia however, it became apparent that the latter sources were too far distant from eastern Canadian markets.

Government policy favoured using these for Pacific Coast markets, leaving southern and central Alberta gas fields to supply local consumption and for export eastward. From the first, federal policy has supported an all-Canadian pipeline eastward north of the Great Lakes, in preference to the easier and shorter route south of the Lakes.

Gas Export Will Stimulate Canadian Economy

The impact from any new source of energy on a nation's economy is sure to be tremendous. For Canada, this has been amply demonstrated over the past nine years by the impact from the rapid growth in western oil production. So great is the predicted increase in Canadian energy requirements over the next 20 to 25 years, about double that of today, that the expected further fivefold increase in gas consumption, 3½-fold increase in electric power, threefold increase in domestic oil, still leave room for a 50 per cent increase in oil imports and considerably more imported and even domestic coal consumption than at present.

Natural gas is more economical than coal or even oil, since no space is required for storing fuel in bins or tanks. No handling, no stocking or ash removal is necessary. Dependability is another point in its favour. A supply is always available without transport by truck or tank wagon. In cleanliness and in heat value it most nearly approaches the ideal fuel. It is the most versatile of our natural resources. In some parts of Canada it can readily replace electric power for space and water heating, thus releasing electric power, where scarce, for other uses.

According to the American Gas Association, science has already developed more than 25,000 applications for natural gas in industry. Three out of every four new petrochemical plants in the United States built during the last few years are using natural gas as a raw material. Already there are large and diverse petrochemical industries growing up around Edmonton and at Sarnia, Ontario, using Alberta gas for synthesis.

Largest of these are the Canadian Chemical Company plant and The Sherritt Gordon Nickel Refinery near Edmonton. The former produces cellulose acetate from by-products of Canadian petroleum for treatment of 300 tons daily of west coast pulp. The latter uses natural gas for an ammonia leaching process of the nickel and copper sulphides, without the customary roasting and reduction. The success of this project has broad implications for the Sudbury area, where combined production of 300 million pounds a year, some 16 times Sherritt's production, may some day be largely refined by the same process, using Alberta gas from the proposed Trans-Canada pipeline.

Westcoast Wins Fight for Pacific Markets

Westcoast Transmission Company, first of the two surviving pipeline companies to reach the construction stage, had been denied Federal Power Commission approval in their first attempt to seek a permit to export, in June 1954. The company's original plan was to pipe gas from northern Alberta and northern British Columbia via the Yellowhead Pass and Kamloops, to Vancouver and the states of Washington and Idaho, U.S. cities of Seattle, Portland and Spokane.

The FPC had questioned the feasibility of the project and the adequacy of its gas reserves, pointing out the hazard of a United States market area being entirely dependent on gas supplies from a foreign country which, it claimed, could be cut off peremptorily at will.

Early in 1955 Westcoast made a deal with the Pacific Northwest Pipeline Company, guaranteed by El Paso Natural Gas Co., to join its gas reserves in northern Alberta and B.C. with these Company's reserves in the San Juan Basin, to serve market areas in Washington, Oregon, Idaho and later California. New hearings started in October, and final FPC approval of the new setup was announced on November 25, 1955.

Trans-Canada the Leading Contender for Eastern and U.S. Midwest Markets

Trans Canada Pipelines was originally backed by the Canadian Delhi Corporation, whose objective was to serve Winnipeg, Toronto, Montreal and towns and cities along the route, with a 2,200-mile pipeline starting from Princess, Alberta. Competing with it was Western Pipelines, which sought the limited objective of serving Winnipeg through an 800 mile pipeline, with branches to other prairie cities. Both of these obtained charters in 1949.

The present Trans Canada Pipelines Company is a merger of these two groups, forced by the federal government in January 1954. It is backed by C. W. (Clint) Murchison, billionaire Texas oilman and promoter, who looks upon it as his greatest undertaking. The Tennessee Gas Transmission Company who have a contract with Trans Canada for 200 million cubic feet per day delivered at Emerson, Manitoba, for serving Minnesota, Wisconsin and other central state areas, have a substantial interest in the Company. So has Canadian Gulf Oil, which will provide about two thirds of the gas for the project.

The Company proposes a 2,350-mile pipe from Princess via Winnipeg, Lakehead, Kapuskasing, North Bay to Toronto and Montreal with branches to serve Sault St. Marie, Sudbury, Ottawa and Hull. Diameter will be 34 inches to the Ontario border, 30 inches from there to Toronto, then 24 inches Toronto to Montreal with a 16-inch branch to serve Ottawa-Hull. A branch would leave the main line at Winnipeg to deliver gas to the Tennessee Gas Transmission System at Emerson. Cost of the entire project inclusive of gathering and distribution systems is estimated at about a billion dollars.

The Company now has until October 30, 1956 to show it is able to finance the project exclusive of the stretch of 675 miles across the initially unproductive territory through northern Ontario between Winnipeg and Kapuskasing, Ontario. The Federal Government and the Ontario Government propose to build the pipeline across this Ontario gap through a Crown Company, and lease to the Trans Canada for 10 years, with an option to purchase. A bill authorizing the setting up of this Crown company is now before Parliament for approval.

FPC Hearings Will Be Lengthy

Meantime the Federal Power Commission in Washington is conducting hearings regarding the project. This promises to be the most complicated and controversial legal battle in FPC history and it may be the longest. Widespread opposition has developed from many gas companies in the central States, as well as from railways, coal operators and the powerful United Mine Workers of America.

While there is little hope that a decision may be reached before the October 30, 1956 deadline, there is the possibility that Trans Canada may arrange financial assistance for building the western leg of the project as far as the Ontario border during 1956, with the assistance of Tennessee Gas Transmission and Canadian Gulf Oil Co. Such an offer, if accepted by the federal government, might result in extension of the deadline for proof of ability to finance, and thus retain the Company's permit.

Meanwhile, a rival group headed by Frank McMahon, Alberta gas and pipeline promoter, and backed by a group of US investment houses headed by Eastman Dillon & Co., has proposed to build the entire Canadian line without government assistance other than relief on sales tax and duty. This group proposes the sale of 400 million cubic feet of gas daily to four big midwestern gas producers, more than twice the export sought by Trans Canada.

Elections and Transfers

At the meeting of Council held at Headquarters, on Friday, April 20th, 1956, a number of applications were presented for consideration and on the recommendation of the Admissions Committee the following elections and transfers were effected:

Members:

B. Alexander, *Montreal*
D. S. Anderson, *Vancouver*
L. T. Beck, *New York*
S. H. Bingham, *New York*
J. D. Buchanan, *Cornwall*
W. F. Campbell, *Ottawa*
D. G. Edwards, *Newark*
J. Eilau, *Vancouver*
G. N. Essauloff, *Toronto*
H. A. Gadd, *Cobourg*
W. A. Horn, *Toronto*
H. V. Ievers, *Toronto*
J. H. Kila, *Sherbrooke*
H. C. Lee, *Montreal*
R. H. Magwood, *Ottawa*
L. H. J. Maile, *Toronto*
V. A. M. Robertson, *London, Eng.*
W. B. Snarr, *Ottawa*
L. W. Swain, *Guelph*
D. L. Tarlton, *Toronto*
G. F. Welter, *Montreal*

Juniors:

F. Bright, *London, Eng.*
A. Edmonds, *Montreal*
J. C. Holden, *Montreal*
J. E. Souccar, *Montreal*
E. Staible, *Yorkton*
R. T. Williams, *North Bay*

Affiliate:

J. A. Page, *Montreal*

Transferred from the class of Junior to that of Member:

L. C. Banfield, *Montreal*
J. W. Black, *Ottawa*
R. E. Crossey, *Montreal*
J. W. A. Donald, *Windsor*
G. A. Harrison, *La Tuque*
J. G. Lefebvre, *London, Eng.*
A. F. MacDonald, *Winnipeg*
R. C. McDermott, *Toronto*
K. W. Moore, *Toronto*
R. C. P. Preston, *Picton*
K. F. St. George, *Corner Brook*
R. Tetreault, *Granby*
R. E. Thompson, *Montreal*
W. M. Walker, *Winnipeg*
R. Watson, *Montreal*
G. Wood, *Toronto*

Transferred from the class of Student to that of Junior:

C. F. Adams, *Cornwall*
B. J. Ferries, *Winnipeg*
A. Long, *Montreal*

The following Students were admitted:

Queen's University

W. M. Duncan
L. O. Gloin
K. A. Methot
G. B. Miller
W. J. E. Milligan
W. D. Morgan

University of Toronto

R. J. A. Barr
D. J. Knapp
J. A. Krupicz
K. G. Linseman
R. G. Ridgeway

Royal Military College

A. V. Andrews
J. W. Beare
R. L. J. Lalancette
D. E. Stothers

Nova Scotia Technical College

G. L. Crooks
J. E. Andrews

University of Alberta

B. C. Compton
D. A. Rae

Dalhousie University

R. H. G. Mitchell
D. W. Street

McGill University

J. J. P. Larouche

University of New Brunswick

S. W. Hill

Graduate

G. Lee, Montreal, B.A.Sc., British Col. 1955

Associations

G. A. White, London, Ont., Student, Assn. P.E. of Ontario
J. H. Tonn, Student, Assn. P.E. of Manitoba

Applications through Associations:

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections have become effective:

ALBERTA

Member:

R. M. Donald

SASKATCHEWAN

Student:

A. Stuart

QUEBEC

Junior:

J. G. Kirkland

St. Lawrence Seaway and Power Project

The *Engineering Journal* reviews the progress of the St. Lawrence project.

At the Barnhart power plant, one gantry crane assists in construction of the second.

In spite of a rugged winter, good progress was made on both seaway and power developments; 1956 is the key season of the construction period, and the most important as far as progress is concerned. Seven thousand or more workers will be employed in the Cornwall-Massena area, or some 15,000 in all between Montreal and the 1000 Islands.

Progress by Ontario Hydro

Approximately 26,000 cubic yards of concrete had been placed at end of March in the permanent structures in the north end of the power-house excavation. During the month, the concrete placing operations accelerated and some 22,000 cubic yards were placed during March.

To speed up the concrete operations, three gantry cranes are to be erected on the power-house site, two on the upstream face and one on the downstream face. One has already been erected, and erection of the second was virtually completed by the end of March. It is expected that the third unit will be ready by next month.

During March, work on the St. Lawrence transformer station in the 115-kv. section was pressed to completion. This section was scheduled to go into initial operation the first week in April. At the same time, initial steps had been taken to effect the change-over of the transmission lines replacing those from the Cornwall transformer station, which is to be removed commencing in April. Many tests had been made on the new equipment during the month.

The Cornwall transformer station was being removed to make way for the new diversion canal. For that channel, earth excavation had been completed in the closure structure area, where the dyke will meet the new canal. Progress also had been started on rock stripping within the closure structure area.

Heavy snow and cold weather slowed up the house moving operations during the month. By the end of March, 115 houses had been taken to New Iroquois. At the New Town No. 2, sewer and watermain installation progressed favourably. Work was well advanced on the construction of the pump-house and the installation of the water intake. At New Town No. 1, house surveys were virtually completed. The sewer and watermain work was pressed forward despite bad weather.

In channel improvement work, progress was made in excavation on Galops Island despite unfavourable conditions. The contractor had completed part of the excavation down to grade at the west end of the Island and had exposed rock over an area of about one acre.

Generally, the month of March presented unfavourable work conditions throughout the entire project because of the severe snowstorms, high winds and sudden thaws. Total personnel employed averaged 2,875 for March.

Ontario Hydro has called tenders for the relocation of a section of the CNR line which will be affected by the seaway. This undertaking will consist of track laying, ballasting and associated work for some 39.5 miles of double-track main line. All permanent construction materials will be supplied either by the Commission or the Railway. The line must be relocated for operation by the Railway on May 1, 1957. Tenders closed on April 17, 1956.

Progress by NYSPA

Progress was retarded by a strike called on March 12, 1956, by the International Union of Operating Engineers, Local 545, causing all construction work to be shut down until March 19. Despite this delay more than one and one half-million cubic yards were excavated during the month, bringing the total to date to thirteen and one-half million yards for the entire project. At Iroquois dam 7,000 cubic yards of concrete were placed during the month, bringing the total to date to 22,000 yards in the east section of the dam and in the spillway apron.

The contractor was given an incentive rate on concrete poured before April 1. Propane gas heaters of 4 million B.t.u. per hr. capacity under canvas or paperboard panels were used for protection. Excavation to date for the South Galop channel was nearing the two million cubic yard mark.

At Long Sault dam, excavation for Cut "F" was 56 per cent completed. Excavation was started for the extension of Cut "G". Quarrying and hauling of rock to the north cableway tail tower had been started in preparation for construction of the Cofferdam "E". Long Sault dam will be the focal point of activity during the coming season. By next September progress on the gate structure will permit the spectacular river diversion of 240,000 c.f.s. flow of the river. In the power-house area, excavation, drilling and grouting of the foundation progressed, as erection of the contractor's construction plant neared completion.

At Massena intake, excavation, drilling and grouting continued concurrently with the erection of the contractor's construction plant. Approximately half of the bedrock area had been exposed. Bids were opened for the construction of water facilities, and the contract was awarded on March 21, 1956. Long Sault canal construction power line was completed and the relocated 13.8-kv. construction power line to Barnhart Island neared completion.

Work on engineering drawings and specifications continued on schedule. Specifications for tunnel diversion gates and channel improvements at Point Three Points, Leishman's Point and Ogden Island were issued. Expediting of critical items was continued. Sixteen carloads of gantry crane components, originating at Paceco, Oakland, California, have arrived for Long Sault and Iroquois dams. Total personnel employed averaged 2,165 in March.

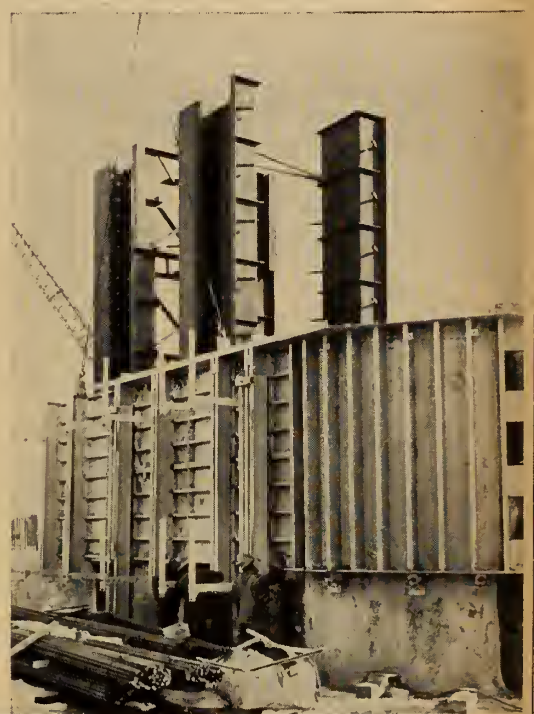
Progress by SLSA

Two contracts have been awarded for the supply and handling of fine aggregates for St. Lambert lock, in the Lachine section of the seaway. These two contracts involve a total of 205,000 tons of sand required for concrete. The contract for supply (f.o.b. siding at St. Lambert) valued at $440,750 was awarded to Standard Lime Company Limited. The contract for handling sand from the siding to the lock, valued at $88,150, has been awarded to the Carrière de Trois Pistoles, Enr.

The first construction contract in the 16-mile-long Soulanges section of the seaway was awarded March 28 to Atlas-Winston, Limited, of Montreal, the lowest of three tenderers. This contract, for first stage construction of lower and upper Beauharnois locks, is valued at $3,479,750. The second lowest bid amounted to $3,851,168, while the third lowest bid amounted to $8,077,750. Completion is called for October 31, 1956.

This contract will initiate the construction of two single locks, and their approaches, adjacent to the power development at Melocheville, whereby the junction between Lake St. Louis and the navigation channel in the Beauharnois power canal will be completed. The lift of the locks will be approximately 47 feet each, the level of Lake St. Louis being approximately 94 feet lower than the level of the Beauharnois power canal already built to the required 27-foot seaway depth.

The work includes clearing of the contract site, excavation of some 200,000 cubic yards of common excavation and of some 1,100,000 yards of rock excavation, rock grouting, cofferdam construction and unwatering, construction of service roads and the relocation of a portion



Iroquois dam. Pier forms are raised to the next lift.

Iroquois dam. Excavation operations are in progress and concrete operations continue.

of the New York Central railroad line.

A week ago (Thursday, March 22), the Authority's President revealed Authority plans to build a four-lane roadway tunnel under the Lower Beauharnois Lock which the Authority will build, to ensure uninterrupted traffic on Provincial Highway No. 3. This contract also provides for the excavation required for the construction of the tunnel.

Progress by SLSDC

Only one bid was received by the Corps of Engineers, agent for SLSDC, for the Grasse River lock near Massena. The contract was awarded to the same five-firm joint venture group already at work for NYSPA on the Long Sault dam and the Barnhard Island power-house, Perini-Walsh-Morrison Knudsen-Utah-Kiewit, for $26,800,000.

The Corps of Engineers does not customarily award a contract unless the low bid is within 15 per cent of the estimate. After due consideration, however, to the time that would be lost in readvertising in hopes of lower bids, since schedules are critical, the contract was awarded at a price some 23 per cent over the estimated cost. It was the largest awarded to date on the U.S. portion of the seaway navigation project, and includes supply and erection of two swing bridges for rail and highway traffic. Completion is called for by January, 1958.

Comment on the Seaway

Seaway Threatens Maritimes

The seaway will exaggerate the economic differential between the Maritime Provinces and the wealthier regions of Canada if the Atlantic coast ports are unable to maintain their share of port traffic, Donald J. Patton, of the University of Maryland, told the Association of American Geographers, meeting in Montreal April 3.

At present Halifax and Saint John share the Canadian Atlantic coast port traffic about equally. Fifty per cent of the total traffic comes during the winter months and 25 per cent of the remainder is local trade among the Maritime Provinces, he said. The vital interest of the Maritimes is to increase the summer port traffic. Although local traffic can be expected to remain about the same and winter traffic to increase, the seaway will give both Halifax and Saint John stiff competition for shipping during the summer.

The two Maritime ports, however, have several points in their favour. Halifax is on the direct line of the sea lane from Northwest Europe and the Mediterranean to the United States. It is therefore easy for these ships to put in at Halifax to deliver goods for Canada. Moreover goods destined for central Canada can be put off in Halifax at greater advantage than if they are carried on to New York or Boston, because of the differential tariff rates, Dr. Patton said.

Low rail rates from the Maritime Provinces to the rest of Canada also makes it possible for goods to be freighted from Halifax and Saint John to central and western Canada at lower cost than from the American ports, in spite of the shorter distances from the American ports. The direct competition for shipping between the St. Lawrence River and Great Lakes ports and the coast ports which the seaway will bring about, however, is a matter for very serious thought since, in this respect, Saint John and Halifax will have a grave geographical disadvantage, he added.

Dr. Wilbur Zelinski expressed the view that while the seaway would accelerate the booming development of the industrial heartland about the lakes, it could not seriously reduce the economic impetus of other regions. It just wasn't that big — at least compared to other projects and developments.

Professor Richard S. Thoman, University of Omaha, said foreign trade zones (free ports) had not prospered in the U.S., and cautioned against their institution on the seaway. A better idea, he observed, might be the more flexible system of bonded warehouses for storing goods during trans-shipment through a country other than their destination.

St. Lambert Protests Victoria Bridge Spur

Canadian National Railways plans for building a spur off the west or upstream side of Victoria bridge as an alternative rail route while ships are passing under the lift span over the St. Lambert seaway lock, are being vigorously opposed. This spur would be carried through the west end residential area of St. Lambert on a 25-foot embankment.

Delegates from St. Lambert and the City of Montreal were advised on April 10 by CNR President Donald Gordon that their proposed solution of building the proposed Nun's Island highway bridge to carry both trains and automobiles would not be feasible. Gradients the bridge needed to clear shipping would be too steep for locomotives unless the approaches were three or four miles long, which was not possible. Curves suitable for railway tracks would not suit the layout of the highway bridge.

St. Lambert's minimum target is to have the spur line changed to a location on the east or downstream side of the bridge. A direct appeal, supported by a petition, is to be made to the Prime Minister.

Montreal Bridge Traffic Doubles in Five Years

Montrealer's feel sufficient provision for future traffic on their bridges is not being provided for. Vehicular traffic over the Harbour bridge has almost doubled in the five-year period from 1949 to 1954. There is good reason to believe the rate of increase may be even greater the next five years.

Even without the stimulus to Montreal arising out of the opening of the seaway, predicted by Seaway Authority President Chevrier and by Transport Minister George Marler, the rate of house building in Montreal has exceeded any other metropolitan area in Canada. Moreover the rate of growth in Canada's automobile registrations is exceeding the rise in population. But the proposed Nun's Island bridge can hardly be opened for traffic before 1959 or 1960.

No Quick Fortune in Seaway Terminals

President Brooks of Toledo Marine Terminals warns that the dock operator who thinks he is going to make a quick fortune when the seaway rush starts, is in for a disappointment. All Great Lakes ports find that bulk commodities pour through specially built terminals, and packaged general cargo handling is an infinitesimally small part of the port's work.

Publicists, he contends, are "off the beam" in forecasting any large and rapid increase in the flow of general cargo the first year or so. Besides this, there is always the possibility that port authorities may move into the cargo terminal business and give privately operated marine terminals hot competition.

Metal Projects May Add Seaway Traffic

Reynolds Metals is considering aluminum plant expansions in northern New York and in Canada. The possibility of bulk shipments by seaway and of power from the New York State Power Authority are both factors in the project which is still in the nebulous stage.

The Jones and Laughlin Steel Corporation has joined in the hunt for Ungava iron ore in an area north of Sept Isles, believed to contain a billion tons of lean but easily beneficiated ore. If the project pans out the seaway will have another major customer.

Toronto Bids for Seaway Business

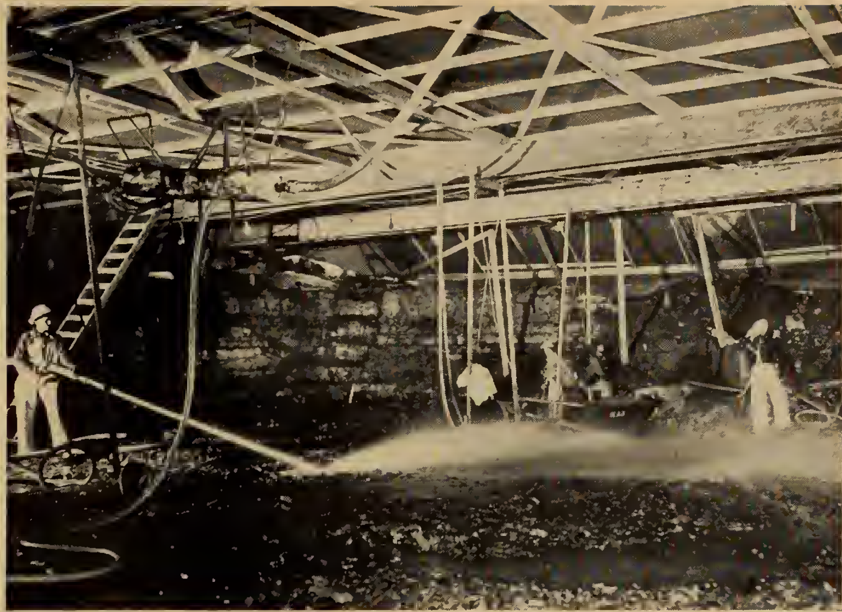
Toronto is already a seaway port, ranking fourth in Canada after Montreal, Vancouver and Hamilton, in that order. It is already handling more freight than Seattle, Marseilles, Oslo or Halifax. It has 11 miles of docks, 34 miles of waterfront railway trackage and 21 direct overseas lines operating on regular schedules with 125 vessels.

H. B. Griffith, manager of the Toronto Harbor Commission, believes many new ships will proceed to Toronto, instead of trans-shipping at Montreal. Toronto will become a turn-around point, as Montreal is today. It has one tremendous advantage. Those who direct its port are free to go out and sell the port's advantages over other ports. For this purpose it has set up a Trade Development Department.

The port of Montreal on the other hand, is under administration of the National Harbours Board. Such a government agency cannot go out and "sell" the port of Montreal to the disadvantage of other Canadian ports. Montreal needs a Trade Development Department of its own which would in no way rival the Harbours Board, but would rather supplement its endeavours. This is what the Halifax Port Commission has been doing for the past four years for the city and port of Halifax.

Operation Policy Must Encourage Use of Seaway

President Lionel Chevrier, of the St. Lawrence Seaway Authority, addressing members of the Institute of Internal Auditors on April 20, gave a progress report on the construction going forward from Montreal to Lake Erie, revealing that 30 construction contracts have been let for a total of $75 million. The value of work completed is approximately $15 million, or 20 per cent of awards to date.



Iroquois dam. Rock foundation is prepared for concrete by cleaning surface with high pressure streams of water.

"After everything is in readiness for the opening of navigation in 1959 — the Authority will be organized to carry out its permanent duties — the operation of the seaway, including the collection of tolls to cover the costs of construction and operation. In this the seaway will be operating in similar fashion to other business organizations. It will have costs to meet, revenues to collect and services to sell," he declared.

Legislation in both Canada and the United States requires that costs be amortized by the two seaway authorities over a period of 50 years. This represents a departure from long-established practice in both countries, where canals have been maintained free of tolls, he pointed out.

"It puts the seaway in the same class as the Panama and Suez canals, though the available routes for by-passing the seaway are not nearly as circuitous or expensive as they are for either of the other great canals. The seaway is paralleled by rail and highway routes, and . . . in the Middle West it will encounter competition from the Mississippi route," Mr. Chevrier said.

"These traffic considerations provide guarantees against any restrictive or monopolistic policy on the part of the two authorities. They cannot afford to take the attitude that their traffic is secure regardless of whatever policy they might adopt. Their policy must not only produce revenues sufficient to recover the costs of the project, but must also encourage the widest possible use of the seaway. The greater the volume of traffic the easier it will be to cover costs and to lighten the toll charges. This in turn will encourage greater use of the seaway."

Referring to the scale on which the seaway's locks and channels have been planned, Mr. Chevrier pointed out that with 27-foot navigation, those responsible for building the seaway felt they had arrived at what economists call the 'optimum solution.' Fundamentally the seaway is a public highway; some limiting standardization is necessary and there can be no responsibility to provide for outsize vessels, he declared.

"Certainly at the present time, the cost of increasing the capacity of the seaway beyond that now planned is out of all proportion to the probable benefits of such a step. But as the dimensions cannot be expanded every year or so to keep pace with the growing size of ocean vessels, we are naturally building for the future."

Mr. Chevrier underlined the expansion in industrial activity and markets and remarked that "the real value of the Seaway becomes correspondingly greater." We can be confident, he concluded, that the construction is taking place at a most opportune time — when it can be integrated into the existing transportation system with relative ease, and when both from the power and navigational point of view it can be said without exaggeration that it is a necessity.

Thirty-five Years Ago

Comment on the *JOURNAL* of May 1921

In 1921 argument concerning the proper use of the term "engineer" was at its height. Professional engineers, ourselves included, wanted exclusive use of it, while many labour bodies and a lot of other people could point to long established practice on this continent which gave them the right to use the word to apply to skilled artisans.

The professional engineers were beaten before they started, but seem not to have realized it, for almost every issue of the *Journal* about this time carried an editorial or correspondence bearing on the matter. The issue for May, 1921, was no exception; two correspondents fulminated, one because the International Union of Steam and Operating Engineers dared to call itself that, the other because the author of a new book was billed as a "household efficiency engineer."

It seems not to have occurred to those who were so bitter on the subject that the term "engineer" had become so thoroughly ingrained in our speech that to dislodge it was a real impossibility; as well try to get people to agree to call a child a "baby" up to, say, the age of one year and something else after that and not to use the word in any other connotation.

Provincial Associations Organizing

With the organization of the provincial associations, all in their infancy in 1921 and some not even started, most of this agitation died away. Licensed engineers became "professional" engineers by law and the term is now loosely applied by the public to all engineers eligible for registration, whether legally licensed or not.

Speaking of provincial associations, this *Journal* announced the inaugural meeting of the Corporation of Professional Engineers of the Province of Quebec, held at Institute headquarters "recently." The original officers were A. R. Decary, president; K. B. Thornton, vice-president; F. B. Brown, secretary; Arthur Surveyer, C. N. Montsarrat, J. M. Robertson, A. B. Normandin and J. E. Gibault, councillors, all members or associate members of the Institute.

The Ontario engineers' registration bill had received second reading and had been referred to a special committee, the usual practice. It was hoped that it would be passed "without material change."

Employment

The principal editorial in this issue of the *Journal* was by way of being a puff for the Institute's employment service. It was touted as being the best existing agency for bringing employers and potential engineering employees together, especially at the time of writing, when "it is undoubtedly a fact that Canada is caught in the backwash from war prosperity and the . . . business world's current watchword is 'Ca'canny' ". That our employment service was really accomplishing something was shown by the publication of a quite complimentary letter from an employer who had secured a draughtsman through it.

Engineers' Status

As long as I can remember engineers have groused about their place in society and many have been the suggestions as to how to improve it. I have my own opinions on this matter, but this is not the place to expound them and were I to do so, I should probably be banished from these pages for life. The Toronto Branch had tackled the problem in a systematic way by appointing a Social Service Committee; its first brief progress report appeared in this *Journal*. Many of the committee's recommendations were those made regularly by similar bodies. Others at least had the merit of a certain degree of novelty.

On education the committee said, "University education is weighted down with much work in the first year that should be transferred to the last year of high school." This has now been partially accomplished. But the committee member who thought that "the present method of (political) representation is faulty and it is suggested that . . . representation by occupation would produce better results", got little support for his ideas. Did he have a vague notion of Mussolini's corporate state in the back of his mind?

Technical Papers

Perhaps I have spent time enough commenting on features of this *Journal* which were really not its most important; the technical papers always occupy that position. The principal paper in this issue was a long and exhaustive treatise on superheaters — twelve pages — by H. B. Oatley of the Superheater Company. Whatever its merits, and it seemed to have many, it certainly must have disabused the reader of any idea that a superheater was merely a coil of pipe stuck into a boiler flue at some convenient place. I would imagine that, except for changes in materials, today's superheaters are not much different from those described by Mr. Oatley.

Another long and interesting paper dealt with methods of proportioning concrete, by Professor G. M. Williams, A.M.E.I.C., of the University of Saskatchewan. He critically examined three current theories of proportioning — Fuller's maximum density theory, the water-cement ratio theory and the aggregate surface area theory — and found them all wanting in some respect. His own proposal was not so much a new and radical theory as it was a logical method of procedure, what I suppose would today be called "trial-mix", as the procedures he recommended seem quite similar to those now used by concrete technicians. His main point was that the common practice of proportioning by volume was completely unreliable, often giving compressive strengths much lower than it was supposed to. For example, he refers to a 1:2:4 mix as being "standard" then for 2,000-lb. concrete, whereas many of his experimental mixes in these proportions did not reach 700 p.s.i. in compressive strength.

Frank Williams, A.M.E.I.C., spoke to the Moncton Branch on designing locomotives so that they would not be hard on track; his remarks were reported in this *Journal*. If he were speaking on the same subject today, he would hardly be so much concerned with "dynamic augment" and "impact" as he was then, neither of which can be of much importance in the design of today's diesel-electric monsters.

Work of C.S.A.

The Canadian Engineering Standards Association's main committee had just met and its proceedings were published here. They occupied only a column and a half and the matters reported on were few, but it was evident that the association was beginning to make its influence felt. Among other things, it decided to send its secretary, R. J. Durley, M.E.I.C., later to become our general secretary, to an international conference of standardizing societies in London. This was the first of many such conferences, which have helped to put Canada on the map standards-wise, and especially to bring us into closer and more friendly contact with the other standards associations of the Commonwealth.

If the Institute could point to no other accomplishment, its firm and continuous support of the Canadian Standards Association, in old form and in new, is quite enough to warrant our gratitude and that of countless others, too.

Correspondence

Engineering in Israel

One of the many pleasant things about being general secretary of The Engineering Institute of Canada is to receive interesting and newsy letters from members in far parts of the world.

A few months ago a member out in Israel wrote in at some length to tell of the work he was doing and of the many problems that were facing that new country. Permission to publish was requested and granted.

Members of the Institute, particularly young members like Mr. Shanas, may well envy him the interest and variety of his experience. On the other hand they may be happy that theirs is an easier lot. No matter what they think of the position in which Mr. Shanas finds himself they will have to admit that here we have a colourful instance in which a young member of our profession far from Canada is standing firm in his difficult place and working diligently for the good of the people who so well deserve his support. This is real nation-building and members of the Institute may well be proud to have the young man's name on their membership list. Mr. Shanas was graduated in civil engineering from Manitoba in 1947. Ed.

Dear Sir,

This past year I have been chief design engineer in the Water Department of the Jewish Agency's Negev Project. To explain this, the Jewish Agency through its Settlement Department is responsible for setting up new agricultural settlements, handing out the necessary grants and loans, planning and designing the villages in all aspects from general town planning through crop rotation and irrigation down to the financial budget of every last settler. Then too, it is in charge of building the villages, supplying the necessary equipment, implements, livestock, seeds and tools; looking after the various services as electricity, roads, water, etc.; instructing and training the settlers (all new to farming and many even illiterate and from backward countries) and in general helping with the management until the settlement is on its feet and the villagers themselves are capable of carrying on.

Our branch, the Negev Project, looks after an area of about four thousand square miles, more than half the size of all of Israel. Nearly all the settlements in the Negev, about 75 in number, are still under our care and, political conditions permitting, many more are to be established in the near future. Now in an area with an average annual rainfall (no snow at all) of between 4 and 12 inches, the key to all settlement is water. Nearly all crops have to be irrigated. The proper design of irrigation works in our highly eroded and erodable soil, as well as the general water supply for all of these settlements, has been my particular charge.

To date we have about 22,000 irrigated acres under intensive cultivation, only one-third of what is needed by the present settlements, and as I previously mentioned many new villages are to be established. This is a radically new field for me, one far from any of my studies at Manitoba or experience since, and although I originate from the "Gateway to the Golden West" it's only recently that I learned to distinguish a head of wheat from a head of barley. Therefore, I had to put in a lot of extra work and study. And if all this weren't enough to keep me busy, we have on all sides of us our neighbours continually threatening us with physical annihilation — not only a threat to destroy all that we have built and to turn the country back into the barren lifeless wastes it was but a few years ago, but also a threat against our very lives.

The recent arms shipments and the daily border incidents you read about show us that this threat, unfortunately, is all too real and actual; so no little of our time and efforts have to be spent in warding it off. And also as luck would have it, my own home, one of the aforementioned settlements, has suddenly found itself right in the center of the troubled area — immediately facing the Gaza Strip. Undoubtedly you have heard the name Kissufim in the news this past year. So all in all I am not left with much spare time, and writing letters, as my people back in Winnipeg can tell you, has always been one of my weak points.

Now that I have wandered so far away (I thought you might be interested to hear of work and conditions somewhat different to those of most engineers in Canada itself) I had better get back to the main point of this letter which was to inform you that I've decided to retain membership in the Institute for yet another year. Not that conditions as I outlined them in my letter of a year ago have changed any, but that I find that I am quite reluctant to give up the honour of being a member of the Institute and to cut the ties, weak as they are out here, with the people that gave me my start in the profession. Also the *Journal* with its regular reports of engineering progress in Canada and occasional familiar names and faces still remains among my favourite reading. In this respect, you may be interested to know that an almost complete set of the *Journal* since 1946 — the year I joined the Institute — is now on file in the library of the local branch of the Association of Engineers and Architects in Israel, in the new, old, Biblical town of Beersheba.

And now in closing, kindly accept my humble belated Season's Greetings. I hope you have had a very merry Christmas and duly enjoyed all the festivities of the past Yuletide week. With the ushering in of a new year I would like to convey my best wishes to you and, through this letter, to all the members of the Institute for a year of increased happiness and success; to the engineering profession in Canada for a year of progress and even greater accomplishments; and above all, for a year of real undisturbed peace with greater understanding and goodwill among all men.

E. L. Shanas, M.E.I.C.,
Kibbutz Kissufim,
Hanegev, Israel
January, 1956.

NEWS OF THE ASSOCIATIONS & CORPORATION

Information received through co-operation with the provincial organizations

Ontario

Professional Degrees

For some fifty years or more, the University of Toronto has had available for graduate engineers further professional degrees carrying the abbreviated titles of C.E., M.E., etc., in civil, mining, mechanical, electrical, chemical and metallurgical engineering.

In recent years, the interest in these degrees on the part of graduate engineers has declined almost to the vanishing point and a continuation of the facilities by the University no longer seems necessary.

Consequently, the Senate of the University at a recent meeting approved an amending statute which will terminate these professional degrees but with a provision whereby any applicant who can demonstrate a bona fide program already underway will be permitted, at the discretion of the Executive Committee of the School of Graduate Studies, to complete requirements for the degree up until May 1, 1957.

Nuclear Engineering Course

Announcement has been made by the University of Ottawa, whose degree in chemical engineering was recently accepted by Council of this Association, that beginning in September, 1956, a graduate course in nuclear engineering will be given by the Faculty of Science in co-operation with Atomic Energy of Canada Limited.

The course will lead to the degree of Master of Science (Nuclear Engineering) and will be open to mechanical and chemical engineers, engineering physicists, and physicists. Part of the twelve-months course will be spent at the Chalk River Plant of the Atomic Energy of Canada.

Our Senior Citizens
by Ralph W. Harris

One thing in life is just as sure as Death or Taxes. That is, that we grow older year after year. Nor can the most vigorous and aggressive of us shelter behind the belief that "It Can't Happen to Me".

The proportion of senior citizens in our population is increasing both steadily and rapidly.

The present trend in industry and business to fix unalterable rules for comparatively early retirement, the prevalence of Pension Plans, Group Insurance and Old Age Pensions recognize the fact, but multiply and emphasize certain economic inequities.

Perhaps the first of these inequities is felt by the man over forty who is barred from employment because he is too old to join the firm's Pension Plan, yet the Plan insists that a very high percentage of those of the payroll must be contributing members.

The active man who faces compulsory retirement at age 60 is presented with still more serious problems. If he is a family man he has probably been unable to build a substantial estate in any form but protective life-insurance, yet the ten year period from sixty to seventy demands a substantial sum if he is to retain a standard of living even comparable with that he has been able to establish during his peak years.

The Old Age Pension is totally inadequate to provide the barest essentials of food, shelter, clothing and fuel.

We are deliberately creating within the richest economy the world has ever known a new class of people who can, and want to be, self-supporting but who are gradually being forced into the position of economic-parasites.

Within our own Profession the problems of the "retired" and the "about to be retired" are assuming ever-increasing importance.

It is a strange anomaly that, in times when every scrap of technical knowledge, training and experience is in demand, our economic system is forcing capable engineers into idleness.

Your Association has formed a new Committee to study the problems of members in the senior age groups and to search for practicable means through which their ability and energy may be usefully employed for the common good.

Under the Chairmanship of J. Roy Gilley, this Committee on Gerontology has already done considerable organization work and preliminary study.

Sub-committees have been assigned to consider — (a) Employment, (b) Library, (c) Publicity, (d) Services (Counselling, Recreation, etc.)

The problems facing the Senior Citizen may be Economic, Social or purely Humanitarian. We believe they can be solved.

Employment

In planning its activities, the sub-committee on Employment is desirous of building up a list of the older or retired members who would be interested in full or part-time work. To this end members who are interested are requested to send to the Secretary, Committee on Gerontology, Association of Professional Engineers, 236 Avenue Road, Toronto, details of engineering experience, nature of employment desired and whether on a full or part-time basis. With this knowledge of the nature and extent of the demand, the committee will be in a position to make the information available to prospective employers as well as to develop in employers a better understanding of the very valuable fund of experience and engineering know-how which is available in the group in question.

—Reprinted from
The Professional Engineer,
March, 1956.

News of Members

James D. Kendall is now residing in Wanaque, N.J. and is employed by the Kearfolt Company Inc., of Clifton, N.J., as a project engineer in the company's motor laboratory. Previous to making this change in employment, Mr. Kendall was with Canadian Cutler-Hammer in Toronto.

L. W. Ward, of L. W. Ward and Associates, has announced his change in office address to Suite 15, 23 Applewood Village, 1077 Queen Elizabeth Way, Port Credit, Ont.

Peter Gelin, has established a service as consulting structural engineer at 259 Beatrice Street, Toronto. Mr. Gelin is specializing in thin shell roofs and domes, shells for industrial purposes, shell bridges and vibration problems of structures.

G. A. Urmston, has moved to Oakland, Cal., and has joined Kaiser Engineers, a division of Henry J. Kaiser Company, as service engineer. Mr. Urmston, who is an engineering graduate of Cambridge University, England, was earlier with C.I.L. 1954 Limited, Montreal, as a structural designer.

H. Hugh Mullinger was recently elected president of Columbia Engineering and Sales, Inc., of 553 Beaufait Avenue, Detroit, Michigan.

Mr. Mullinger was formerly with Canadian Breweries Ltd., following his graduation in chemical engineering from the University of Toronto in 1947. From 1950 until becoming associated with Columbia Engineering and Sales, he was an industrial sales engineer for Sinclair Refining Company, Detroit.

Harold W. Blakely has been appointed Canadian Sales Manager of York Shipley Inc., of York, Pa. York-Shipley of Canada will market its complete line of industrial-commercial package type steam generators and hot water boilers, factory-coordinated fuel-burning systems, rotary oil burners, oil — and gas — fired residential systems and air-conditioning equipment. The headquarters of York-Shipley of Canada is 215 Harborn Road, Cooksville, Ont.

A graduate in engineering and business from the University of Toronto, Mr. Blakely has been a sales engineer for the Ashland Oil and Refining Company of Cleveland and Buffalo, and assistant sales manager for Babcock-Wilcox and Goldie McCulloch Ltd.

Peter D. Stevens, has also been appointed a sales representative of York-Shipley of Canada for the Toronto-Kingston area and also Northern Ontario.

J. D. Kean has resigned his position as county engineer for Peterborough County, and has joined Curtis Bros., general contractors, as engineer. Mr. Kean's new address is R. R. No. 3, Peterborough, Ontario.

A. J. Pluhar has been appointed manager of the non-destructive testing division of Warnock Hersey Co. Ltd., Mr. Pluhar's headquarters will be in Toronto.

Mr. Pluhar graduated in civil engineering from the University of Prague in 1931, and has had many years of experience in engineering and research, as well as in the application of welding and non-destructive testing techniques.

H. W. S. Le Bel has been appointed chief engineer of the Mead-Morrison Division, Welland, Ont., according to an announcement of the United States Steel Corporation.

Mr. LeBel is an engineering graduate of McGill University of the class of 1937 and brings to his new responsibilities a broad range of experience in design and plant engineering. Latterly he has been associated with the Electro Metallurgical Company of Canada Ltd., of Welland.

Raymond F. Sherk has been named representative in Toronto and Southwestern Ontario for Spartan Air Services Ltd., and Canadian Aero Services Ltd.

Mr. Sherk is a graduate of the University of Toronto and a former R.C.A.F. pilot, and brings a background of engineering, marketing and flying to his new position.

M. W. Hotchkin of Kirkland Lake, was elected managing director of Wright-Hargreaves Mines Ltd. Mr. Hotchkin, who is president of the Association of Professional Engineers of Ontario, succeeds **Ralph L. Healy** in this position, Mr. Healy's retirement having been made necessary through ill health.

Mr. Hotchkin has been engaged in mining for some 48 years and is well known in all parts of this continent. For a number of years he was general manager of Toburn Gold Mines in Kirkland Lake, and three years ago when Toburn discontinued its operations, Mr. Hotchkin joined Wright-Hargreaves as engineer in charge of outside exploration.

P. C. Nicolle is manager of Greyhawk Uranium Mines Ltd., Bancroft, Ont. Prior to assuming this position Mr. Nicolle was field engineer with Kennco Exploration Ltd., of Toronto.

Boris A. Pazitch has moved from Windsor, Ont. to Niagara Falls, Ont., where he is employed on the engineering staff of H. G. Acres and Company. For the past three years he has been associated with Truscon Steel Company of Canada Ltd., in Windsor.

H. C. Minns and **R. H. Bigham**, of Hamilton, Ont., announce the organization of a new company, Package Air Conditioning Engineering Limited, to serve the commercial, industrial and residential air-conditioning markets. The headquarters of the company is at 500 Main Street East, Hamilton.

Mr. Minns is an engineering graduate of Queen's University, Kingston, and was formerly the plant engineer of English Electric Co. Ltd. More recently he has been manager of air conditioning installation and service for Blenkhorn and Sawle Ltd., of St. Catharines.

Mr. Bigham, after several years as application sales engineer for the apparatus division of Canadian General Electric Company Ltd., has been in charge of the Hamilton branch of Blenkhorn and Sawle Ltd.

Saskatchewan

E. J. Durnin Elected President

The new president of the Association of Professional Engineers of Saskatchewan for the year 1956 is E. J. Durnin, construction engineer with Saskatchewan Power Corporation.

Mr. Durnin was born in Dauphin, Man., and received his B.A. degree from the University of Saskatchewan. After serving for three years with the R.C.A.F. as a pilot officer, he qualified for his B.A.Sc. degree in electrical engineering at the University of Manitoba in 1928 and enrolled in the Canadian Westinghouse Company test course in Hamilton, Ont.

Upon completion of the course he returned to Saskatchewan where he accepted the position of junior engineer with the Saskatchewan Power Commission, becoming successively district superintendent and commercial superintendent.

In 1940 he joined the Royal Canadian Engineers, serving for five years in Canada, Great Britain and Northwest Europe. He was discharged at the close of the war with the rank of major, after which he returned to the Saskatchewan Power Corporation where he was named engineer in charge of construction and transmission on distribution and substation projects.

Mr. Durnin has been active in the affairs of the Association. In 1948 he was named a member of Council, and in 1955 he was elected vice-president. He is also a member of the Canadian Electrical Association and of the Engineering Institute of Canada.

Nova Scotia

C. N. Murray is Association President

C. N. Murray, general superintendent of the Dominion Steel and Coal Corporation of Sydney, N.S., is the newly-elected president of the Association of Professional Engineers of Nova Scotia.

Mr. Murray was born in Sydney and received his education at Acadia University and the Nova Scotia Technical College, graduating from the latter in mechanical engineering in 1935.

He began his engineering career with Alexander Murray and Company and afterwards joined Dominion Steel and Coal Company Ltd. as instrument clerk. In 1943 he was named superintendent of blast furnaces, subsequently becoming assistant to the general superintendent, and general superintendent, the position he now holds.

A member of the Engineering Institute of Canada, Mr. Murray is a past-councillor, as well as a past-chairman of the Cape Breton Branch.

New Brunswick Elects Council

The following are the Officers and Members of Council of the Association of Professional Engineers of New Brunswick for 1956:

President, D. R. Webb, Saint John; Past President, D. J. Brewer, Fredericton; Vice-President, W. D. G. Stratton, Moncton; Councillors, K. V. Cox, Lancaster, N.B.; L. O. Cass, Saint John; R. E. Tweeddale, Bathurst; C. E. Weyman, Fredericton; F. K. Leighton and R. L. Parsons, Moncton; and P. G. Robinson, Chatham, N.B.

The Secretary-Registrar is J. H. McKinney, P.O. Box 24, Saint John, N.B.

Manitoba

Association Office Opened

Since a full time office for the Association of Professional Engineers of Manitoba has been opened, applications for membership in the Association have increased considerably. To date these applications are well ahead of the number at this same time last year.

One of the great advantages to the membership at large in having an office operating in the downtown area, is the ability to get vital engineering information without the delays that were encountered before. It is eventually hoped that the Association will conduct an employment service which will be of assistance to the engineering employer as well as the employee. An engineering library located at this office is also a distinct possibility, which would be invaluable to many of the practising Engineers in this province.

The Late D. A. Ross

It was with deep regret that we learned of the passing of D. A. Ross on April 1, 1956. Mr. Ross was a prominent engineer and architect for the past 40 years. Until retirement he was a member of the firm of Pratt & Ross, Architects and Engineers, and also was a member of the Court of Revision for many years.

G. W. Moule

G. W. Moule, contract engineer, City of Winnipeg Hydro Electric System, a member of the Council of the Association of Professional Engineers of Manitoba for the past three years, is leaving Winnipeg to accept a position with the B.C. Power Commission. Mr. Moule graduated from the University of Manitoba in 1937 and was employed by C.I.L. from 1937 to 1945. On leaving C.I.L. he joined the Hydro and has been with them until the present time. Mr. Moule served as secretary for the Winnipeg Branch of the E.I.C. for many years and is considered to have been one of the best secretaries in the history of the Branch. Any who know or have been associated with Gerry will wish him lots of luck in his new position.

British Columbia

Three well-known members of the Association of Professional Engineers of British Columbia will be granted honorary degrees of Doctor of Science by the University of British Columbia at the Spring Convocation ceremonies on May 15.

Dr. H. J. MacLeod, former Dean of Applied Science, and member of Council of the Association in 1939 and 1940, will be honoured for his distinguished academic career in Alberta and British Columbia, which terminated with his retirement from the University of British Columbia in 1953. He is now a member of the B.C. Power Commission in Victoria. He will deliver the address to students graduating on May 15.

Also honoured will be Thomas Ingledow, and Col. W. G. Swan, both of whom are past-presidents of the Association. They will receive their degrees in recognition of their "great contributions to engineering in British Columbia, as well as to the educational and social life of the province". Mr. Ingledow is vice-president of the B.C. Electric Company and Col. Swan heads the consulting engineering firm of Swan, Wooster and Partners.

Engineers in the News

W. C. McKenzie has joined the consulting engineering firm of Choukalos, Woodburn and Hooley, and the firm has now changed its name to Choukalos, Woodburn, Hooley and McKenzie Ltd.

Mr. McKenzie has had extensive experience in administration and public works contracts and in supervision of construction and design obtained while with the Provincial Bridge Department, and more recently as resident engineer with Phillips, Barratt and Partners on the Oak St., and Granville bridges.

H. T. Libby, of B.C. Electric Co. Ltd., was recently promoted from superintendent of gas distribution to manager of the gas distribution department.

A. W. Moore, of the Consolidated Mining and Smelting Company, has been appointed to the post of assistant superintendent of the Alberta nitrogen department at Calgary. He has been at Trail as superintendent of the ammonia group.

James Atwell, of the Consolidated Mining and Smelting Company, at Trail, has been promoted from the position of superintendent of the fertilizer group to assistant superintendent of the Warfield Department, Chemicals and Fertilizer Division.

H. R. Wright will be joining the consulting firm of A. L. Swanson on May 1 and the firm will become Swanson, Wright and Co. Ltd., Mr. Wright has been chief engineer of the central engineering division of Alaska Pine and Cellulose Co. Ltd., for the past three years. Previously he had experience with C. C. Moore and Company, as Vancouver branch manager; Pacific Mills Ltd., at Ocean Falls, as electrical and project engineer; and the B.C. Electric Company, as industrial power engineer.

Art Ewans, previously with Westcoast Equipment Ltd. is now with Rosco Metal Products (B.C.) Ltd.

E. G. Tallman is another Ontario Hydro engineer who has taken a position with the B.C. Power Commission. He has been appointed to the position of senior projects engineer.

John Lamb, of Britannia Mining and Smelting Company has been promoted from assistant mine geologist to exploration geologist.

W. S. Jackson, with the Provincial Water Rights Branch at Nelson, has been promoted from assistant hydraulic engineer to assistant district engineer.

W. Nimisczeck, who has been with the Aluminum Company at Kemano, is now with H. A. Simons Ltd. in Vancouver as a design engineer.

J. A. Millican, district engineer at Nelson for the past four years, resigned his post to join Mid-West Copper and Uranium Mines Ltd., which operates the Velvet Mine near Rossland and has other Kootenay mining interests. Mr. Millican will continue to live in Grand Forks.

L. Telfer was recently elected chairman of the West Kootenay branch of the Association. Other officers are: **R. J. Armstrong,** vice-chairman; **D. Dolgov,** secretary-treasurer; and **R. Deane, R. G. McEachern, S. M. Rothman, J. W. Peck,** and **J. D. Little,** executive members.

W. T. Pound has been appointed vice-president, engineering, of St. Lawrence Corporation Ltd., and expects to make his initial headquarters at Three Rivers, Que. His services will be available to all mills and woods operations throughout the corporation. Mr. Pound was formerly with Crown Zellerbach Canada Ltd. as assistant resident manager, Ocean Falls, B.C.

G. T. J. Hughes has resigned from H. A. Simons Ltd. and has accepted an appointment as design engineer with the Consolidated Mining and Smelting Company of Canada at Trail.

J. C. Cant has accepted a position as cost engineer with Dawson, Wade and Macco. He was formerly with H. G. Acres and Co. Ltd. on the Upper Campbell Lake development.

O. E. Weightman of Kimberley, has been transferred by the Consolidated Mining and Smelting Company to its Coast Copper property.

A. W. Turnbull has accepted a position with Vancouver Iron Works Ltd. He was formerly on the staff of D. M. Drake.

R. O. Cutler is now with the Trans-Mountain Oil Pipeline Company in Vancouver.

H. Kettleson, recently at Salmo, B.C., with Canadian Exploration Ltd., has accepted a position with Algom Uranium Mines Ltd., Elliot Lake, Ont.

Peter Long is now employed by the City of Victoria. He was formerly with the Department of Highways at Chilliwack.

J. V. Sunell, previously with Reliance Import and Sales Co. Ltd. is now on the design staff of Ford, Bacon and Davis in Vancouver.

R. E. Wells has accepted a position with the Saguenay-Kitimat Company at Kitimat, B.C. He had been with Associated Engineering Services Ltd. in Vancouver.

L. Esser has taken a position with Vancouver Iron Works Ltd. He has been employed by Westminster Iron Works Ltd.

Eugene Butkov, a 1954 University of British Columbia graduate in engineering physics, and the winner of the Association Gold Medal for that year, has just won a scholarship valued at $1,200 from the National Research Council of Canada. He will undertake post-graduate work at McGill University.

E. V. Hird is now with Lenkurt Electric Company of Canada Ltd. in the application engineering department in Vancouver. He was formerly manual equipment engineer with the B.C. Telephone Company.

Ernest Peters, who is an instructor with the Department of Mining and Metallurgy at the University of British Columbia, recently accepted a permanent position with the Electro Metallurgical Company, Niagara Falls, New York, and expects to leave Vancouver about June 1.

J. F. Walker, Deputy Minister of Mines for British Columbia, has been elected president of the Canadian Institute of Mining and Metallurgy for 1956.

M. B. Hansen of the Canadian National Railways engineering department, has been promoted from division engineer at the Vancouver terminal. to assistant district engineer.

H. R. Banks, retired superintendent of the Sullivan Concentrator of the Consolidated Mining and Smelting Company, who has made his home in Kimberley for 32 years, recently left British Columbia to take up residence in Ottawa.

F. S. Foyston, formerly of Alaska Pine and Cellulose Ltd. at Port Alice, is now with Hansel Engineering Co. Ltd., Vancouver.

Professional Recognition

A man who is a large company's vice-president, industrial relations, (and also a professional engineer), said recently, "If engineers want the privileges, status and pay of professionals, they must act like professionals and accept professional responsibilities."

This statement is simple, the truth in it self-evident.

There's no argument.

Yet, ask yourself: Am I applying myself in the best way possible to the fulfilment of my professional training?

And there may be some argument there.

As a professional engineer, working in Canada, you have unlimited opportunities. This country's need for professional engineers is expanding constantly. This is happening not only in established industries, but also in a thousand new ones springing up around us in the wake of our nation's bursting growth. It is possible that the attitudes developed now towards engineers will be the attitudes of our nation's future, too. And that brings us back to that opening quotation.

The whole question of proper professional recognition of the engineer is a warmly-discussed subject right now, as you know. But no matter what the other pros and cons, it is a truth in any calling that a man to a large extent creates his own level of acceptance. That's how it is with you, too.

You have special problems. You must operate usually—in the beginning, at any rate—as a member of a big team. Yet the real fulfillment of your professional training comes in the individual contributions you make to that team. These come from training plus imagination. The training you have. But imagination is found most often in the man whose mind works beyond the narrow realm of his formal training.

Engineering training, because of its special and exacting nature, sometimes is achieved at the expense of broader education. But that needn't be important in the long pull.

The engineer who believes that his training ends the day he walks away from his university for the last time is not the man to whom this is addressed, because he has sealed his destiny before it is properly begun. The good professional engineer will use every chance he gets to expand his hard-won engineering education and preliminary professional training into something bigger. This he does not only by developing professional skill, but also by a conscious broadening of his senses of responsibility and ethics, improvement of his ability to communicate ideas, his professional conduct and personal appearance.

These things pay off.

One of the largest automotive companies decided to find out recently what had made a man in its top management group get to the top. (Incidentally, 25.4 per cent of all top management in this company were engineers by training.) A survey was made, searching for common denominators among the reasons why these men had outstripped their competition. These were the findings:

—Even when working on short-range projects, these men always had been looking ahead, preparing by study and observation for broader duties.

—Confronted with problems, they had shown daring, imagination and perseverance in exploring new means and methods.

—If any particular job had required some specialized knowledge, they had gone out and attained that knowledge.

"In these and other ways, these men were willing to pay going market price for success," this survey said.

"Others, with ability, were not willing to pay such a price and so had to be satisfied with something short of full success."

Let's quote another engineer, speaking of his profession: "Success for the practising engineer today and in the foreseeable future is predicated upon his possessing not only technical competence but also social and personal competence."

Mental honesty, self-discipline, and the ability to complete every engineering assignment to the best of one's training, experience and skill is technical competence.

What is social and personal competence, for an engineer?

Partly, it is the obligation to live, on and off the job, like a professional.

Partly, it can be expressed by saying that it is essential you realize that as a professional man you are identified as part of management. This identification should be both a challenge and a goal for you.

You, as a professional engineer, have a special role to play in economic and industrial expansion. You make judgments which other men in your company are not equipped to make. Management relies on your judgments, often to the extent of staking whole courses of action — and investment. People are hired, advertising campaigns launched, sales, efforts triggered, on the results of your work. It is a great responsibility. Are you doing all you can to fit yourself for it?

Your background and training has provided the basic tools for you to accomplish this goal. In the end it is up to you, the individual engineer, to transform the fruits of your ability into the rewards both tangible and intangible of full professional recognition.

—Prepared by the Association of Professional Engineers of Ontario, and reprinted from "The B.C. Professional Engineer," *February 1956.*

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Roy Marshall Walker, M.E.I.C., retired structural design engineer with Hydro-Quebec, died on February 25, 1956, in Montreal, Que.

Mr. Walker was born in Toronto, Ont., on January 24, 1890. He studied at the Technical High School in that city and was a 1912 graduate of the University of Toronto, with a B.A.Sc. degree in civil engineering. As a student he gained experience during the summer months with a geological survey party, with the Dominion Bridge Company, and with the Walter J. Francis Company, in Montreal, which firm he joined on graduation as as assistant engineer and draftsman. He was with the Riordon Pulp and Paper Company for a short time, in 1915, but joined Canadian Explosives Ltd., later that year as a project engineer and assistant engineer in charge of construction and repairs, and remained with the firm until, in 1921, he accepted a position with the Hydro-Electric Power Commission of Ontario, at Morrisburg, Ont. After a short time he moved to Montreal with the Montreal Light, Heat and Power Company, which later became Hydro-Quebec, and remained with the organization as assistant engineer and structural engineer, until his retirement in July 1955.

He was a member of the Electrical Club of Montreal, and the Corporation of Professional Engineers of Quebec.

Mr. Walker joined the Institute as a Student in 1910, became a Junior in 1913, transferred to Associate Member in 1921, and to Member in 1940. He was granted Life membership on January 1, 1956.

R. M. Walker, M.E.I.C.

Reginald Herbert Balfour, M.E.I.C., who retired in 1942 as sales manager of Philips Electrical Works and the Automatic Electric Company, died in Montreal, on September 17, 1955.

Born in Quebec City, August 14, 1874, and educated at Bishops College School, Lennoxville, Que., he was one of McGill University's graduates, obtaining his B.Sc. degree in mechanical and electrical engineering in 1897.

He joined the Lachine Rapids Hydraulic Power Company in 1897 and became superintendent. This company was absorbed into the Montreal Light, Heat and Power Company about 1903, and Mr. Balfour held various positions with the firm during the next seventeen years. He was assistant general superintendent of power distribution at the time of his resignation in 1914 to become chief engineer of the Montreal Electrical Commission. During his term with the Electrical Commission considerable progress was made, particularly in the financial district, with the transfer underground, of the power, light, telephone and telegraph cables.

In 1917 Mr. Balfour was offered the sales managership of the Eugene F. Philips Electrical Works, manufacturers of electrical wires and cables, and was subsequently made a director of the company. About 1933, control of the Philips Company was acquired by American interests and a sales oganization known as Canadian Telephones and Supplies was set up. This firm eventually became the Automatic Electric Company. He became district manager in 1937. At the time of his retirement he had served the company for twenty-five years.

He was a member of the Corporation of Professional Engineers of the Province of Quebec. He became a Student member of the Institute in 1899, transferred to Associate Member in 1903, and Member in 1940. In 1942 he attained a life membership.

Colonel Frank Chappell, V.D., M.E.I.C., died at his home in Oshawa, Ontario, on February 20, 1956.

Colonel Chappell was born at Cardiff, Wales, on December 1, 1883. He studied at the University College of South Wales, graduating in 1907 with a civil engineering diploma, then came to Canada where he was engaged in post graduate work in municipal engineering at McGill University. He accepted a position in Oshawa in 1909 as town engineer and superintendent of water works. In 1915 he was appointed industrial engineer with McLaughlin Motor Company and Chevrolet Motor Company. The first world war intervened and he spent three years overseas with the Canadian Engineers, CEF, in France and Belgium, where he was mentioned in dispatches.

Col. Frank Chappell, V.D., M.E.I.C.

On his return to Canada in 1920 he was appointed superintendent of the radiator plant, with General Motors, at Oshawa. He later became assistant factory manager, factory manager, and in 1934 was named public and industrial relations manager.

During the second world war he assumed heavy responsibility, being appointed commanding officer of the Central Mechanization Depot, R.C.O.C., and Mechanics Training Centre, London, Ontario. He went overseas in 1941, and in 1944, due to ill health, accepted his dicharge and retired from the Canadian Army.

Col. Chappell had been commissioned in the 34th Ontario Regiment in 1913. From 1925 to 1928 he commanded the Ontario Regiment as lieutenant colonel, and from 1932 to 1936 he was colonel commanding the 25th infantry brigade.

The community of Oshawa benefited from his untiring efforts — from 1911 to 1940 as a member of the Oshawa Hospital Board, and work with the education and library board. He was president of the Canadian Legion in 1926, and in 1938 president of the Oshawa Chamber of Commerce. In 1930-39 he was president of the Oshawa Boy Scouts Association.

He joined the Institute in 1908 as a Student, became an Associate member in 1913, a Member in 1936, and attained Life membership in 1944. He was also a member of the Military Institute.

Oliver Archibald Barwick, M.E.I.C., architect and structural engineer in Montreal for many years, died in Montreal on March 11, 1956.

Mr. Barwick was born in Montreal, on January 3, 1889. He followed a five year apprenticeship in draughting, before entering McGill University and in 1914 was graduated with the degree of bachelor of architecture.

Rejected from military service and beginning his graduate career in the opening months of World War I, Mr. Barwick soon started what was to be a valuable contribution in the field of munitions, both at that time, and in the second conflict. With Mond Nickel Company briefly in 1914, he joined Canadian Inspection and Testing Laboratories in 1915, as inspector of shell parts, and for two years, during 1916 and 1917, carried on night work in the field of microscopic experiments and tests on the manufacture of ammunition, first with the Montreal Ammunition Company, Longue Pointe, Montreal, and later with Dominion Bridge Company and Dominion Copper Products Company, Lachine, Que. He also did some private consulting work on heat treatment and calibrations for smaller plants.

The war over, in 1919, he accepted a position with P. Lyall and Sons as draughtsman on the shopwork of the new parliament buildings at that time under construction in Ottawa, and he was concerned with designing and draughting plans for the construction of the Capitol theatres in Montreal and Calgary. His services were also called upon in the plans for the expansion of the Royal Bank in the West Indies. In the next few years he had extensive experience in various architectural projects, including association with Bannigan, Armstrong and Thompson, Toronto, and James, Proctor and Redfern, Toronto. He was also in private practice in Montreal for some time and was construction supervisor of the head office building of the Royal Bank of Canada, built in Montreal during the twenties.

In 1940, after a period of service as senior assistant architect in the engineering services branch of the Department of National Defence, he was asked, on the basis of his First War experience, to take charge of the metallurgy department of Dominion Bridge Company Limited in connection with a shell plant then being put into operation in Toronto. Mr. Barwick accepted the appointment and, in the spring of 1940 travelled to Great Britain, where he observed similar projects in England and Wales. On his return to Canada he remained with the plant until production was established. He then diverted his services to include work on hull construction with United Shipyards, and was also building and equipment engineer with Wartime Merchant Shipping Limited.

He returned to private practice in 1944, although he had kept some architectural work of a private nature in operation. The following year he began an association with the Montreal firm of architects, Ross and McDonald, that was to last for ten years. About a year before his death Mr. Barwick chose to return to full-time private practice.

A resident of St. Lambert, Que., he was for a number of years chairman of that municipality's architectural commission, chairman of the by-laws committee, and member of the board of assessors.

Mr. Barwick was a member of the Association of Architects of the Province of Quebec, and of the Royal Architectural Institute of Canada.

He became a Member of the Institute in 1923, transferred to Member in 1940.

Edward Darling, M.E.I.C., president of Darling Brothers Limited, died on February 26, 1956, in Montreal.

Born in that city on October 4, 1873, he was a McGill University graduate, receiving the degree of B.Sc. in 1894. He joined the firm of Darling Brothers, founded by his two brothers, and until 1901 worked in the capacity of draughtsman. He subsequently became works manager and vice-president. From 1925 he was president and general manager, being, in all, at the time of his death, sixty years with the firm.

Mr. Darling was president of the board of management of Verdun Protestant Hospital, having served both as governor and president, and last year, despite his advanced age, accepted reelection.

E. Darling, M.E.I.C.

He joined the Institute as a Member in 1925, attained Life Membership on January 1st, 1956.

Melvin Lambeth Gale, M.E.I.C., vice-president of Turnbull and Gale Construction Company in Vancouver, died suddenly at his home in Vancouver, on February 12, 1956.

Born at De Winton, Alberta, on October 10, 1903, he followed his studies at Western Canada College, in Calgary, and at the University of Alberta, receiving a B.Sc. degree in civil engineering in 1927.

For the first three years after his graduation Mr. Gale was estimator, designer and general supervisor with the Permanent Construction Company in Edmonton. In 1930 he left the firm to operate independently as engineer and general contractor. He accepted the appointment of assessor in the Department of Municipal Affairs of Alberta in 1934, and served in this capacity for some time. After an interlude as general contractor in partnership, in 1937, under the name Gale and Allyn, he moved to Vancouver in 1938, becoming structural engineer with Armstrong and Monteith Construction Company Limited. In 1946 he was chief engineer and supervisor of construction with the firm.

Later, the organization known as Turnbull and Gale Construction Company Limited was formed.

Long active in the Boy Scout movement in Vancouver, he was in 1951 awarded the Boy Scout Medal of Merit for outstanding services, while he was serving a four-year term as assistant district commissioner.

Mr. Gale joined the Institute in 1935, as an Associate Member, and transferred to Member in 1940.

Maurice F. Carty, S.E.I.C., who graduated from the University of Alberta last year, died on February 8, 1956, following a lengthy illness.

He was born in Ottawa, on October 2, 1930, and attended Lisgar Collegiate in that city. In 1949 he enrolled at McGill University where he studied for a time. He transferred to the University of Alberta in 1953 and received a B.Sc. degree in electrical engineering from that university in 1955.

Mr. Carty worked as a student during the summer months, 1950-52, with the radio aviation section of the Department of Transport, Ottawa, with the E. B. Eddy Company at Hull, Que., in 1953 as an electrician's helper, also with T.M.C. (Can.) Ltd., Ottawa, as a project engineering assistant in 1954.

Upon graduation he was immediately accepted by the Department of Transport in Montreal as an engineer in the District Aviation Radio Office at Dorval Airport.

His father is E. G. Carty, M.E.I.C., of Ottawa, retired general executive assistant with the Department of Transport.

Real Couture, S.E.I.C., who graduated from the Ecole Polytechnique in 1955, died as the result of an accident early in September, 1955. He had been planning to go on to further studies at the Massachusetts Institute of Technology in a few weeks time.

Born at St. Joseph d'Alma, on the twenty-sixth of December, 1929, he was educated at St. Joseph College and the Academie de Chicoutimi, Que., before going on to study engineering at the Ecole Polytechnique, Montreal.

While a student in 1951 he had been employed as rodman by Pentagon Construction Company Limited.

Mr. Couture joined the Institute in 1952.

THE ENGINEERING INSTITUTE OF CANADA

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News of the Personal Activities of Members of the Institute

E. V. Leipoldt, M.E.I.C. — Shawinigan Engineering Company Ltd., announces the appointment of Mr. Leipoldt as vice-president and consulting engineer. He has been a director and vice-president of the company since 1947.

Mr. Leipoldt, a South African, studied extensively in Europe, later gained engineering experience there, in South America, and the United States. He came to Shawinigan Engineering in 1920.

He is a member of the Canadian committee of C.I.G.R.E., most active international organization in the electrotechnical field, with headquarters in Paris, and known in this country as the International Conference on Large Electrical Systems.

E. V. Leipoldt, M.E.I.C.

J. A. Burke, M.E.I.C. Another top appointment on the part of Shawinigan Engineering Company Ltd., is the recent promotion of J. A. Burke, from general superintendent to vice-president of construction.

With Shawinigan since 1937 when he was a field engineer on construction projects at Trois-Rivières, La Tuque and Shawinigan Falls, he became general superintendent in 1948 when construction of the Trenche powerhouse was started.

Mr. Burke holds degrees in both electrical and civil engineering gained at the University of Alberta.

G. R. Rinfret, M.E.I.C., whose name appeared high on the list of recent appointments in the Shawinigan Engineering Company Limited, has been named vice-president of engineering. He was made chief engineer in 1952, and in 1955 was appointed vice-president and elected a director.

Mr. Rinfret is a native of Dawson City, Yukon, and was educated at Loyola College in Montreal, the Shawinigan Technical Institute and McGill University. He joined the Shawinigan Water and Power Company in 1918 and was transferred to Shawinigan Engineering when it was organized the following year. He was resident engineer on construction of Shawinigan's Rapide Blanc development and the St. Maurice Power Corporation plant at La Tuque. After World War II he spent some time in China when the Shawinigan company took part in a study of hydro-electric sites for the Nationalist government.

J. A. Thomas, M.E.I.C., hydraulic engineer, with Shawinigan Engineering Company Limited, has been assigned to the position of chief engineer, in the civil division.

A Queen's University graduate, he joined Shawinigan Engineering in 1948, to become hydraulic engineer shortly afterwards. Since 1954 he has been hydraulic engineer in charge of civil engineering design and has been engaged in the design of various major hydro-electric developments in Canada.

J. A. Burke, M.E.I.C.

G. R. Rinfret, M.E.I.C.

R. E. Grout, M.E.I.C., since 1954, senior electrical engineer for Shawinigan Engineering Company Limited, is now chief engineer of the electrical division.

He joined Shawinigan in 1937 as a junior engineer and after doing design work on various installations he was loaned to Defence Industries Limited and participated in the electrical design of the NRX atomic reactor at Chalk River. Since then Mr. Grout has been in charge of the electrical design for a number of developments within his company and elsewhere.

W. P. Harland, M.E.I.C., will be manager of the field division for Shawinigan Engineering Company Limited, according to recent announcements made by the firm. This follows a 1953 appointment as supervising engineer.

Prior to that time he worked as resident engineer or field engineer on a number of major construction projects, including the Trenche development. He joined the company in 1948.

From Lethbridge, Alta., and a University of Alberta graduate, he also attended the California Institute of Technology where he was awarded a civil engineering degree in 1944.

W. Sharples, M.E.I.C., a long-time employee of Shawinigan Engineering Company Limited, who is carrying out special duties of an administrative nature, has been named personnel manager of the company's Montreal office.

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From Quebec City, he studied in Montreal, graduated from McGill University, then joined Shawinigan Engineering as a draughtsman. In 1933 he was assigned to the plant engineering department of Shawinigan Chemicals Limited, but returned to the engineering company in 1938 as assistant to the structural engineer. In 1941 he was assigned to Wartime Merchant Shipping Ltd., hull steel department, as assistant manager and returned to Shawinigan Engineering the following year.

Mr. Sharples is a member of the Publication Committee of The Engineering Institute.

H. T. Libby, M.E.I.C., of the British Columbia Electric Company Ltd., and superintendent of gas distribution since 1946, has been appointed manager of the gas distribution department. He has been associated with the firm for more than thirty years.

Mr. Libby is the author of several technical articles, mostly concerning gas distribution, one of which was printed in Canada, United States and Great Britain.

He is a member of the British Columbia Engineering Society, the National Association of Corrosion Engineers, the American Gas Association; the Vancouver Board of Trade, and the Association of Professional Engineers of British Columbia.

Also active in Engineering Institute circles, since becoming a member in 1947, he was in 1955 elected to represent the Vancouver Branch on the Council of the Institute.

F. L. Sparks, M.E.I.C., has been appointed managing director of McIntosh Industrial Equipment Limited and president and general manager of Refinery Vessels and Maintenance Limited, at Calgary.

The president and general manager of Steel Crafts (Alta.) Limited in Calgary in 1952, he was the following year appointed managing director.

Mr. Sparks is a 1950 graduate of the University of British Columbia.

J. G. Chenevert, M.E.I.C.

J. G. Chenevert, M.E.I.C., was recently elected president of the Association of Consulting Engineers of Canada Inc. In 1953 he was among those chosen to direct the organization.

Mr. Chenevert is a long-time member of the Montreal firm of consulting engineers, Surveyer, Nenniger and Chenevert.

He is a graduate of the Ecole Polytechnique, in Montreal.

Air Vice Marshal M. M. Hendrick, M.E.I.C., air member for technical services at R.C.A.F. Headquarters in Ottawa, last year transferred from chief of telecommunications and was promoted to his present rank. He now holds responsibility for the design and development of all Air Force equipment and facilities as well as the policies governing the procurement, storage, distribution, inspection and maintenance of all Air Force material.

With an outstanding wartime record behind him, in which he served as chief liaison officer, communications and electronics, on the Canadian Joint Staff Missions in Washington, and later was called to the A.E.A.F. signals staff and the R.C.A.F. planning staff overseas. Air Vice Marshal Hendrick has since then held a number of important posts. In 1945, as a group captain he took over the Directorate of Signals, in Ottawa and remained in charge for two and a half years. Then, in 1948, after a brief period as commanding officer of the R.C.A.F. station at Edmonton he was sent to North-West Air Command Headquarters at Edmonton, in connection with operations and training. Promoted to air commodore in 1949, he was named Air Member of the Canadian Joint Staff and Air Attache at Washington, D.C., which post he took over early in 1950.

Air Vice Marshal M. M. Hendrick, M.E.I.C.

He attended the Imperial Defence College course in London in 1952, and the following year received a posting to Ottawa as chief of telecommunications, with responsibility for the electronic activities of the Air Force. During this period these included the planning and design of the Mid-Canada Line, the bringing into service of the micro-wave communications ring to serve the Air Defence Command, the installation in Europe of the mobile micro-wave net and new high powered radars for the Air Division overseas; the reorganization and extension of the R.C.A.F. administrative tape relay communication system, based both on landline and radio teletype, and continuous planning for the improvement of our radar ground environment and the introduction of automacity therein.

Air Vice Marshal Hendrick is a member of the Canadian Aeronautical Institute. He joined the Engineering Institute in 1932 as a Student, was transferred to Junior in 1938, and to Member in 1947.

J. E. Leo Roy, M.E.I.C.

J. E. Leo Roy, M.E.I.C., chief engineer with the Quebec Hydro Commission's Auxiliary Services, has been elected president of the Corporation of Professional Engineers of Quebec.

A civil engineering graduate of Ecole Polytechnique in 1930, Mr. Roy received his electrical engineering degree from McGill University two years later. He was at one time associated with the Shawinigan Water and Power Company as sales engineer, and the Quebec Power Company in Quebec City, as assistant superintendent of the power division. In 1946 he accepted a position in the same capacity in Quebec Hydro's distribution department. In 1953 he was appointed to his present position.

Mr. Roy has very recently been elected president of the Montreal Electrical Club. He is a past secretary-treasurer of the Quebec Branch of the Institute.

G. W. E. Nicholson, M.E.I.C., is president of the Tennessee River Pulp and Paper Company which last month opened executive offices in New York.

For a number of years he was associated with the Union Bag and Paper Corporation, Savannah, Georgia, and New York, and also spent some time with the Southern Kraft Corporation, and the Bogalusa Pulp and Paper Company Inc.

Prior to 1931 Mr. Nicholson sojourned in Montreal.

A. M. Hudson, M.E.I.C., has joined the staff of the Foundation Company of Canada in Montreal where he holds the position of equipment manager.

Recently associated with Rayner Atlas Limited in Niagara Falls, Ontario, as mechanical coordinator, he has also been chief of the mechanical division, War Assets Corporation, and during the war was with the Department of Munitions and Supply in Ottawa.

Earlier, in 1934, he was with the De-

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partment of Northern Development of Ontario as project manager. Prior to that time he was associated with the Canadian Ingersoll-Rand Company Limited, and also participated in several railway projects in the years following his arrival from England in 1908.

Major W. A. McDill, R.C.E., M.E.I.C.

Major W. A. McDill, R.C.E., M.E.I.C., has been appointed technical staff officer with the Directorate of Engineer Development, Army Headquarters, Ottawa.

Major McDill graduated from the University of British Columbia with a B.A.Sc. degree in mechanical engineering, in 1948, and also holds B.E. and M.E. degrees from Colorado Agricultural and Mechanical College.

After completing these studies he went on to the Royal Military College of Science where he completed the sixth technical staff course, and was then, in 1954, appointed Canadian engineer liaison officer in the War Office at Whitehall.

Rolf S. Lockeberg, M.E.I.C., has recently been appointed assistant to the vice-president of R. L. Crain Limited, in Ottawa, Ontario.

Mr. Lockeberg received his B.Sc. degree in mechanical engineering from Queen's University in 1940 and served during the war years as an aeronautical engineering officer in the R.C.A.F. He later attended the Harvard School of Business Administration, receiving his M.B.A. degree in 1947. He then joined Canadian Ingersoll-Rand Company Limited in Montreal, where he served as controller from 1950 to 1954. From 1954 until the beginning of this year, he was controller of B. W. Deane and Company, in Montreal.

R. S. Lockeberg, M.E.I.C.

Jack Morris, M.E.I.C., whose name was among recent company promotions, is now manager of Courtauld's (Canada) Limited plant in Cornwall, Ontario.

Mr. Morris joined Courtauld's (Canada) Limited in 1945 as engineering division manager. He had come to Canada from his home in England in 1933 as technical representative for an English engineering company. At the outbreak of World War II he was called to active service with the Princess Louise Fusiliers (MG) serving as general staff officer and later as assistant to the director of chemical warfare, N.D.H.Q., with the rank of lieutenant colonel.

J. Morris, M.E.I.C.

He is a member of the American Society of Mechanical Engineers.

A. M. H. Norris, M.E.I.C., formerly associated with Jacques Price, consulting civil engineer in Windsor, N.S., is this year located in Fredericton, N.B., with the Central Mortgage and Housing Corporation, and is at present with the C.M.H.C. Camp Gagetown Project as service contract engineer.

Keith Dixon, M.E.I.C., superintendent of lights for the Department of Transport in Victoria, B.C., since 1949, has accepted the position of district marine agent with the Department.

A veteran of two world wars, who earned the rank of colonel, Mr. Dixon was with the Department of Transport in Prince Rupert, B.C., after the second conflict. Earlier in his career he was associated with the Esquimalt and Nanaimo Railway, at Victoria, the Ontario Department of Northern Development, and the Canadian Pacific Railway.

C. K. Lockwood, M.E.I.C.

C. K. Lockwood, M.E.I.C. Vice-President of sales is the new appointment received by C. K. Lockwood of Shawinigan Chemicals Limited, formerly vice-president, stainless steel and alloys, in Montreal.

With Shawinigan Chemicals since 1937, Mr. Lockwood was appointed sales manager of the stainless steels and alloys division in 1945 and became vice-president of the division in 1953. The following year he was elected to the board of directors of the company.

Mr. Lockwood has been active in the Alloy Casting Institute and in 1954 was named president of that organization. He was chairman of the Montreal chapter of the American Society for Metals, and has served the National Research Council. In 1951 and 1952 he was on loan from Shawinigan, working as chief of the stainless steels section, steel division of the Canadian Department of Defence Production.

T. W. Lazenby, M.E.I.C., has been elected chairman of the Kootenay Branch of the Institute.

Born in England, he received his high school education in that country, in the city of York. He then enrolled in a lengthy course in mechanical engineering, at the same time serving a seven year apprenticeship as mechanical draftsman. Later he was awarded a

T. W. Lazenby, M.E.I.C.

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scholarship, and went on to Leeds University.

Mr. Lazenby came to Canada in 1923 and was located in London, Ont., with E. Leonard and Sons, Ltd., as chief draftsman. He remained there for some time and it was not until 1936 that he transferred to the west coast to take up a position in the same capacity with the Vancouver Engineering Works, Vancouver, B.C. After five years with the Vancouver Engineering Works he transferred to his present position with the Consolidated Mining and Smelting Company of Canada, in Trail, B.C. He has been associated with the company's design office for the past fifteen years.

Mr. Lazenby's membership in the Institute dates from 1928. He was secretary of the Kootenay Branch from 1949 to 1952.

P. M. Tomney, M.E.I.C., is branch manager with Canadian Westinghouse Company Ltd., in Moncton, N.B.

A 1950 graduate of the Nova Scotia Technical College with a B.Eng. degree in electrical engineering, Mr. Tomney has been with the company for some time. In 1952 he was apparatus sales engineer for the company in Halifax, N.S.

A. P. Robinson, M.E.I.C.

Arnold P. Robinson, M.E.I.C., previously with Northwest Industries Limited, in Edmonton, has been appointed plant manager of the Inland Cement Company Limited plant at Edmonton. With Northwest Industries Limited since 1952, he had become assistant manager of the company. Mr. Robinson studied at the University of British Columbia.

Major J. H. MacLean, M.E.I.C., is officer commanding the 200 Minor Base Workshop, R.C.E.M.E., in Halifax.

He had previously been officer in charge of the unit, last year receiving a promotion to the rank of major.

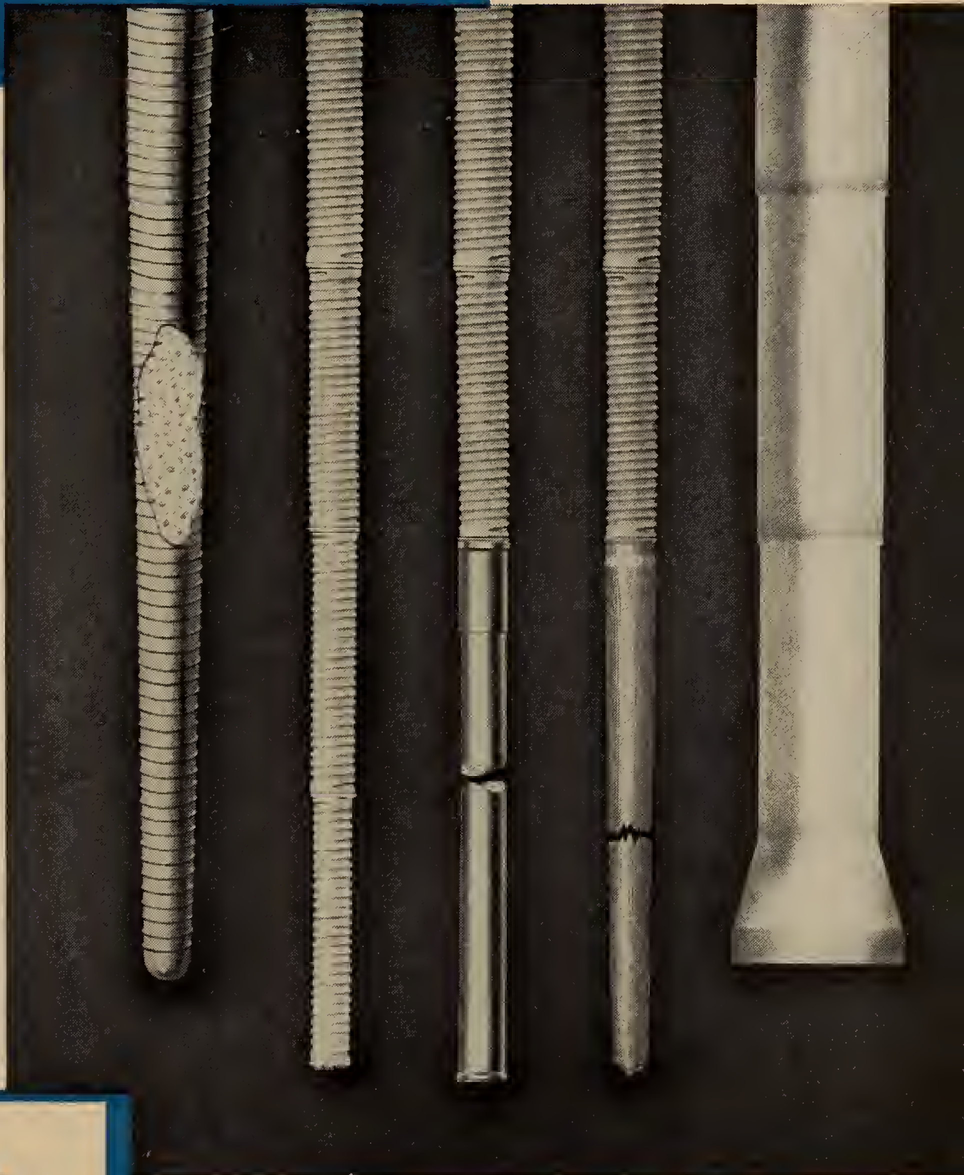
Major MacLean spent some time in Britain attending a technical staff officer course at the Royal Military College of Science in Great Britain. He returned to Canada early in 1955.

He is a University of Toronto graduate, with B.A.Sc. and M.A.Sc. degrees, gained in 1941 and 1949 respectively.

J. R. Harris, M.E.I.C., has been appointed manager of the Toronto branch of the Swedish General Electric Limited.

Mr. Harris was born in Jamaica, B.W.I., and obtained his bachelor of engineering degree from McGill University in 1946. After having attended the test course of Canadian General Electric Company Limited in 1946-47 he joined the Hydro Electric Power Commission of Ontario. He was later

J. R. Harris, M.E.I.C.



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employed by C.S.A. Approvals Laboratories as testing and equipment engineer, until joining Swedish General Electric Limited in 1953.

He is a member of the Corporation of Professional Engineers of the Province of Ontario, the Canadian Electrical Association, the Toronto Electric Club, and holds an associate membership in the American Institute of Electrical Engineers.

C. Climo, M.E.I.C., of Niagara Falls, Ontario, is temporarily located in Logan, Ohio, where he is the resident engineer on a new three million dollar plant now under construction by the Carborundum Company. It will be devoted to the manufacture of resin bonded abrasive wheels.

Mr. Climo, long-time staff member with the Carborundum Company, Niagara Falls, N.Y., expects to return to his firm at the completion of the Ohio project, in about a year's time. His permanent position is that of chief design and construction engineer.

He served as chairman of the Niagara Peninsula Branch of the Institute during 1950-51.

M. A. Burns, M.E.I.C., is with the geophysical department of Mobil Oil of Canada in Calgary, Alta.

Mr. Burns, a graduate of the University of Alberta, in mining engineering, was formerly associated with Western Geophysical Company Limited.

H. A. Cann, M.E.I.C., sales manager with the mechanical goods division of the Dominion Rubber Company since a 1952 appointment, has recently been named sales manager of the division's operations in the Prairie Provinces, with headquarters in Winnipeg.

Mr. Cann's association with the company dates from 1938 when he graduated from the University of Manitoba.

Mr. Cann joined the company in 1938 following his graduation from the University of Manitoba, and after lengthy war service with the R.C.E. returned to join the company's Edmonton branch sales staff.

H. A. Cann, M.E.I.C.

G. A. Cunningham, M.E.I.C.

G. A. Cunningham, M.E.I.C., has been elected Chairman of the Halifax Branch of the Institute.

Mr. Cunningham was born in Peterborough, Ontario, attended high school in that city and went on to engineering studies at the University of Toronto, where he received a B.A.Sc. degree in 1929. On graduation he obtained a position on the staff of Riley Engineering and Supply Company Ltd., Toronto, as chief engineer. He joined Imperial Oil Limited in 1932 and was employed as district representative in Welland, Ont., and St. Catharines, Ont. Then, in 1948 he was chosen manager of industrial

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sales for the company's maritime division.

Mr. Cunningham's affiliations with the Institute go back to 1927 when he joined as a Student. In the thirties he was active in the Peterborough Branch and served on the executive of the London, Ont., Branch, as vice-chairman in 1945 and 1946.

D. M. Jenkins, M.E.I.C.

Donald M. Jenkins, M.E.I.C., has been elected chairman of the London Branch of the Institute.

Mr. Jenkins is a native of Blyth, Ontario. He received his high school training in that province and in 1940 he went to work at McKinnon Industries, Ltd., a G.M. division at St. Catharines, Ont. In 1943, he enlisted in the Canadian Army and after his discharge in 1946, from the Royal Canadian Electrical and Mechanical Engineers, he enrolled at the University of Toronto. On his graduation in mechanical engineering in 1949, he joined the Ontario Paper Company at Thorold, Ont.

He moved to General Motors Diesel Limited, in April, 1950, as a project engineer and became senior project engineer and then assistant chief of the department. In September, 1952, he was appointed chief engineer.

K. M. Mote, M.E.I.C., has accepted an appointment as plant engineer with Messrs. Borg, Warner Ltd., of Letchworth, Herts, England.

Mr. Mote was associated with British Cellophane Ltd., Bridgewater, Somerset, England. In 1954 he went to Mexico to work with Celorey, S.A., in Monterrey. Last year he was with Procter and Gamble Company as their London, England, construction engineer.

He is a graduate of Birmingham Central Technical College.

A. J. Arens, M.E.I.C., formerly with the Materials Testing Laboratories in Lethbridge, Alta., has been named manager of Atlas Transit Mix in that city.

W. H. Hooper, M.E.I.C.

He is a 1953 graduate of the University of British Columbia.

W. H. Hooper, M.E.I.C., has been appointed manager of domestic product sales with Amalgamated Electric Corporation Limited.

Mr. Hooper joined Amalgamated Electric in 1940 as sales engineer. Since that time he has held the important executive positions of manager, of dis-

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tribution equipment, and of apparatus sales.

Mr. Hooper is a graduate in electrical engineering from McGill University. He is a member of the Association of Professional Engineers of Ontario.

I. M. Hamer, M.E.I.C., director of Dowty Equipment of Canada Limited, has received the appointment of vice-president and general manager of the company.

Mr. Hamer, who graduated from the University of Toronto in 1937 joined the parent Dowty organization in England in 1940. Since returning to this country in 1941, as chief engineer, he has been in charge of the Canadian company's engineering operations. He became a technical director in 1951.

Robert J. Griesbach, M.E.I.C., has recently been made a partner of O. J. McCulloch & Co., consulting engineers, Montreal.

He graduated from McGill University in 1942 with a B.Eng. degree in civil engineering and gained a variety of construction and design experience with the Foundation Company of Canada, and with Surveyer, Nenniger and Chenevert, consulting engineers, before joining his present company in 1950.

Wm. Rutherford, M.E.I.C., has accepted the position of oil and gas process engineer with Dutton-Williams Brothers, Engineers and Constructors, in Calgary.

He has recently held an appointment with the Foundation of Canada Engineering Corporation, and was sent to Edmonton as resident engineer on the construction of a cement plant for the Inland Cement Company Limited.

Mr. Rutherford has also been associated with the Rankin Company Limited in Montreal, as director of technical development, and was for a time with Central Mortgage and Housing Corporation in that city as construction engineer.

He is a civil engineering graduate of the University of Durham.

R. E. Stopps, M.E.I.C., is a technical officer with the Canadian Standards Association, in Ottawa. He has recently been associated with Canadian Comstock Company Ltd., in Hamilton, Ont.

Mr. Stopps began his engineering career with the department of Transport, at Ottawa, in 1944 as an assistant radio engineer. Later he worked for Imperial Tobacco Company Ltd., in Montreal, and for El-Met Parts Ltd., at Dundas, Ont.

He is an electrical engineering graduate of McGill University.

E. I. Rubinsky, M.E.I.C., district engineer with Raymond Concrete Pile Company Ltd., has been transferred from Montreal to the company's headquarters in Toronto.

Originally a graduate of the University of Beirut, Lebanon, with a B.Sc degree in civil engineering, Mr. Rubinsky received a M.Sc. degree from Harvard University, in 1951. He worked in engineering in Ottawa before joining Raymond Concrete Pile Company in 1954.

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L. P. Cousineau, M.E.I.C., has been named general manager of Cartier Construction Company in Montreal.

Associated with Angus Robertson Limited in Montreal since 1947, he was assistant chief engineer and, at the time he left the firm had become project manager.

Earlier in his career he was associated with the National Syndicate of Electricity, Marine Industries Limited, and the Quebec Streams Commission. He joined Dufresne Engineering Company Limited of Montreal in 1941, remaining with the firm until 1946. During this time he was engaged in a number of large construction projects and was for a year loaned to Quebec Shipyards Limited. In 1946 he became town engineer for the community of Val d'Or, Quebec.

Mr. Cousineau has a civil engineering degree from the Ecole Polytechnique and also studied in Paris, graduating as a welding engineer from the Ecole Superieure de Soudure Autogene, following his Canadian studies.

W. Clyde Baggs, M.E.I.C., with Bathurst Power and Paper Company since 1937, has been named general manager, mills division.

Prior to that time he held the position of chief engineer and it was in 1951 that he received the appointment of mills manager. He was transferred to the executive offices of the company in Montreal in September, 1954.

Mr. Baggs was briefly with the International Power and Paper Company of Newfoundland on his graduation from McGill University, before joining his present company. He holds a B.Eng. degree from that university.

W. C. Baggs, M.E.I.C.

Eldon V. Hunt, M.E.I.C., with the Alberta Gas Trunk Line Company Limited in Calgary as chief engineer until recently, has accepted employment in New York. His present position is that of assistant construction manager with Ebasco Services Incorporated.

He is a graduate of the University of Colorado and a member of the American Society of Civil Engineers.

J. G. Chalmers, M.E.I.C.

J. Gordon Chalmers, M.E.I.C., administrative vice-president of Bathurst Power and Paper Company Limited, with headquarters in Bathurst, N.B., has retired after forty-two years with the company, and its predecessor.

A native of New Brunswick, from Belledune, Mr. Chalmers obtained a variety of experience in the nine years which preceded his joining the Bathurst organization in 1914. An apprentice machinist with Alex Dunbar and Sons, of Woodstock, N.B., and then machinist with various firms, he had also been a marine engineer with the Northern Dredging Company. In 1915 he had already been named superintendent of the power plant and electrical department with the Bathurst Company, and five years later was general superintendent of the plant, in charge of all engineering. From 1935 to 1952 he rose from the position of mill manager to administrative vice-president.

He is a director of the company and will continue to serve the firm as resident director, in Bathurst.

William N. Wray, Jr.E.I.C., is with Dutton Williams Brothers Ltd., in Calgary, Alta.

He graduated from McGill University, class of 1954, with a B.Eng. degree in civil engineering.

E. T. Cotton, Jr.E.I.C., is with the Electric Reduction Company of Canada, at Buckingham, Que. He was associated with the Canadian General Electric Company Limited as a plant engineer in 1953, having been engineer in training with the firm previously, in Peterborough, Ont.

He graduated from Queen's University in 1950 with a B.Sc. degree in mechanical engineering.

E. G. Hazle, Jr.E.I.C., has been taken on the staff of the Canadian Arsenals Ltd., Toronto.

Previously with Canadian Gypsum Company Ltd., in Toronto as plant engineer, and with Toronto Asphalt Roofing, Manufacturing Company Ltd., he is a mechanical engineering graduate from Queen's University, class of 1948.

Paul A. Webb, Jr.E.I.C., has been sent by his firm, Phillips Electrical Company Ltd., Brockville, Ont., to Great Britain where he will spend a year with

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British Insulated Callender's Cables Ltd., at Prescot, Lancs, Eng.

Mr. Webb is a mechanical engineering graduate of McGill University, class of 1954.

E. E. Olson, Jr.E.I.C., who is on leave of absence from Canadian National Railways department of research and development in Montreal, is studying at the University of California Graduate School of Business Administration, for an M.B.A. degree.

He is a graduate of the University of British Columbia, class of 1952, in civil engineering.

Peter H. Cameron, Jr.E.I.C., has been transferred to Montreal by Canadian General Electric Company Ltd., from Toronto. In 1953 he was named supervisor of sales promotion, wire and cable division, Canadian General Electric Company, Toronto.

A 1949 graduate of McGill University, he has a B.Eng. degree in electrical engineering.

Carl A. Hennigar, Jr.E.I.C., has accepted a position with Sterling Electric Company Ltd., in St. Catharines, Ont. In 1953 he joined E. L. Dodington, consulting engineer in that city, and has also been associated with the Montreal East refinery of the B.A. Oil Company of Canada Ltd.

Mr. Hennigar graduated in electrical engineering from McGill University in 1950.

W. G. Gall, Jr.E.I.C., has accepted a position with the Hydro Electric Power Commission of Ontario, distribution department, at Niagara Falls, Ont.

Mr. Gall graduated from the University of Manitoba, class of 1954, with a B.Sc. degree in electrical engineering.

Lieut. (L) L. G. Holtby, R.C.N., Jr.E.I.C., is stationed in Belfast, Ireland, where he is a member of the R.C.N. electrical trials team, currently carrying out trials aboard the new R.C.N. carrier, H.M.C.S. "Bonaventure". On completion of the trial program he will join the ship as an electrical officer.

He was previously in Ottawa with the trials section of the Electrical Engineer in Chief of the Royal Canadian Navy.

Lieut. Holtby graduated in electrical engineering from the University of British Columbia in 1950.

Roland Dion, Jr.E.I.C., is at Knob Lake, Schifferville, Que., with Mobec Ltd. Formerly with Canadian Fairbanks Morse Company Ltd., at Loretteville and Quebec, Que., he is a graduate in electrical engineering from Laval University, class of 1951.

Francis J. McNaughton, Jr.E.I.C., has been transferred to the Ottawa office of the National Harbours Board, from St. John, N.B.

He graduated from the University of New Brunswick, in civil engineering, class of 1953, and joined the National Harbours Board at that time.

R. A. Stewart, Jr.E.I.C.

Rae Alden Stewart, Jr.E.I.C. First prize in the Bausch and Lomb Photogrammetric Awards for the most outstanding papers on photogrammetry has been awarded to Rae Alden Stewart, field officer with the Canadian Topographical Survey Department, Ottawa.

The Prize-winning paper, "The Application of the Balplex Plotter to Trimetrogon Obliques," developed new aerial mapping techniques and won him the citation plus a cash prize of one hundred dollars.

Mr. Stewart obtained an M.Sc. degree in geodetic science in 1955. He majored

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in photogrammetry at the Institute of Geodesy, Photogrammetry and Cartography at the Ohio State University.

Originally from the University of New Brunswick, he graduated with a B.Sc. in civil engineering in 1950.

M. Brault, JR.E.I.C., has been named branch development engineer with Canadian Liquid Air Company Ltd. in Montreal. He was formerly resident engineer with the company.

Mr. Brault holds a B.Eng. degree in civil engineering from McGill University. He graduated in 1952.

T. R. Walton, JR.E.I.C., has been in Jamaica since last summer with the Alumina Jamaica Ltd., where he is employed in the operating division of the plant. He was formerly a field engineer with the Ontario Research Foundation in Toronto.

Mr. Walton holds a degree in mechanical engineering from the University of Toronto, class of 1950.

D. Hicks, JR.E.I.C., has been taken on the staff of Engineering Management Inc., in San Francisco. He has been associated with Marwell Construction Company in Clearwater, B.C. Mr. Hicks is a 1953 graduate from Queen's University in civil engineering.

R. J. DiCicco, JR.E.I.C., has accepted a position as maintenance superintendent with the Asbestos Corporation at Thetford Mines, Que.

Mr. DiCicco graduated from McGill University with a B.Eng. degree in mechanical engineering, class of 1951, then joined Consolidated Paper Corporation Ltd., as a woodlands mechanical engineer at Grand'Mere, Que.

G. W. Madore, JR.E.I.C., has been named director and manager of the engineering services department of Foresteel Products Ltd.

In 1953 he was appointed manager of the air conditioning division of the firm. Earlier he was associated with the Canadian General Electric Company Ltd., heating and air conditioning departments, and with the Minneapolis-Honeywell Regulator Company Ltd., as sales engineer, in Montreal. He is a mechanical engineering graduate of McGill University.

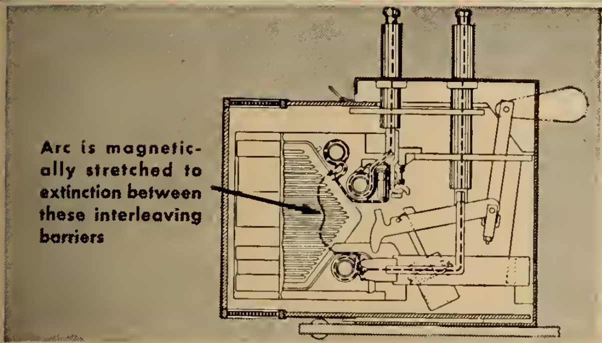
J. P. Kot, JR.E.I.C., has joined the engineering staff of the Potash Company of America, in Saskatoon, Sask.

Mr. Kot, a 1949 graduate of the University of Saskatchewan in electrical engineering, has recently been associated with Giffels and Vallet of Canada, consulting engineers in Windsor, Ont., as chief electrical engineer. He has also been with Price Brothers and Company at Kenogami, Que., as hydro engineer and the Boiler Inspection Insurance Company at Montreal.

Murray F. Pittuck, JR.E.I.C., is at present located at Chaudiere Station, Que., with the Shawinigan Engineering Company. He joined the company in 1951 and became assistant superintendent of transmission line construction the following year.

In 1955 he was promoted to the position of superintendent of that depart-

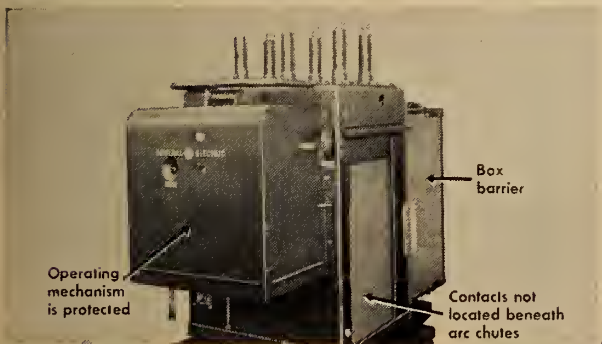
4 reasons why G-E magne-blast breakers are best for metal-clad switchgear



Most reliable operation

1

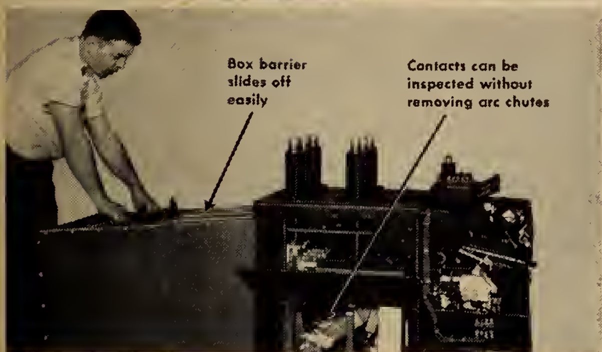
The G-E magne-blast principle of arc interruption has been proved by years of heavy duty operation in utility reclosing feeder service, high capacity motor starting applications, arc furnace control, and tough capacitor switching jobs. ALL THREE PHASES are switched simultaneously—eliminating any possibility of "single phasing" the load due to switching. Booster cylinders provide quick low current interruption—magne-blast blowout coils assure super-fast high-current interruption.



Seldom needs maintenance

2

Most causes for maintenance have been eliminated or reduced in G-E magne-blast breakers. Products of arc interruption cannot fall on the contacts because the arc chute is located *horizontally to the rear* of contacts. Box barrier, which is not open at top, helps protect arc chutes. Operating mechanism is protected by steel cover. Interrupting characteristics of arc chutes actually improve with age. The arc is magnetically stretched to extinction in AIR—eliminating oil maintenance problems.



Easy to inspect

3

All parts of G-E magne-blast breakers are readily accessible for inspection and maintenance. Contacts can be inspected *without removing arc chutes*. Lightweight box barrier *slides off* for easy inspection of arc chutes. Operating mechanism is located outside and in front of breaker—can be reached without removing breaker from housing. Although normal G-E recommendations are for inspection and maintenance once a year, many users find inspection every two or three years is adequate for their needs.

Designed for greater safety

4

Low center of gravity of G-E breakers makes them practically impossible to tip over accidentally—reducing this common hazard of breaker handling. Compare the low center of gravity (at left) with that of any other breaker on the market. And for greater operating safety—service-proved Self-X insulation, which will not support combustion, provides better *built-in fire protection* for breakers in case of trouble. Apparatus Dept., 212 King St. W., Toronto, Ont.

GENERAL ELECTRIC SWITCHGEAR

AAD-81501

CANADIAN GENERAL ELECTRIC COMPANY LIMITED

• *Personals*

ment, working at Shawinigan Falls, Que.

Mr. Pittuck is a 1951 graduate of McGill University with a civil engineering degree.

George Bird, JR.E.I.C., formerly of Regina, Sask., has been transferred to Toronto by the Canadian Bitumuls Company. With the company since 1951, he was named district manager of the Prairie Provinces district in 1954.

He is a 1949 graduate in civil engineering from the University of Toronto.

George R. W. Bliss, JR.E.I.C., who graduated from the University of New Brunswick, class of 1954, in civil engineering, now works for the New Brunswick Electric Power Commission design department in Fredericton.

Paul Vilim, JR.E.I.C., has joined the staff of the Atomic Energy of Canada, Ltd., in the engineering services division, at Chalk River. He is a graduate of the University of Manitoba in mechanical engineering, class of 1953, and has been employed by the Hydro Electric Power Commission of Ontario, in the R. L. Hearn generating station at Toronto.

William Yukish, JR.E.I.C., has accepted a position with the Foundation Company of Canada, project department, in Montreal.

In 1953 he was with the general engineering department of International Petroleum Company in Talara, Peru; and has also been associated with McKay and Cocker Construction Ltd., in London, Ont.

Mr. Yukish is a 1950 graduate in civil engineering from the University of Toronto.

John Q. Davidson, JR.E.I.C., is with Fraser Companies Ltd., New Castle, N.B.

Previously with the firm at Edmundston, he is a graduate of the University of New Brunswick, class of '53.

H. T. Abbott, JR.E.I.C., has joined Brunswick Balke Collender Company in Toronto, as a plastics engineer.

Project engineer with General Motors Diesel Ltd., in London, Ont., in 1955, he is a graduate of the University of Manitoba where he graduated with a B.Sc. degree in electrical engineering in 1950.

W. G. Dolman, JR.E.I.C., is with the Fort William Hydro Electric Commission, Fort William, Ont.

He was formerly city engineer at Selkirk, Man., and Fort Francis, Ont., and holds a B.Sc. degree in electrical engineering. Mr. Dolman graduated from the University of Manitoba, class of 1950.

G. A. Patterson, JR.E.I.C., is resident engineer with the Bailey Meter Company Limited, in Regina, Sask.

A graduate of the University of Saskatchewan, class of 1948, with a B.Sc. degree in mechanical engineering, he spent a year instructing at the university. In 1950, he joined the Bailey Meter Company Limited, and has worked as sales service engineer in Regina and Winnipeg.

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fire-proof — a sound barrier — economical

Reinforced "SIPOREX" panels of various thicknesses and lengths are ideally suited for interior partitions. These precast, cellular concrete panels permit rapid construction and their dimensional accuracy permits the use of paint or thin plaster finishes. "SIPOREX" partition walls are vermin-proof, rot-proof, fireproof and provide a highly effective sound barrier. Complete information is available from any of the offices of SIPOREX LIMITED.

Left: square edge panels ready for plastering.

Right: chamfered edge panels requiring only painting.

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LIMITED

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13 Place d'Aiguillon.

• *Personals*

A. M. Syme, JR.E.I.C., has joined the staff of Imperial Oil Ltd., Edmonton, Alta.

He has, until recently, been employed with the Hudson Bay exploration and development company at Kluane Lake, Yukon Territory.

Mr. Syme, a graduate of McGill University obtained his B.Eng. degree in mining engineering in 1950, and his M.Sc. degree in geology the following year.

W. Kruchowski, JR.E.I.C., has become a member of the distribution engineering branch of the Quebec Hydro-Electric Commission in Montreal.

Formerly design engineer with the Foundation Engineering Ltd., in Toronto, he has, since 1954, been with the Regina, firm of Stock, Ramsey and Associates.

He graduated from McGill University in electrical engineering, class of 1950.

Jean Bourassa, JR.E.I.C., has accepted a position with the City of Sherbrooke, Que., in the gas and electricity department.

Mr. Bourassa graduated from the Ecole Polytechnique in 1949, has been associated with the Montreal Tramways Company and in 1955 was on the engineering staff of Beauharnois Light, Heat and Power Company.

Donald J. Kee, S.E.I.C., who graduated from the University of Toronto last year with a B.A.Sc. degree in civil engineering, is with the Ellis Construction Company Ltd., in Marathon, Ont.

Richard H. P. Tims, S.E.I.C., is working for Northwest Industries Ltd., Edmonton, as a designing draftsman. He was, in 1950, aircraft draftsman with A. V. Roe (Can.) Ltd., in Toronto.

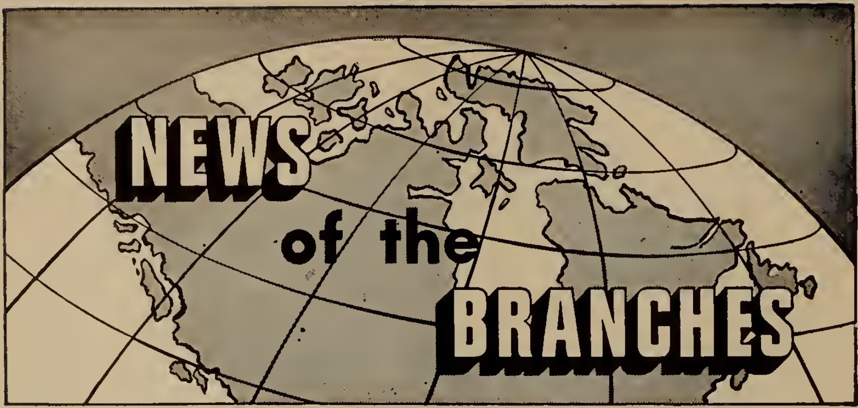
Michel Larochelle, S.E.I.C., who graduated in civil engineering from Laval University in 1955 is employed as divisional engineer with the Department of Agriculture, drainage service, Province of Quebec.

Charles R. MacFadyen, S.E.I.C., a 1955 graduate in civil engineering from the University of Saskatchewan is with the Bell Telephone Company at Dawson Creek, B.C., where he is working in the company's special contracts division.

W. J. Brice, S.E.I.C., 1955 graduate from the University of Saskatchewan, with a B.Sc. degree in mechanical engineering, is working for Schlumberger Wells Surveying Corporation, Virden, Man.

Correction
W. G. Mitchell, M.E.I.C.

In the March issue of the *Journal* it was erroneously stated that Mr. W. G. Mitchell was once professionally associated with Dominion Bridge Company. The *Journal* wishes to convey the fact that he joined the Canadian Bridge Company in 1929 and has remained with the company.



Activities of the Forty-seven Branches of the Institute

and

abstracts of papers presented at their meetings

Belleville

J. A. Grant, M.E.I.C.,
Secretary-Treasurer

Annual Meeting

The annual meeting of the Belleville Branch was held on April 9, 1956, at the Masonic Temple and 24 members attended.

The chairman called on the secretary-treasurer to read the minutes of the previous annual meeting which was held on April 18, 1955. It was moved by C. R. Whittemore and seconded by G. A. M. Bradford that the minutes be adopted as read.

Year Is Reviewed

Mr. Lusk then outlined the activities of the past year including such subjects as the Business Administration Course just completed, the B.C.I.V.S. and Quinte High School scholarships, the Branch Newsletter, the President's visit to Peterborough which was attended by several Belleville members and their wives, the Committee on Confederation and the Committee on the Admittance of Science Graduates. He outlined the purposes of the Engineering Institute of Canada and recommended that members keep these in mind.

The membership and financial reports were presented by the secretary-treasurer. It was moved by S. Sillitoe and seconded by G. B. Thompson that the reports be accepted.

The possibility of visits to the General Motors Plant at Oshawa and the St. Lawrence Power Project were discussed. The meeting was advised by Mr. Downman that due to the recent strike, plant tours of the General Motors Plant would not be possible until well on into the summer. It was recommended by Mr. Lusk that a visit to the St. Lawrence Power Project be deferred until the fall at which time the work would be advanced to the stage where a tour would be of greatest interest.

The possibility of changing the meeting time from 8.00 to 8.30 was discussed and it was decided that the present meeting time of 8.00 p.m. was preferable. C. R. Whittemore of Deloro pointed out the current shortage of engineers and urged that all members encourage high school students to enter the engineering field whenever the opportunity arose.

New Officers

The slate of officers for the coming year was presented by the chairman on behalf of the Nominating Committee as follows: A. D. Janitsch, chairman; J. A. Grant, vice-chairman; W. C. Benger, T. J. McQuaid and W. L. Canniff, committee members for a two-year term; A. E. Argue, E. Flinn and B. H. Downman, committee members completing a two-year term.

After calling for nominations from the floor, it was moved by G. A. M. Bradford and seconded by G. B. Thompson that the nominations for chairman be closed. The motion was carried and A. D. Janitsch was declared chairman by acclamation.

It was moved by W. C. Benger and seconded by B. H. C. Downman that nominations be closed for office of vice-chairman. The motion was carried and J. A. Grant elected vice-chairman.

It was moved by W. Sweet and seconded by S. Sillitoe that nominations for the three 1st-year committee members be closed. The motion was carried and Messrs. Benger, McQuaid and Canniff declared elected by acclamation.

The new officers were installed and the chairman, Mr. Janitsch, expressed his thanks for the confidence placed in him by the Belleville Branch. Mr. Janitsch advised that a new secretary-treasurer would be appointed by the new executive committee as soon as possible to replace J. A. Grant who now becomes vice-chairman.

Pipeline Film

A film was shown on the fabrication and laying of the pipeline between England and France during World War II for the supply of oil fuel to the invading forces.

The meeting was adjourned at 9.30 p.m.

Hamilton

A. F. Barnard, Jr.E.I.C.,
Secretary-Treasurer

R. R. Packer, Jr.E.I.C.,
Branch News Editor

Students' and Juniors' Papers Night

Three papers were presented at the annual Students' and Juniors' Papers Night by W. A. Pieczonka, J. H. Westaway, and W. A. H. Filer.

At a luncheon at Wallaceburg, Ont., on March 8, 1956, left to right, seated, William Joyce of the Wallaceburg Brass Company and Wallaceburg Singer Ltd., and J. S. Bulmer, of Dominion Die Casting Ltd.; standing, J. L. Fraser, of the Wallaceburg Brass Company; N. J. Southern, of Dura Chrome Ltd., H. B. R. Craig, consulting engineer, and L. F. Grant, Institute field secretary.

• Branch News

Nuclear Propulsion

Mr. Pieczonka addressed the meeting on "Nuclear Propulsion", as it applied to aircraft. He described three methods used, showing the superiority of the turbojet over the turboprop and the ramjet. The greatest advantage in design is long range, while the biggest disadvantage is shielding the reactor. In a mathematical study to determine the power requirements of a bomber similar to the B-47, it is necessary first to know the size of the reactor. From this, the amount of radiation may be calculated to determine the amount of shielding required. In this case it was found that 64 tons of lead would be needed.

Other problems connected with nuclear powered aircraft are those of structural and landing changes due to increased weight, radiation dangers in the event of a crash, and difficulty in controlling the reactor. These are offset, on the other hand, by extreme long range, low operating cost, and high altitude possibilities.

Mr. Pieczonka mentioned the fact that two submarines using nuclear propulsion have been built, and that the application of nuclear propulsion to locomotives is quite likely. The need here, however, is for a more efficient unit, he said.

Installing a Vertical Generator

J. H. Westaway presented the second paper on "The Installation of a Vertical Generator", in which he pointed out that there are two main types of vertical waterwheel generators: the conventional type with the thrust bearings above the rotor, and the umbrella type with the bearings below the rotor.

He then described the method of levelling the low bracket with a precision level. By using wire attached to a heavy weight suspended in oil, the parts are plumbed; the stator is then positioned; and sometimes the laminated core is stacked in the field. An experienced crew then winds the stator in the field, and the rotor, consisting of shaft, spider and rim, is then assembled. The poles are attached to the rim, and the stator is made ready to receive the rotor. The brakes that stop the rotor also serve as jacks. As the rotor is being lowered, the stator is protected by wood blocks held by a number of men.

Most waterwheel generators use Kingsbury type thrust bearings in which a wedge of oil above the pivoted shoe supports the load. There are various methods for loading the shoes equally: strain gauges may be used, and the average difference between load and no load may be measured with a dial gauge at several points.

After the shaft is checked for runout, the remaining components, such as the guide bearings, exciter, collector rings, and air coolers are assembled. The generator is then checked to prove that it is mechanically sound by driving it without electrical connections. To dry out the stator, the main leads are shorted, and the generator is run with the temperature controlled by varying the field current. Stator windings are tested with a voltage of 20,000 applied to each phase for one minute.

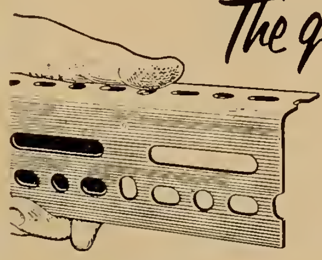
Mr. Westaway concluded his talk by summing up the advances made in waterwheel generator design through the years.

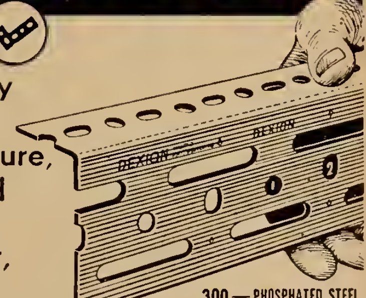
Why Professional Development?

W. A. H. Filer presented the third paper on "Why Professional Development?". He approached his subject by asking how much an employer could buy with $250,000, which is the amount paid to an engineer during his 30 years of service. This question pointed to the fact that the best way to ensure an employer a good return on his investment is the training of the young engineer.

Professional Development programs have been initiated because of the recognized need for post-graduate training of engineers, Mr. Filer said. Two spheres of influence affecting the engineer are those of industry and engineering societies.

Engineering societies do their part in assisting the young engineer to develop into a well-rounded professional man.





• Branch News

The Engineering Council for Professional Development, sponsored by engineering groups in Canada and the United States, studied the problems confronting the young engineer and issued the Monteith Report in 1950. This Report indicated that industry should contribute to the engineer's technical training, orientating him in industry, in his profession, and in community affairs.

The United States has in operation only one Professional Development course at the University of Cincinnati. Canada, under the sponsorship of the Engineering Institute, has in operation as many as 20 programs. That which is in progress in Hamilton was begun in 1951.

Professional Development is based on a liberal education. Flexibility is the keynote of the Hamilton program which is planned for the 150 members of the group, the directorate suggesting the basic outline only.

While technical competence is necessary, said Mr. Filer, it is not a sufficient condition in itself for becoming a professional engineer.

When the judges of the papers, H. E. Archibald, F. E. Milne, and W. Whetan, adjourned to make their decision, Chairman J. J. Kelly welcomed to the meeting the pre-engineering students of McMaster University. Prizes were afterwards presented as follows: J. H. Westaway, first; W. A. Pieczonka, second; and W. A. H. Filer, third.

A.I.E.E.-E.I.C. Joint Meeting

The Hamilton Branch has over a period of years shared a joint meeting annually with the Hamilton Section of the American Institute of Electrical Engineers. This year's meeting, held on April 5, 1956, in the Westinghouse Auditorium, included also the Toronto Section of the A.I.E.E.

Dr. J. A. Hutcheson Is Speaker

J. P. Skillen, chairman of the Hamilton Section, A.I.E.E. as chairman for the evening, asked J. J. Kelly, Hamilton Branch E.I.C., chairman and Professor G. F. Tracey of the Toronto Section of the A.I.E.E. to make announcements for their respective groups. He called on J. W. Kerr of Canadian Westinghouse to introduce the speaker, Dr. J. A. Hutcheson.

Lethbridge

R. D. Hall,
Secretary-Treasurer

Visit To Great Falls, Montana

On April 21, a joint meeting was held with the North Central Branch, Montana Section of the American Society of Civil Engineers. Approximately 40 members of the Branch and their wives joined the Montana Section A.S.C.E. for a combined field trip to the Malmstrom Airforce Base and tour of storm sewer installations. This was followed by a dinner meeting and dance at the Meadowlark Country Club, Great Falls.

Mayor Conklin Greets Guests

Registration was held from 12.30 to 1.30 p.m., after which Mayor Russel Conklin welcomed the Canadian visitors and delegates from other parts of Montana. Delegates were then briefed by Harry A. Balmer on construction in progress at the base and on the layout and operation of this large field.

During the tour of the base, the guests toured a large cold storage plant, permanent type masonry barracks buildings and a theatre, all under construction. Next they toured some portions of the city's 5 million-dollar storm sewer and paving projects. Upon returning to the Country Club, W. Wendland, chief resident engineer for Hoskins and Associates, consulting engineers for the city, explained details of the multi-million dollar projects.

At 6.30 p.m. the ladies joined the group for a "get acquainted" social hour.

Dr. E. W. Shilling Is Speaker

Dr. E. W. Shilling, Dean of the College of Engineering at Montana State College, Bozeman, was the featured speaker at the banquet. The title of his address was "Engineering Yesterday, Today and Tomorrow". Leyland J.

• Branch News

Walker was chairman of the meeting and A. A. Van Teylingen of Havre, was the toastmaster.

Engineer Training Trends

Dr. Shilling stated that the engineering curriculum has improved and is constantly improving. He cited examples of early engineering courses in shop and foundry work, pattern and machine shop training and detailed draughting. He suggested that the most important lesson learned from such training was that when someone was needed to do this work, a tradesman and not an engineer should be employed.

The modern curriculum places less emphasis on detailed draughting and shop work and more on blueprint reading. English and the other humanities courses are receiving more attention. Dr. Shilling stated that many graduate engineers do not know enough English to write their reports. Courses formerly only taught in post graduate work are now being taught to undergraduates and courses are becoming more technical. More stress on mathematics is needed to enable high school graduates to enter schools of engineering.

Extended Courses

For the future Dr. Shilling predicted a five-year course for engineers, and further specialization. This will lead to more graduate work, research and development. Since many are fathers upon graduation, Dr. Shilling cautioned against prolonging courses to the extent that graduates will be grandfathers.

Following the banquet, a very enjoyable dance was held in the Meadowlark Country Club.

J. A. Haberman, chairman of the Lethbridge Branch headed the Canadian delegation. Leyland Walker and E. J. Axllne of Great Falls were in charge of arrangements for the American Society of Civil Engineers.

Mr. Kerr related that Dr. Hutcheson's interest in electrical work was evident at 18 years of age when he operated his own radio repair shop. This business was so successful that he was able to help himself through college. In 1926 he entered the student training program of Westinghouse Electric Corporation, specializing in radio engineering. He was appointed manager of radio engineering in 1940 and three years later became assistant director of the Westinghouse Research Laboratories. In this capacity he attended the atomic bomb tests at Bikini as a civilian observer. Dr. Hutcheson became director in 1948 and the next year, vice-president of the Laboratories. He has been vice-president in charge of engineering of the Westinghouse Electric Corporation in Pittsburg since 1955, and was therefore able to speak with authority on the subject of "Research in the Electrical Industry".

Early Experiments

Dr. Hutcheson traced the development of the electrical industry from the early experiments in 1799 of Galvani, the biologist, who experimented with frog's muscles and by means of the leyden jar found what is now known as electricity. During the period 1800 to 1830 such great scientists as Volta, Ohm, Ampere and Faraday discovered the fundamentals which form the basis of electricity. These men did research but, in many instances, they did nothing to apply this knowledge.

Through the fifty-year period, 1830 to 1880, the inventors were busy applying the fundamental concepts of the scientists. The inventor was described as a "lazy engineer" since he was interested in applying the fundamentals with the least amount of effort. Motors, batteries and electric locomotives were some of the manifestations of the inventor's work. The first electric lamp was produced in 1878.

The third significant step in the development of this industry was the advent of the promoters, business men who were desirous of setting up companies to produce electricity first and then electrical products. Electricity for lighting was the first application of this new phenomenon which introduced the difficulty of transmitting direct current profitably. So it was that alternating current came into being with the necessity for transformers. This history forms the background which clearly indicates the prime importance of research.

Research Laboratories

Research is essentially the process of lowering the degree of empiricism by producing new scientific knowledge. The

Improved Ethylene production

offered by Canadian Kellogg

Pyrolysis process gives better yields and higher selectivity whatever the feed stock

PROVED HIGH ON-STREAM EFFICIENCY AVERAGES 95%

Ethylene demands are exceeding the limits of the existing supply produced by simple recovery from refinery gases. The engineers and contractors of one of Canada's first conventional type ethylene recovery plants, Canadian Kellogg, now offer a unique process for the manufacture of ethylene that holds many advantages over conventional systems and guarantees optimum yields and purity from economically-available feed stocks. The key is the steam-pyrolysis process developed by Kellogg and used with great success in England and on the Continent. The results of this process have been marked by excellent yields of high purity olefins, generally higher than can be obtained by conventional cracking. Equally important is the remarkable, high on-stream efficiency which permits continuous plant operation at high conversions.

Canadian Kellogg invites interested firms to review the considerable cost data on ethylene manufacture, based on pilot plant and actual commercial production, that has been accumulated.

THE **Canadian Kellogg** COMPANY LIMITED, TORONTO, ONTARIO

These are a few of the companies with whom Canadian Kellogg has worked—

Polymer Corporation, Limited
Imperial Oil Limited
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British American Oil Company Ltd.
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oil
- CHEMICAL PLANTS
- REFINERIES
- PROCESS EQUIPMENT & PIPING

• Branch News

value of research is demonstrated in two common products. In 1909 a 60-watt light bulb cost $1.29 to produce. Today the cost is one-tenth, or 12.9c. At the same time the life of the bulb has been extended through research on the tungsten element. It was found that the evaporation of the tungsten caused the bulb to blacken. Instead of creating an absolute vacuum in the bulb, some air was left inside, thus reducing the evaporation. A second example is the steam turbine where the efficiency has doubled through a study of the action of the materials.

Research is being carried on today by universities and industrial laboratories. Initially the universities did all the research and the industrial laboratories applied it, but industry has come to realize that it must share the responsibility for research.

Fundamental and Applied Research

The Westinghouse Electric Corporation Laboratories employ about 650 people in Pittsburg. Forty per cent of the work is devoted to fundamental research, that is toward new knowledge which has no immediate application. Such was the nuclear research done in 1936 preparatory to the atomic bomb On the other hand the remaining effort is directed towards basic research which has more immediate uses. Such knowledge would pertain to magnetic, insulating and structural materials. In many instances research is carried out not for the prime purpose of finding new materials but rather to understand the existing materials better.

Competitive Atomic Power

On the subject of atomic power Dr. Hutcheson stated that atomic energy would be competitive with existing sources of power in ten years. As available supplies of coal and water powei are exhausted the world will be forced to turn to this form of energy.

There was a brief question and answer period after which F. E. Milne, past-chairman of the Hamilton Branch. expressed the sincere appreciation of the 300 men present for a most enjoyable and stimulating address.

Sudbury

H. M. Whittles, Jr.E.I.C.,
Secretary-Treasurer

H. F. Coffin, Jr.E.I.C.,
Branch News Editor

Annual Members' Night

Thursday, April 5, the annual Members' Night was held at the Sudbury Granite Club. The first speaker to present a paper was Kelvin Sproule of the research department of International Nickel Company of Canada Limited. His subject "Atomic Energy ABC".

Atomic Energy ABC

Mr. Sproule pointed out that atomic energy is fast becoming a major factor in both world affairs and in technology, and that it is the duty of engineers both as citizens and in their profession to obtain some understanding of it. As an aid to understanding the potentialities of the atom, the underlying theory of atomic power was viewed in simple terms.

Briefly, atomic energy involves splitting the nucleus of the atom in contrast to chemical energy where only the electrons are involved. In a nuclear reaction, one element changes into another with the conversion of a very small percentage of the matter into a very large amount of energy.

A brief outline was also given of the uses in industry, agriculture and medicine of radioactive isotopes. Examples mentioned were tracing the use pattern of phosphorus in plants, thickness gauges in the rolling of steel, and cancer treatment.

A New Mine

The second member to present a paper was George Charlap of Falconbridge Nickel Mines whose topic was "Some Problems Encountered in Starting up a New Mine".

Apart from the size, shape and depth of orebody at least partially determined by the geologists through diamond drilling, there are still the problems of financing, finding the best method of treating the ores, and deciding the

if you can move it overland **KING** *can build the trailer to do your job*

Top: The KING 84tSW, one of Canada's largest low bed semitrailers, built for hauling transformers at Kitimat. Capacity 110 tons.

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Tell us what you want to haul. Whether it be steel, logs, pulpwood, machinery or bulk loads, KING engineers will find the answers and advise you on the most economical trailer to do your job efficiently. KING engineers are Canada's foremost trailer design specialists. Call on them whenever you have a hauling problem. There's no obligation of course!

MADE IN CANADA TO MEET CANADIAN CONDITIONS

KING Trailers

TRUCK ENGINEERING LIMITED

TORONTO WOODSTOCK MONTREAL

• Branch News

possible future demand for metals. When these have been decided upon, a working force consisting of a planning group, a field group and correlating or executive group are set up. The planning group tries to keep ahead of the field group with plans, while the correlating group plans the right job for the right time. The correlating group also looks after housing, medical accounting and purchasing. The planning and field groups in turn, are divided into such departments as geology, mining, mechanical, electrical and engineering.

Principal Requirements

Mr. Charlap then gave a summary of the principal requirements: access roads, location of headframe, yard elevation, supply of electrical power, temporary quarters close to but away from permanent buildings, type of temporary quarters, services, compressors, type of hoist and size of shaft. The depth of orebody fixes the location of crushing station and depth of shaft. Cables, shaft hardware, hoists, ventilation equipment and pumps are some of the items necessary to start a mine. A railway and mill to process the ore, have to be considered, also.

Mr. Charlap closed by saying, "With competent people, co-operation between the groups and a lot of hard work these "problems can be licked".

After an extensive question period on both papers Mr. Sproule and Mr. Charlap were thanked by Ted Fletcher.

Toronto

Louis Bresolin, jr.e.i.c.,
Secretary-Treasurer

A. C. Davidson, m.e.i.c.,
Branch News Editor

Nuclear Radiation Detection

George Cowper of Atomic Energy of Canada Limited, Chalk River, spoke on "The Detection of Nuclear Radiation" at the Toronto Branch meeting of March 15. The topic is not a new one, but Mr. Cowper made it clear that detection is a very important phase of nuclear engineering. Accurate and reliable detection is essential if nuclear reactions are to be controlled safely.

Various Methods

Various methods of detection were discussed in considerable detail beginning with chemical analysis, which is relatively crude, and ending with scintillation counters which are capable of detecting extraordinarily small amounts of radiation.

Nuclear radiation possesses the definable characteristic that nuclei of radioactive materials are not stable, releasing charged particles and electromagnetic radiation. The change in chemical properties due to the breakdown of the nucleus in a radioactive element can be detected by the usual methods of micro-chemical analysis, and by the measurement of ionization either by electroscopes or by gas (geiger) counters.

Humble Mothball Is Used

Differentiating among the kinds of particles and radiation given off can best be done by scintillation counters and by cloud chambers. It was interesting to note that the humble mothball is used in scintillation counting.

Two points were emphasized by Mr. Cowper; first, the transistor will reduce the bulk of counting apparatus; and second, that the reliability of all components of the detection equipment must be beyond reproach.

For the uninitiated Mr. Cowper's talk was very interesting as it removed some of the mystery connected with nuclear phenomena, by putting the theoretical information on a practical basis.

Editor's Note:— Branch News Editor A. C. Davidson's "spring tonic" for the Journal staff was much appreciated. We hope he will not mind the liberties we take in publishing a part of his letter covering Toronto news this month and in sharing with others his enviable good humour:

. . . You will probably recall that Robert Benchley was once asked to write a thesis on the economics of a certain fisheries treaty which he did from the standpoint of the fish, much to the consternation of the professor who was examining him. I have been sorely tempted to write the visit to

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MONTREAL • TORONTO • WINNIPEG • REGINA • SASKATOON • CALGARY • EDMONTON • VANCOUVER — Sales Offices also at: HALIFAX • QUEBEC • OTTAWA the Hydro steam plant from the standpoint of two lumps of coal.

However I have fought back the temptation as it might offend the sensibilities of our more staid members. The draft is appended (draft in the sense of a written brief and not in the sense of air for combustion) for your delectation and exhilaration. This will do as a spring tonic as I know your labours, like those of the rest of us, do become burdensome at times. . . .

The following is probably the result of the reincarnation of the Muse of Poetry roosting on my television mast overnight during a recent flight of wild fowl northward in the Spring migration.

Therefore, in blank verse after the manner of W. Shakespeare:

Scene I

Enter two lumps of coal on a moving belt.

1st Lump:

Hola comrade!
We meet again
Far from Pluto's regions.

2nd lump:

Aye, 'tis on a mission of great import
That we go into the outer world.
Word comes to dark Erebus' dominions
Telling that some witless wight
Is cold because his electric
Blanket is wattless.
We are to give up our energy
In one brief flash so that
He may be warm'd.

1st Lump:

Hold! Crowd not upon me so!
'Tis dark here in this great cavern.
Our friends press down upon
Us and all is gloom;
Slowly we descend
Into the bowels of some great machine
Which roars and rends,
Shaking us till our very molecules
Rattle apart.
Up we go again
Wafted on by some hot hurricane
Which carries us to a doom
Like that of the three
Who defied the great King of Babylon;
Were roasted yet did not die.
We, too, will burn but
Yet will live, yea,
We change to other form
And slowly sink to a place
From which none do return.
Farewell!

Exeunt two well sintered clinkers.

Scene II

(This could be a bit of byplay between two drops of water as they pass through the Rankine cycle, but I feel the Muse has a clearance from flight control and is off to Churchill, Man. and points North.

This might even inspire a recitative aria between two singers: a coloratura soprano and a basso profundo, the one representing the passage of steam through the nozzles at the high pressure end of the turbine, and the other, the ponderous rumblings of the generator. But this is beyond me: the blank verse effort preceding, and not very well metred at that, is about all I can manage.)

Generating Station Tour

The meeting of April 5 took the form of a plant visit to the Richard L. Hearn Generating Station on the Toronto waterfront. Plant visits are always a popular feature of the Toronto Branch meeting schedule, and this one was no exception as there were at least 150 members in the tour. The Ontario Hydro arranged the tour with one guide for every ten sightseers, and supplied coffee and doughnuts at the end of the two-hour trip. The small parties together with the congenial guides made the visit a memorable one.

Steam generating plants have been thought of by Canadian engineers as standby equipment for emergencies when hydro electric equipment breaks down. It was brought forcefully home that the generators of the Hearn station were supplying a deficiency of hydro generating equipment. On the night of this visit two machines were supplying load, a third standing by, while the fourth was stripped for repairs and inspection.

Fourth Machine Stripped

The fact that the fourth unit was taken down made the visit even more interesting as it was possible to examine the construction of boiler, turbine, generator and auxiliary equipment in detail.

The whole plant represents the latest thinking in the field of heat power engineering and shows that the professional engineers in charge of the operation are alert to trends and forward looking in all that they do.

Quoting statistics of the plant equipment or even saying that the plant is big conveys little or nothing to the reader; a visit is probably the most convincing way to demonstrate such facts. The most important point to be emphasized is that the engineers here are wringing the last available bit of energy from a lump of coal and that very soon, much sooner than anyone expects, other means of obtaining energy will have to be employed.

The thanks of all who went on the trip are extended to those in the Toronto Branch who arranged the trip and to those in the Ontario Hydro who acted as guides and answered questions.

Vancouver

A. D. Cronk, Jr.E.I.C.,
Secretary-Treasurer

C. H. Maartman, Jr.E.I.C.,
Branch News Editor

Students' Night

The Vancouver Branch annual Students' Night dinner meeting was held in the University of B.C. Faculty Club dining room on Tuesday, March 13, 1956. Approximately 80 members and students attended with each student sponsored by a member of the Branch.

The program featured a short talk by H. N. (Dutch) McPherson entitled "Fun out of Living", followed by a competition in the form of three short presentations from the top student speakers

Participants in Students Night of the Vancouver Branch. Above, H. N. "Dutch" McPherson, and left to right: Bill Taylor, John Duerksen, and Joe West.

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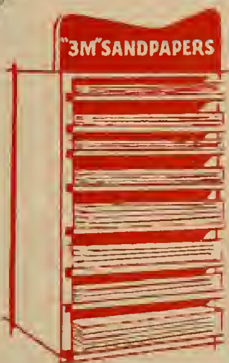

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• Branch News

selected at the noon hour seminar meetings of the University Student Branch. The latter talks, organized along the lines of a toastmaster's meeting with the Student Branch Vice-Chairman Bill Taylor in the chair, were light and amusing. Joe West gave an amusing dissertation on "The Egg", John Duerksen parodied his favourite game, "Golf", and Bev Campbell described the fictitious agricultural industry of "Macaroni Farming".

Mr. McPherson was introduced by Wilf Heslop, Branch executive member. Bill Millar, Cliff Day and Craig Clark introduced the three student speakers. Fred Shrack of the Students' Branch thanked Mr. McPherson while Larry Hunt, Shigeo Saimoto and Art Kempe acknowledged the student talks.

Prize Winners

At the conclusion of the meeting, Judges Wilf Heslop, Ron Wilkins and Pete Fratinger announced the winners of the competition, first prize going to John Duerksen, second to Joe West and third to Bev Campbell. Cheques were presented to each of the student speakers and a further presentation of Student Membership Pins was made to each of the Student Branch officers; Eskil Johnson, Bill Taylor, Murray MacKenzie, Dave Haig and Rod Haefer.

Winnipeg Electrical Section

G. L. MacDonald, M.E.I.C.,
News Editor

University Plays Host

The University of Manitoba played host to the Electrical Section for its February Meeting.

The Section toured the engineering buildings and laboratories and saw a demonstration of an impulse generator, assembled in the laboratory, with cascaded rectifiers producing about 100,000 volts.

J. P. C. McMath Department Chairman

The University made two announcements of interest to electrical engineers and to industry in Western Canada. Dean A. E. MacDonald, of the Electrical Department, announced the appointment of Prof. J. P. C. McMath, as chairman of the Electrical Engineering Department, at the university.

Prof. McMath then announced plans for the building of a high voltage testing laboratory for the University. A new building is being built to house this laboratory, and it is expected that it will be finished late this year and equipment installed and ready to operate sometime in 1957.

High Voltage Testing Bay

The building will include a high voltage testing bay, 60 ft. long by 36 ft. wide by 38 ft. high, to house the high voltage impulse generator and provide space and clearance for the testing of heavy power apparatus. The clearances provided in the test bay will permit the testing of large apparatus to about 2,500,000 volts, and the impulse generator will be capable of producing this voltage.

Testing Equipment

In addition to the impulse generator, equipment will be provided for steady state d.c. testing to about 440 kilovolts and 50 milliamps., and also a.c. testing to 250 kilovolts, 60 cycle, with about 250 kva. capacity.

A section of the laboratory will be occupied by staff of the Canadian Standards Association for approval work, chiefly on electrical apparatus built in Manitoba, or imported electrical equipment not C.S.A. approved elsewhere.

It is expected that the facilities provided by this high voltage testing laboratory will be unique in Canada at the present time, and will provide a very valuable means for training and research at the university, and for the electrical industry in Western Canada.

• Branch News

D. B. Brandt Guest Speaker

The Electrical Section held its March meeting in the Westinghouse Auditorium. D. B. Brandt, of the General Electric Company, Schenectady, addressed the meeting on the subject, "Planning for Simplified Relay Application". Mr. Brandt told the Section that the tremendous electric system growth facing the industry and the shortage of technical manpower will require a new approach to system relaying.

This can be achieved by the selection of an overall plan of protection for all system components, and the re-use of this plan whenever a similar component is added to the system. The plan should be flexible to accommodate new ideas, techniques and equipment. This plan will minimize application effort initially and provide the greatest flexibility in modification or additions to a system to meet load growth. Protective relaying could now be planned ahead because of advances in relaying equipment and methods, and because of better co-ordination between system planning and relay engineering.

Advances in Relay Components

Advances in relaying components have been made along the lines of increased speed, improved selectivity and greater freedom from the effect of current transformer errors. The advances have resulted from increased knowledge of the characteristics of system disturbances and system components, and improved relay design and construction. With increased knowledge of the characteristics of system disturbances, it has been possible to devise relaying equipment that is capable of distinguishing between one or more unique characteristics of each type of disturbance. Transformer differential relays, for example, may be provided with harmonic restraint to prevent operation from magnetizing inrush by using harmonics in the magnetizing current. Generator differential relays are provided with means to prevent false operation resulting from transient current transformer ratio errors during external faults.

A variable per cent slope characteristic is employed which retains the desired sensitivity under full load conditions, but which provides a rapidly increasing percentage restraint for increasing external fault current magnitudes. This increasing restraint characteristic is put under directional control, restraint being permitted to exist only when the fault current flows from the generator into the system. This overcomes the hazard of failure to operate when the system supplies high current to a generator fault. This feature is known as product restraint.

High Speed Voltage Relay

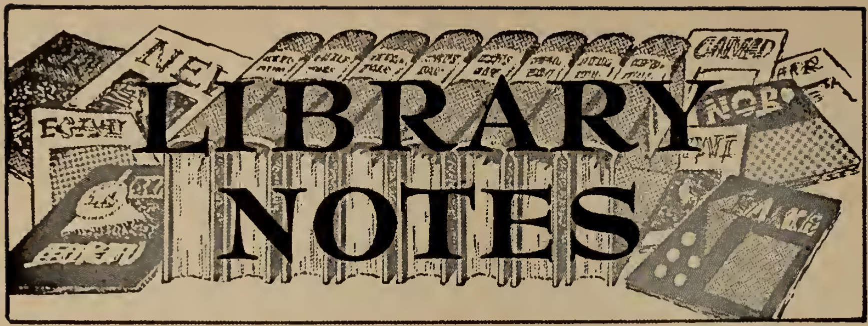
The development of a high speed voltage relay has greatly simplified bus differential relaying using bushing current transformers. Directional comparison relaying for transmission lines, using carrier current pilot or micro wave pilot and distance relays, both phase and ground, for protection of sub-transmission lines, are well suited for standardization.

Standard Relay

An example of standardized relay application was discussed for a unit type generating station, where the generator, main power transformer and station service transformer are solidly connected, and the station expands by adding additional units. In this case, the generator is protected by product restraint differential relays. The main power transformer and the station service transformer are protected by harmonic restraint percentage differential relays, and the station service transformer zone includes the low side circuit breaker. The high voltage switchgear and station service low voltage switchgear have differential protection, in the former using bushing current transformers, and in the latter, current transformers in the metal-clad switchgear.

Proper Relay Selection

A plan for selecting proper relays will bring about better electrical service at a reduced cost because the expensive system studies and relay readjustment to obtain adequate protection are reduced. Each utility should establish what is considered the proper standard relays for all components of the electrical system. These relays should reflect the best practice of the day and should be kept up to date as new relays and new methods are evolved.



Additions to the Institute Library

Reviews — Book Notes — Abstracts

BOOK REVIEW

Proceedings of the international conference on the peaceful uses of atomic energy, v.3, Power reactors. New York, United Nations, Toronto, Ryerson, 1956. 389pp., illus., $7.50 (U.S.).

The International Conference on the Peaceful Uses of Atomic Energy held in Geneva in August 1955 was the first international meeting on the subject. Consequently, the information contained in the more than one thousand papers presented there, and the discussions the papers provoked, constitute the most important and up-to-date collection of material available.

The United Nations is publishing the complete text of the Proceedings in sixteen volumes. The first of these to appear, Volume III, is entitled Power Reactors. It contains thirty papers presented at Geneva, together with a verbatim record of the discussions which took place at the six sessions.

The first two sections, comprising five papers, deal with fuel cycles and experience to date with nuclear power plants, including a description of the 5,000 kw. nuclear power station which has been operating in the U.S.S.R. for over a year.

There are descriptions of the reactors for power production which were being designed when the conference took place, and of the power reactor prototypes which were in operation or under construction last August.

Four papers from France describe primarily gas-cooled reactors; the seven papers from the United States deal with a variety of reactors; the Dutch papers consider reactors designed to use suspension of radium particles as fuel; the Russian paper describes a boiling homogenous reactor, and there is also a description of the project for a fast breeder reactor to be built at Dounreay in Scotland.

Included in the volume is a catalogue of existing and planned nuclear reactors which was prepared especially for the Geneva Conference.

The other fifteen volumes to be published in this series will cover the world's energy requirements and the role of nuclear power; various aspects of reactor design; geology of uranium and thorium; the effects of radiation; radioactive isotopes, etc. These sixteen volumes will provide the most valuable reference work on atomic energy which is likely to appear for many years.

S. C.

BOOK NOTES*

Prepared by the Library
The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

***Aircraft gas turbines.** C. W. Smith. New York, Wiley, 1956. 448pp., diagrs., $8.75.

The aim of this book is to provide for engineers a well-rounded picture of the aircraft gas turbine power plant, with somewhat greater emphasis on the theoretical aspects than on mechanical and structural details. The Brayton and other gas turbine cycles, theory of flow in ducts, nozzles, and diffusers, and the design of components are fully treated. Selected problems of stresses, materials, performance, and installation are also discussed. The book contains sufficient aerodynamic and thermodynamic theory for full understanding of the contents without recourse to other texts.

The analytical theory of heat. Joseph Fourier. New York, Dover, 1955 [c.1878]. 466pp., $1.95.

This classic work covers radiant heat, cause and reflection of heat rays, communication between internal molecules, uniform and linear movement of heat, heating of closed spaces, movement of heat in a ring, solid sphere, solid prism, and solid cube, use of trigonometric series in the heat theory, and propagation of heat in an infinite rectangular solid, etc.

Boiler house and power station chemistry, 3rd ed. Wilfrid Francis. Toronto, Macmillan, 1955. 348pp., diagrs., $10.00.

The main object of this book is to provide an account of the chemical considerations involved in the combustion of coal and in the generation of electricity. In this edition, a description has been included of the properties and preparation of alternative fuels, with methods for the rapid calculation of combustion engineering data relating to them.

Besides the chapters dealing with these two main subjects there are sections on boiler availability, methods for the cleaning of boilers, and methods for the analysis of fly ash from boiler flues and passes.

The appendix includes conversion factors, abridged Callendar steam tables, and a comparison between standard sieves.

Book of ASTM standards, 1955, including tentatives. Philadelphia, American society for testing materials, 1955. 7v. $84.00 per set.

This is the largest book of standards to date, containing some 2,150 standard specifications, tests, and definitions for materials. Each of the seven parts covers a certain area or group of areas of materials, and standards of a general nature appear in several parts.

The division by volumes is as follows: ferrous metals; non-ferrous metals; cement, concrete, ceramics, thermal insulation, road materials, waterproofing and soils; paint, naval stores, wood cellulose, wax polishes, sandwich building constructions; fuels, petroleum, aromatic hydrocarbons, and engine antifreezes; electrical insulation, electronic materials, plastics and rubber; textiles, soap, water, paper, adhesives, and shipping containers.

Each part is complete with a detailed subject index and a list of standards in numerical order. To keep the book up to date, supplements to each part will be issued late in 1956 and 1957.

Champs de vecteurs et de tenseurs. Edmond Bauer. Paris, Masson, 1955. 204pp., 2200fr.

The author of this work, a physicist, has tried to present the subject of vectors and tensors in a way which will be useful to mathematicians as well as to those in his own field.

The first three chapters deal with basic principles, while following sections apply the established formulae to the subject of electromagnetism. Included are the fundamental electromagnetic laws of Coulomb, Ampere, Maxwell and Lorentz.

The constitutional diagrams of alloys: a bibliography, 2nd ed. J. L. Haughton and A. Prince. London, Institute of metals, 1956. 323pp., £1.15.0.

About twice as many references are found in this edition as in the first edition published in 1942 and all have been brought up-to-date.

The bibliography is divided into sections covering the binary, ternary, quinary and senary systems which are arranged in alphabetical order of the chemical symbols of the metals composing them. Under each system the references are listed in chronological order and the location of the abstract in the Institute's publications is noted. The bibliography also indicates whether the original article contained a new or revised constitutional diagram or a portion of one.

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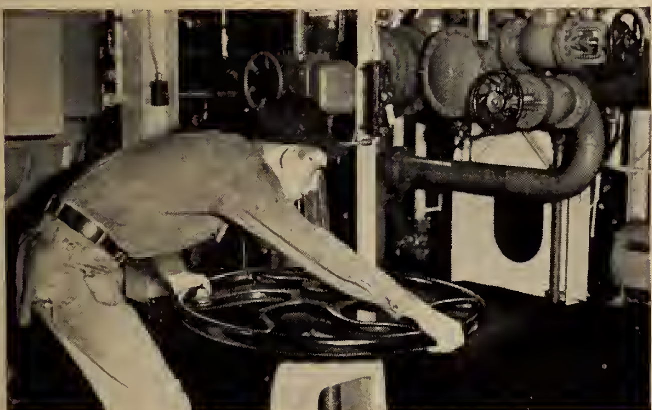

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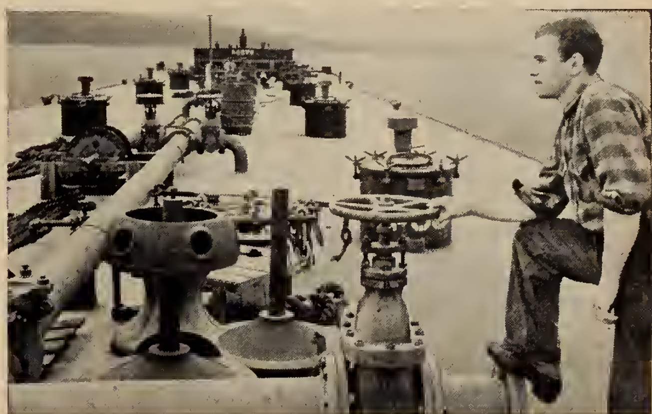

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• Library Notes

***Construction planning, equipment and methods.** R. L. Peurifoy. Toronto, McGraw-Hill, 1956. 534 pp., illus., $10.20.

The purpose of this book is to show how the application of engineering fundamentals and methods of analysis can improve the quality of construction while at the same time reducing costs. The subjects covered include job planning, construction management, factors affecting equipment selection, and such fundamentals as soil compaction, the effect of altitude and temperature on engine performance, rolling resistance, etc. Considerable space is devoted to the performance, cost, and suitability of various kinds of equipment, and to drilling, tunneling, foundation grouting, and other procedures.

Diesel operation and fault diagnosis. G. B. Fox. Toronto, Nelson, Foster & Scott, 1955. 191pp., illus., $4.75.

The scope of this practical manual is wide, covering small single-cylinder units and automotive engines, as well as the larger types of diesels for marine and industrial uses. It is a detailed instruction book on the various components of the diesel engine and on the manner of diagnosing troubles.

After a brief history of the compression-ignition engine, there is a description of the fuel-injection system which includes comments on the various types of equipment now in use and their maintenance. This is followed by chapters on instrumentation, engine tuning, location of faults, pistons, rings and liners, bearings and lubrication, fuels, combustion, air compressors, starting devices, the log-book and overhauls, and supercharging methods. The last chapter describes a dozen current engines to illustrate the various classes of diesel.

Electrical measurements and measuring instruments, 4th ed. E. W. Golding. Toronto, Pitman, 1955. 913pp., illus., 40/–.

There have been many new developments in this field since the third edition of this book was published in 1950 and these have been incorporated into this new edition. Most important, perhaps, are the subjects of M.K.S. units and rationalization which are fully covered, although the author has continued to use the C.G.S. system.

Because it is essentially a textbook the emphasis is on theory and principles but a number of worked examples have been given as illustrations. Among the subjects presented are circuit analysis, inductance, measurement of resistance, potentiometers, magnetic measurements, illumination, high-voltage measurements, wave-forms, transient phenomena, measuring instruments, the measurement of power and energy, and electronics and electronic measuring devices.

Electronic data processing for business and industry. R. G. Canning. New York, Wiley, 1956. 332pp., $7.00.

Many executives will welcome this comprehensive presentation of a most important subject. Perhaps its greatest value lies in the fact that no previous knowledge of the electronics field is

Improve protection and reduce maintenance costs with

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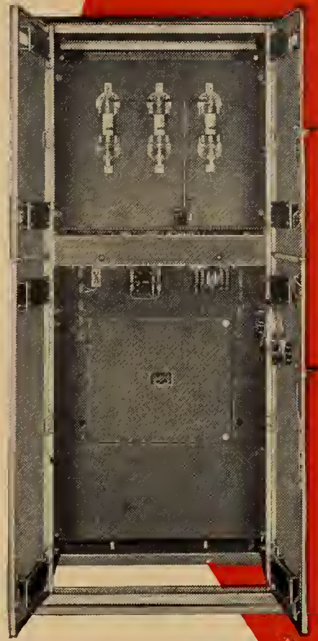
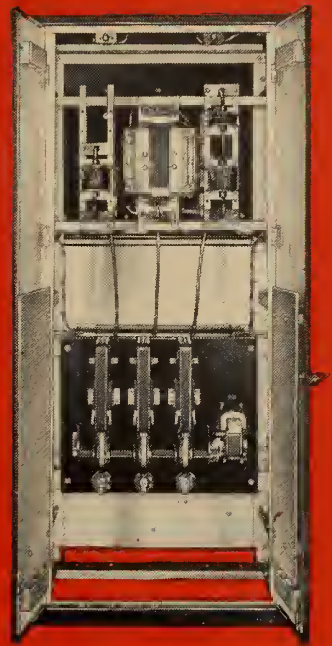


Front



Rear

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Rear

Front

Narrow Type High Voltage Starter

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• Library Notes

necessary to understand the processing systems described.

The author first covers the basic operations of electronic computers and the method of instructing the machine to perform various operations. Specific applications in different types of industry are analyzed, and the appropriate electronic systems outlined.

A large part of the book is devoted to a study of the systems engineering approach to individual data processing problems. This explains how to determine the requirements of any firm then describes a method for laying out a suitable electronic system.

The connection between operations research and the various electronic systems is considered, and this chapter is followed by a description of available commercial electronic systems. The book concludes with a suggested plan of action for management to obtain a reliable system.

Encyclopédie technologique de l'industrie du caoutchouc, v.4 G. Génin and B. Morisson. Montreal, Fomac, 1956. 587pp., illus., $24.60.

The first two volumes of this series are still to be published but the third volume has appeared and covers the subject of rubber technology and its various uses. The present work discusses tires and inner tubes, and the direct uses of latex. The first section comprises eight chapters which deal with all phases of the manufacture of tires and tubes and their repair.

In the second part of the book various authors describe latex mixtures, the manufacture of such articles as latex gloves, sponge rubber, glue with latex base, the use of this material in the manufacture of paints and varnishes, the paper industry, elastic, artificial rubbers, and other pertinent subjects.

Entrepreneurs et entreprises. Paris, Moniteur des travaux publics, 1955. 202pp., illus., 2250 fr.

One of the main features of this elaborate history of some forty French construction firms is the illustrations and colour photographs. It is an interesting picture of the evolution of technology as well as of the lives, careers, and accomplishments of many famous members of the construction industry. The structures cited in the book include not only French landmarks and important public buildings but also those in other countries.

In addition to the history of each builder, there are articles by well-known authors on French building technique, the evolution of the construction industry, with its economic and social aspects, the role of the contractor in erecting civic buildings and historical monuments, the place of the contractor in the development of roads and railroads, and so on.

Factory electrification. F. T. Bartho and C. H. Pike. London, Macdonald, 1956. 398pp., illus., 35/-.

Those engineers concerned with the installation and maintenance of electrical plant will find this book of value. The authors discuss factory electrification in terms of principles, and describe representative types of equipment with their capabilities and limitations. The book does not cover special equipment such as welding plant and furnaces.

In detail, there is information on main distribution switchgear, power transformers, cables and wiring systems, a.c. induction and 3-phase commutator motors, d.c. motors, synchronous motors and power-factor improvement, and motor control gear. The last chapter provides a valuable survey of motor application.

***Fluid flow in practice.** J. R. Caddell, ed. New York, Reinhold, 1956. 119pp., illus, $3.00 (U.S.).

A concise treatment of selected aspects of the flow of fluids (including slurries) in pipelines and pumps, with some attention given to applications for gases. The volume is made up of six papers covering the following subjects: basic principles; planning piping systems; the selection of valves, pumps, and flow meters; operation and maintenance of equipment; and trends in research. This is the third volume in an "Experience in Industry" symposium series.

Function and training of the chemical engineer. Toronto, Ryerson, 1955. 85pp., $1.25.

This is a report of discussions heard at an international conference of chemical engineers held in London in 1955. The six sessions dealt with several aspects of chemical engineering, including the part played by the chemical engineer in bridging the gap between research and plant construction, his role in plant operation and management, educational courses in chemical engineering, and the practical training of the chemical engineer before and after entering industry.

***Fundamentals of press tool design.** W. F. Walker, New York, Philosophical Library, 1955. 152pp., diagrs., $4.75 (U.S.).

This book gives concise, practical information on the design of tools for over twenty different operations performed by the more commonly used types of press tools. The operations treated include blanking, piercing, clipping, shaving, matching, bending, drawing, cupping, etc., with variations of each operation illustrated by a series of drawings. Basic information on the construction and uses of the various types of tools is included, and the calculation of blank sizes and selection of tool materials are briefly considered.

***Fundamentals of transportation engineering.** R. G. Hennes and M. I. Ekse. Toronto, McGraw-Hill, 1955. 520pp., diagrs., $10.20.

Major sections of this survey of the civil engineering aspects of transportation are devoted to roads and pavements, and to airport, railroad, and river and coastal engineering; briefer sections deal with pipelines and belt conveyors. The book includes design and layout data, and planning and construction standards and procedures of value to both students and practicing engineers.

Geometry of four dimensions. H. P. Manning. New York, Dover, 1956 [1914]. 348pp., $1.95 (U.S.).

After a discussion on the history of fourth dimensions and on their foundations, the author goes on to perpendicular and simple angles, symmetry, order, motion, Euclidean geometry, figures with parallel elements, and regular polyhedroids, etc.

Handbook of drainage and construction products, 5th ed. W. H. Spindler, ed. Guelph, Armco drainage & metal products of Canada, 1955. 579pp., illus., $5.00.

The wide scope of this handbook includes chapters on strength research, strength design, durability studies, subsurface drainage, special drainage problems, and installation instructions. Each section is summarized at the beginning to save time in searching for information.

Numerous tables, diagrams and illustrations add to the value of the book. Students, as well as practicising engineers, will find it a useful tool.

Kempe's engineer's year-book for 1956, 61st ed. London, Morgan, 1956. 2v., illus., 75/-.

Since almost every engineer is well acquainted with the wide scope of this reference work, we need only mention the changes which appear in the 1956 edition. These include a new chapter on foundations and earthwork, the rewriting of the aerodynamics and aircraft propulsion sections, additions to the chapters on electrical and electronic engineering, gas and steam engineering, steam turbines, explosives, concrete, and depreciation.

Machinery's screw thread book, 16th ed. Brighton, Machinery publishing co., 1956. 224pp., diagrs.

This edition has been completely rewritten. It contains much more detailed information than previous editions, and is also completely up-to-date. The section on screw-thread measurement by the wire method is claimed to be the fullest account ever published. The present edition omits any coverage of gauge tolerances.

Among the types of screw threads included are British threads of Whitworth form, unified and American series, American translational and pipe threads, continental forms and series, and horological threads.

Nomography and empirical equations. D. S. Davis. New York, Reinhold, 1955. 236pp., $6.75.

The engineering applications of empirical equations and nomography are explained in this book, which describes the use of these tools to speed up calculations.

Part I deals with the development of empirical equations for two- and three-variable data and describes new techniques using trigonometric and hyperbolic functions and the modified Gompertz equation, as well as other devices for two-variable data. Simple methods for correlating three-variable data are included.

In the second section the theory and construction of several industrially important types of chart are described. Among these are addition charts, logarithmic, nonlogarithmic multiplication, recurrent variable, and line coordinate charts. The last chapter deals with graphical anamorphosis.

Office automation; integrated and electronic data processing. R. H. Brown. New York, Automation consultants, 1955. 283pp., loose leaf, illus., $12.50 (U.S.).

In non-technical terms this manual outlines the whole field of office automation. Written for business executives, government officials, students, and office workers on all levels, it gives the essentials of the subject with references to more detailed information elsewhere. Its scope includes the entire field of data processing.

The first section deals with the commercial aspects of office automation and this is followed by a description of the new tools and equipment in the field. The

• Library Notes

author explains how the new machines are used and what benefits can be derived from them. The sociological aspects of office automation are discussed, as well as such new scientific techniques as operations research, cybernetics, the information theory, and automatic programming. The last section covers some of the potential applications of electronics in the business field.

Personality and group relations in industry. M. P. Fogarty. Toronto, Longmans, Green, 1956. 341pp., $5.40.

Those interested in industrial relations will find this book useful background reading. In a rather unusual arrangement, its point of departure is the level of the single human personality, rather than that of the group. The author presents a psychological study of the personality and traces the changes which occur through life. He then progresses to a discussion of small, primary working groups, and includes several case histories.

In the last section of the book he deals with large working groups, studying them sociologically, economically and politically.

Practical metrology, vol. 2. K. J. Hume and G. H. Sharp. London, Macdonald, 1956. 71pp., diagrs., 7/6.

This is the second of four volumes which contain laboratory experiments in metrology with complete instructions on performing and recording them. The experiments in this book include the measurement of plug gauge, plate gauge, spur gear, pitch error of screw gauge, form and angle of plug screw gauge, the checking of a form gauge and a sine bar; and taking a cast of a small ring screw gauge.

Propagation des ondes dans les milieux périodiques. Léon Brillouin et Maurice Parodi. Paris, Masson, 1956. 347pp., diagrs., 4600 fr.

This work is based on an earlier book by Brillouin, entitled "Wave propagation in periodic structures", but contains new chapters bringing the material up-to-date.

A series of problems, ranging from electrical engineering to electromagnetism and wave mechanics of the spinning electron, are bound together by a common mathematical background. They all deal with periodic structures of various kinds, and they all lead to similar results. The general theory developed in the book also bears a close connection with many problems of applied mathematics such as the Mathieu functions and Mathieu's and Hill's equations.

Significance of tests and properties of concrete and concrete aggregates. Philadelphia, American society for testing materials, 1956. 393pp., $5.25 (U.S.) (ASTM special technical publication no. 169).

The subject matter in this new edition is divided into four general sections. The first includes papers on sampling, statistical considerations, evaluation, and needed research. The second deals with tests and properties of freshly-mixed concrete, hardened concrete, and special categories such as ready-mixed and lightweight concrete and aggregates. The papers in part 3 cover tests and properties of concrete aggregates, while the last group discuss other materials: water,

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curing materials, air entraining admixtures and mineral admixtures.

Standard specifications for highway materials and methods of sampling and testing, 7th ed. Washington, American association of state highway officials, 1955. 2v., $7.50 (U.S.).

In this edition specifications and test methods are published in separate volumes. There are 100 specifications, 45 of them revised, covering hydraulic cements, bituminous materials, soils, aggregates, brick, culvert and sewer pipe, bridge paints, reinforcing steel and wire rope, metallic materials for bridges, and miscellaneous materials. Whenever ASTM standards are identical with those of this Association, reference is given to the ASTM serial designation.

Part 2, on methods of sampling and testing, contains 140 methods covering the same divisions as in Part 1. There are some 60 methods added or revised since the previous edition was published in 1950.

Steel structures painting manual. Joseph Bigos, ed. Pittsburgh, Steel structures painting council, 1954-55. 2v., illus., $6.00 (U.S.) a vol.

The first volume of this manual, entitled Good Painting Practice, covers surface preparation and painting practice in various industries. The eighteen chapters are written by experts, and cover such topics as chemical surface preparation, painting of bridges, painting of steel vessels for salt and fresh water service, pipeline protection, etc.

The second volume, Systems and Specifications, contains specific recommendations for the painting of steel structures, supplementing the general recommendations found in volume I. The specifications, prepared by the Steel Structures Painting Council and having their designations, cover surface preparation, pre-treatment, paint application, paints and complete paint systems.

These volumes were prepared as part of the Council's efforts "to make more effective and more economical the protection of steel surfaces". The many illustrations and the clarity of the text will make the Manual valuable to all concerned in any way with the painting of steel structures.

Strength and elasticity of materials, v.4., part 2. W. H. Brooks, London, Macdonald, 1956. 464pp., 35/-.

This volume completes the series of solutions to London University engineering examination questions.

The solutions are grouped in sections, the subjects ranging from slope and deflection of beams, compound beams, stresses in curved bars, temperature stresses and strains, shearing stress distribution and thick cylinders, to three dimensional stress systems, periodic vibration of loading systems, and dynamic loading.

Tape recorders: how they work. C. G. Westcott. Indianapolis, Sams, 1956. 176pp., illus., $2.75.

All phases of tape recording, from the theory of magnetic recording to recommended procedures for testing recorders, are described in this book. There are chapters on the motorboard mechanisms, drive motors, volume indicators, bias oscillators, equalization circuits, and magnetic recording heads. The author explains how recorders operate, how to get the best frequency response with .owest noise level, how to avoid tape overload, and how to obtain best bias settings.

Théorie générale de l'équation de Mathieu. Robert Campbell. Paris, Masson, 1955. 272pp., diagrs., 2900 r.f

The object of the author in this work is to set forth Mathieu's equation in such a way that engineers and physicists will no longer find it a barrier in their calculations.

The first chapter deals with Mathieu functions and their characteristic equations. The next section describes functions of a secondary order, including those of Mathieu, Whittaker, and MacLachlan. The last chapter is concerned with the general theory of Mathieu's equation.

Thermal power from nuclear reactors. A. S. Thompson and O. E. Rodgers. New York, Wiley, 1956. 229pp., $7.25.

This book indicates the progress which has been made in the field of atomic energy for it deals with the practical problems faced by the mechanical engineer in designing nuclear reactors for the generation of mechanical or electrical power. Many of the advanced nuclear theories are not touched on but the author has attempted to familiarize the engineer with the current thought of physicists.

The first chapters give a concise review of nuclear fission and these are followed by a description of new concepts and methods of analysis developed for the design of reactors. Some of the problems treated are thermal stresses, transient behaviour of reactors, and distribution of gamma rays and neutrons. Engineering techniques such as numerical and dimensional analysis are applied to these problems and workable design criteria are presented.

Thermodynamics and engineering. W. E. Ranz, ed. Pennsylvania. University. Dept. of engineering research, 1955. 194pp.

This collection of papers originated at a conference on thermodynamics held in 1955 at the Pennsylvania State University. They have been separated into the three categories of science, industry, and education. In the section on science the subjects include irreversible processes, statistical thermodynamics, relaxation phenomena, electrochemistry, electric and magnetic systems, and elastomer thermodynamics. Contributions from industry concern heat engines, distillation calculations, and chemical rate processes. In the field of education the papers discuss thermodynamics as an engineering science in the curricula of the future.

Towards the automatic factory. London, Political & economic planning, 1955. (Reprint from Planning, v.21, June 13, 1955, p. 65-84). 2/6.

This little pamphlet covers some important aspects of automation. Beginning with a definition of the word, it goes on to discuss the extent of automation and prospects for the future, economic problems, and human and social implications.

The Youtz-Slick Lift slab method of construction, engineering manual. Austin, Texas, U.S. Lift slab corporation, 1955. various pagings, $5.00.

A radically new construction method which is used for vertical positioning of massive objects is described in this manual. The Youtz-Slick equipment is a portable elevator of great capacity and the lifting is done with hydraulic jacks placed on either permanent or temporary columns. Its main use to date has been to raise concrete floor and roof slabs.

The basic principles of the method are presented so that architects and engineers may study its possibilities.

The Lift slab method of construction is a trade mark of the United States Lift slab corporation, which has a licensee in Canada, where the tallest structure built by this method to date had been erected.

(*Continued on Page 735*)

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ENGINEERING CAREERS

CANADA

The Civil Service of Canada

It is estimated that well over 5,000 professional engineers are working for the people of Canada in the various public services, municipal, provincial and federal. Of these, nearly 2500 are employed in the Civil Service of Canada. Many others are employed in the crown corporations and federal public utilities, such as the Canadian National Railways, and as consultants.

The federal civil service is, therefore, by far the largest employer of engineers in the country. Its strength represents over 11 per cent of the number of registered professional engineers in Canada.

Engineers in the public services have an important role. A past president of the Engineering Institute of Canada said in effect that Canada's economic future, although dependent on private capital and initiative was in no small measure in their hands. He pointed out that the country's wealth of natural resources must be surveyed on a scale beyond the capacity of private enterprise, that government research and development is essential to the most effective social and economic use of these resources, and that intelligent conservation and control is necessary to prevent their wasteful exploitation.

It follows that the Civil Service Commission of Canada, along with independent agencies such as the National Research Council and the Defence Research Board, must make every effort to recruit and hold competent engineers to undertake the many pressing tasks which must be completed before private capital can be fully effective.

We shall confine our remarks to engineers in the classified service (under the Civil Service Commission) and on the staffs of the National Research Council and Defence Research Board. In so far as Crown Corporations, such as the Atomic Energy Limited, the Central Mortgage and Housing Corporation, the St. Lawrence Seaway Authority, and the Defence Construction Limited are concerned, suffice it to say here that the government's general policy on personnel matters serves to guide these agencies, but their practices tend to be more like industrial practices than would be the case if they were under the jurisdiction of the Civil Service Commission.

The scope of engineering activity in the Civil Service of Canada touches upon every imaginable engineering specialization, covers the country geographically, extends into our relationships with other countries and is unquestionably greater than it would be with any other employer. In each specialization, work normally involves applied research, design and development, construction or production and inspection. Some functions are concentrated in one departmental unit; some are dispersed administratively. The activities of various types of engineers, and the departments in which they are employed, are appended under the heading "Engineering Activities."

RECRUITING

Two basic principles underlie civil service recruiting and selection. First, there is a statutory as well as moral obligation for the Civil Service Commission to let all qualified people know of the existence of vacant classified positions which are open to public competition. Secondly, all qualified candidates who express an interest in these vacancies have a right to demonstrate their personal and technical competence before an objective examining body. These principles, inherent in the merit system, make recruiting both expensive and time consuming. On the other hand, they protect the rights of those who apply and, in a more general sense, the Canadian public which is entitled to the services of well qualified and effective civil servants.

Engineers are in short supply all over the country, and this, coupled with our expanding needs, has made recruiting difficult. Government departments had to catch up on a considerable number of projects, which could not be attempted during the war, meet those which have occurred since, and at the same time service a large defence establishment.

Our average annual intake to the Classified Service* has been about 180 engineers a year. This represents about 13 per cent of the average annual graduating class in engineering over the same period. If the intake of the Defence Research Board and the National Research Council were added the figure would be about 15 per cent. In relation to the total number employed, the civil service would be getting a fair share of graduating classes if annual intake averaged around 12 per cent. Thus, it appears that the civil service is attracting slightly more than a fair share of available engineers from the Canadian market.

Despite this, however, we have a large backlog of unfilled positions which, at the time of writing, numbers more than 300. To meet these demands it would be necessary to attract the equivalent of nearly 20 per cent of the 1956 graduating class. It is obvious that this will not be possible, and therefore, some activities which are basic to the rapid technological and economic development of the country must be curtailed.

In an effort to reduce the impact of this shortage the Civil Service Commission, in co-operation with the departments and other agencies, has made efforts to have a great deal of semi-professional technical work turned over to draughtsmen and technicians, thereby freeing the professional engineer for professional problems. Although much remains to be done in this regard, much has already been accomplished.

The Civil Service Commission has a continuous recruiting program.

Contributed by G. A. Blackburn, M.E.I.C., Assistant Director, Planning and Development Branch, Civil Service Commission.

*In the past five years.

Various kinds of descriptive literature on engineering activities and specialties have been distributed to university placement officers and professional associations and its availability is announced in professional journals. Also, through educational leave, some people already in the service are brought up to the required professional standards. To summarize, the federal government is attempting to meet essential demands for engineering personnel through general publicity directed at the profession at large, through internal re-organization to make the best use of the talent now available and through in-service training programs and educational leave provisions which are designed to develop potential.

QUALIFICATIONS

The nature of the work at the National Research Council and Defence Research Board necessitates outstanding academic qualifications and aptitude for research and development. Thus, generally speaking, these agencies insist on graduation from accredited university courses as a basic requirement for entrance to professional positions. On the other hand, the Civil Service Commission requires either university graduation or qualifications which permit membership in recognized professional engineering associations, provided candidates have successfully completed examinations approved by the Commission. There are, of course, some work areas in the classified civil service where university training of a high order is essential.

SELECTION

The selection program of the Civil Service Commission usually commences with a study of documentary evidence supplied by and on behalf of each candidate. This study is done by a board, made up of the Commission's personnel selection officers, who are frequently engineers themselves, and other engineering advisers. Following this review, a number of the most likely candidates are usually called for oral interview in order to determine which of the candidates are most suitable. In this process, the Commission relies with gratitude on the invaluable assistance of representatives of the profession.

The need to safeguard the interests of all qualified people who wish to apply, plus the preference accorded to veterans who have served abroad in time of war, make it necessary to spend more time on selection than would be the case in a private concern. As a result, the Civil Service Commission is always trying to resolve the need for quick appointments in urgent areas with the responsibilities imposed upon it by the Civil Service Act. Despite our best efforts, however, the time taken will always be longer than it is in industry. We hope the need for this will be appreciated and that prospective candidates will value the protection afforded to them by the merit system.

The National Research Council and Defence Research Board make their selections in much the same manner as the Civil Service Commission, although with variations in detail.

CAREER PATTERN

Of the 2500 engineering positions in the civil service, about 50 per cent are to be found in five departments, Mines and Technical Surveys, Public Works, Transport, National Defence, and Agriculture; and in the National Research Council. The balance are employed, in varying numbers, in fourteen other government departments.

Latterly, there has been more movement of technical personnel from department to department. The first few promotions beyond the entrance level are usually within one department but as engineers approach the intermediate and senior grades they tend to progress, quite frequently, through inter-departmental promotion competitions. Promotion from within is followed wherever possible. As a rule, senior positions are only open to the public when a high degree of specialization is required and it is unlikely that a suitable person can be found within the civil service. It follows, therefore, that most recruiting is done at the Grade 1 or Grade 2 level.

After the war there was a shortage of engineers with well-developed administrative capacity, with the result that the Commission had to go into the open market to fill some senior positions. Because the Civil Service should be more self-sufficient in future, the Commission has developed training programs in administration for junior engineers and other scientific personnel. This is supplemented at the intermediate and senior levels by courses in administration which embrace all professions. Also, some departments have initiated their own long-range executive and professional development programs.

A second training objective is to hasten the development of young engineers so that they may assume heavy responsibility at a comparatively early age. The latter is of paramount importance since the proportion of senior engineers approaching retirement is rather high as a result of limited engineering activity prior to World War II. Fortunately, the young engineers seem to be rising to the opportunity since many around thirty years of age are now assuming duties which, before the war, they would not be expected to handle until they reached their forties.

A rolling mill at the Mines Branch, Ottawa.

The accompanying table shows various engineering salary levels and the percentage of engineers at each level. The salary ranges are only approximately related to the grades in brackets because the precise salary ranges are being revised at the time of writing. Level F represents a considerable number of special classes, among them district engineers, superintending engineers, chiefs of construction, directors of branches and the like.

Table of Engineering Salary Levels

Level (Grades)	Range ($)	Percent of Engineers
A (1 and 2)	3,900– 5,800	50
B (3 and 4)	5,500– 6,600	27
C	6,200– 7,200	15
D	6,800– 8,400	4
E	8,200– 9,000	3
F (Special)	9,000–12,500	1

The recent expansion of activities and consequent increase in intake accounts for the unusually high percentage at level "A". Ordinarily, the young engineer who comes to us on graduation or shortly thereafter can expect to reach level "B" within four or five years. In other words, with the great number of positions at this level, the young engineer with initiative and ability can reasonably hope to reach $6,600 within six or seven years of graduation. This, we believe, is a satisfactory rate of progress, particularly when he can look forward to higher positions as his capacities develop.

Turnover figures seem to indicate that professional engineers are, on the whole, quite happy in the public service. The turnover rate including retirements is less than 5 per cent a year. In view of the fact that there are some areas in which no long-term careers can be offered and in which the Commission does not encourage people to settle, this turnover rate is we think, quite small.

In determining salaries, the policy, as stated by the Government, is that they should be sufficiently high to attract and retain good candidates in sufficient quantity to meet our needs and that they should be comparable to those paid by good private employers. With this in mind, the Commission's Organization and Classification Branch constantly reviews salaries in business and industry. There have been six general revisions in the past nine years. It is, of course, clear that the rather extraordinary salaries occasionally available in industry cannot be paid in the public service. On the whole, however, civil service salaries, although tending to lag behind industry a bit at the senior levels, are maintained in compliance with the government's policy.

ADVANTAGES AND DISADVANTAGES

The public service has some advantages which are proper to it. In the author's opinion, the most important of these is the personal satisfaction to be derived from playing a part in activity which is of such great consequence in the economic and technological development of the country. There are also such things as stability of employment and various service benefits which will be mentioned later. These introduce an element of security into family life which, in turn, frees the mind for creative endeavour.

On the other hand, there are a number of disadvantages. One aspiring to a very high income will not find it in the public service. Secondly, public servants are usually cloaked in anonymity and it is only at the top levels that public acclaim can be expected for outstanding achievement. Finally, some are frustrated when they find they have to subordinate their own views to those of the general public as expressed through their elected representatives.

Usually, the one who does best and is most content is the person with a strong sense of public service. He can derive great pleasure from even a minor role in the social and economic development of the country. Also, there is much satisfaction to be gained from playing a part in the creation of important policies and projects. This is particularly so at Headquarters in Ottawa and it is well known that a great many professional public servants have turned down very lucrative positions elsewhere in order to remain in the positions which they find so stimulating.

A bridge across the Mississagi River at Iron Bridge, Ontario—a link in the Trans-Canada Highway.

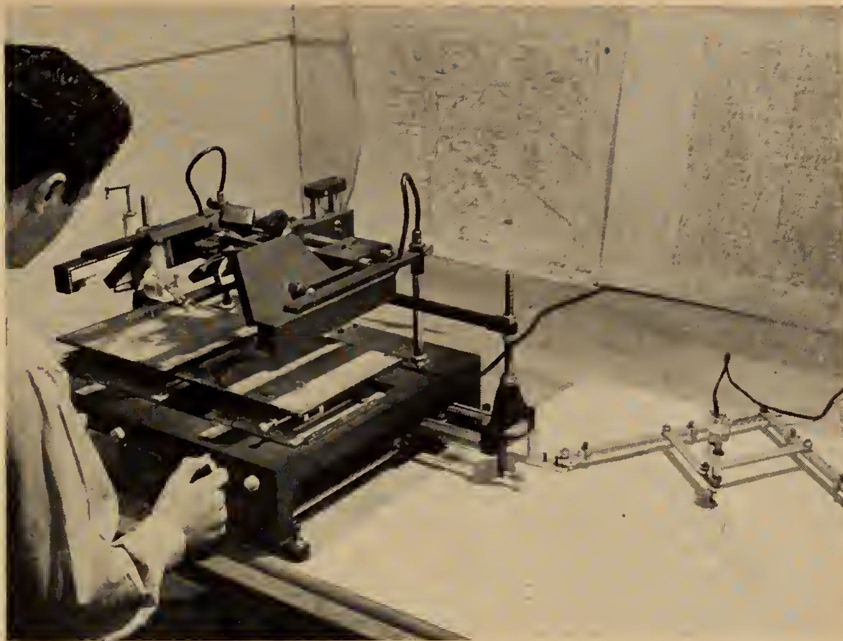
From a technical point of view, there are excellent opportunities for self-development, either through in-service training or educational leave. Some mention has been made of the in-service program and, of course, much can be learned on the job. The educational leave provisions permit leave with full pay to attend university if the added training is essential to the satisfactory performance of the duties of a position; leave with half-pay may be granted if the study will be of mutual benefit to the department and the employee; leave without pay is granted in those cases where the employee is the primary beneficiary.

The Civil Service has numerous fringe benefits among them an excellent pension plan, one of the best in the country, a form of low-cost term insurance, three weeks holidays, sick leave which, if not used, accumulates from year to year and various types of other leave, as well as ten statutory holidays. Under the pension scheme, it is often possible for a person who is moving from private employ into the government to buy back his previous time and have it count for pension purposes. Another thing worthy of note is that engineers can share in the royalties obtained on patents of commercial value, even though the invention is developed in the course of one's normal duties.

CONCLUSION

As suggested above there are advantages and disadvantages in civil service careers. For most professional people, the advantages outweigh the disadvantages. The Civil Service of Canada needs its fair share of professional people and particularly professional engineers, if it is to discharge, in a satisfactory manner, the responsibilities imposed upon it by Parliament. The Civil Service Commission and other employment agencies have set high professional standards and, where required, high technical standards for admission to the government. This we believe is justified since the public deserves the best possible service.

In conclusion, the Civil Service Commission invites the engineering profession to take an interest in the development of sound personnel policies in the government, either directly or indirectly. It would help, for example, if members of the profession would suggest to young engineering graduates that they explore the career opportunities in government, particularly if these young men demonstrate something of the spirit of public service which makes for a successful career in the Civil Service of Canada. There are few places in which they can serve their fellow Canadians to better or more direct advantage.



Topographic survey technician using a stereoscopic plotter.

ENGINEERING ACTIVITIES

An Outline of the Fields of Specialization

The federal public service employs almost every type of professional engineer. Civil engineers make up well over half of our total engineering strength of approximately 2,500; numerically the next largest groups are the electrical and mechanical engineers. Engineers with other backgrounds are employed in smaller numbers. Below are brief descriptions of government engineering activities, broken down by fields of specialization.

Aeronautical Engineers

The National Research Council provides the Canadian aviation industry with research, development and testing facilities, and with the Defence Research Board carries out research work on many problems related to flight at both subsonic and supersonic speeds. The main concern of aeronautical engineers in the Air Transport Board is research, while those in the aeronautical engineering division of the Department of Transport work on design and inspection. Those employed as civilians with the Royal Canadian Air Force also work on inspection and design but mainly in an advisory capacity. Production liaison is carried out in the Department of Defence Production. Junior appointments are unusual in this field because, in most cases, aeronautical engineers are expected to act as advisors to senior officials and must, therefore, have had practical experience before joining the civil service.

Mining, Metallurgical and Ceramic Engineers

Engineers with these backgrounds are employed almost exclusively in the mines branch of the Department of Mines and Technical Surveys. They work in modern laboratories, equipped with the latest facilities for research and development. Mining engineers test minerals and fuels, study mining methods and seek to improve the quarrying, processing and utilization of industrial minerals, including structural materials. They also investigate the processing and utilization of fuels, such as coal, peat, crude oil, natural gas, oil shales, and bituminous sands.

Engineers specializing in physical metallurgy study the physical and mechanical properties of metals and alloys and the methods of production and fabrication. Those concerned with extractive and chemical metallurgy investigate the character and treatment of ores, including radio-active ores and metallic and non-metallic minerals, and seek to improve present methods of ore processing. Others are engaged in applied and fundamental research on raw and manufactured ceramic materials. Some are assigned to field work on technical and economic studies related to markets, taxation and other factors affecting industrial development.

Chemical Engineers

They are engaged in research in the fields of chemical and extractive metallurgy, corrosion, wood utilization, sanitation and in all branches of fuel technology. Most are employed in the Department of Mines and Technical Surveys but some are also to be found in the public health engineering section of the Department of National Health and Welfare and in the testing laboratories of Public Works and National Defence. Chemical engineers are also employed extensively in defence research studies and in applied and fundamental research in the National Research Council.

Civil Engineers

As stated, civil engineers make up the largest group of engineers in the public service. They are employed in a number of departments and are engaged in many activities, including structural design, hydraulics, highway and airdrome construction, public health engineering and hydrometrics. The main employers are the Departments of Mines and Technical Surveys, Public Works, Transport, Northern Affairs and National Resources, National Defence, and the National Research Council.

In highway and airfield work, they are engaged in every facet of activity from initial exploration and location, through construction and inspection. The gamut is just as wide in Public Works where activity has to do with buildings, docks, piers and other kinds of heavy construction. Many interesting problems in design are encountered in northern construction where permafrost and muskeg present great challenges. Interesting problems in hydraulics are met in the harbours and rivers branch of Public Works, in the water resources division of Northern Affairs and National Resources, and in the canals branch of the Department of Transport. In structural design stimulus is to be found in the air services construction division of Transport, the structural division of Public Works, and the building and construction divisions of National Defence. Again, the problems of complicated communications, permafrost, and muskeg make many of the projects unique. Assisting with these and other problems, civil engineers in the National Research Council provide research services both to other government departments and to the Canadian building industry. The hydrometric work done by engineers and technicians in the water resources division of the Department of Northern Affairs and National Resources is, of course, of major importance inasmuch as it provides planning data for hydro-electric and irrigation projects.

A great many civil engineers, as well as engineers with other backgrounds, are employed in the surveys and mapping branch of the Department of Mines and Technical Surveys. These engineers, along with their technicians, have revolutionized large-scale topographic mapping practices by exploiting technical developments in other countries and creating special equipment to meet Canadian needs. Geodesists, hydrographers, topographers, and experts in map reproduction techniques provide basic data for virtually all big resource development projects in this country. A number of engineers are engaged in land surveys of Crown properties; most of these are in the legal surveys branch of the Department of Mines and Technical Surveys.

Electrical Engineers

The majority of electrical engineers are concerned with problems in electronics which have to do with research, the design and development of new equipment and the production, installation and maintenance of radiation and communications systems for both civil and military purposes. Most of this work is done in the Department of National Defence, the National Research Council, the Defence Research Board, and in the Department of Transport. In the last named department, quite a large number work on the development, installation and maintenance of aids to marine and air navigation; radio and television interference problems; and on the operation of the government telegraph and telephone systems.

Electrical engineers are also employed in considerable numbers in electric power design, and on the installation and maintenance of equipment in public buildings, airfields and military structures. They are concerned with transmission and illumination systems, standby equipment, and, in the case of canals, with electrical control mechanisms for mechanical equipment. Finally, in the Department of National Defence both electronic and power engineers are employed in connection with the production, design and manufacture of equipment for the armed services.

Mechanical Engineers

The Departments of Transport, Public Works, and National Defence are the main employers of mechanical engineers. Much of their work has to do with ventilation equipment for public buildings, mechanical equipment in dry docks and ocean terminals, lift and swing bridges, aids to navigation, railway equipment and power houses. In other areas, particularly in the mines branch and the National Research Council, mechanical engineers are engaged in research on stress analysis and the fatigue properties of materials, and on many phases of aeronautical, hydraulic, and mechanical engineering and naval architecture. Still others in National Defence and the Defence Research Board work on the development of armament and motorized transport. Production engineering is the one field in which the Civil Service of Canada offers little of interest.

Engineering Physicists

The main employers of engineering physicists are the National Research Council, the Defence Research Board, and the mines branch of the Department of Mines and Technical Surveys. All are engaged in fundamental or applied research. Problems in physical metallurgy involve the physics of metal deformation, alloy constitution and nuclear metallurgy. In this field, and in radiation, the most up-to-date equipment is provided for spectroscopy, radiation physics, thermodynamics and other areas of investigation. Quite a few engineering physicists are also engaged in the electronics work mentioned in the section on electrical engineers. In the field of communications, the engineers in military establishments have made appreciable contributions to the technology of defence.

Miscellaneous

Engineers are also employed in many other areas not normally associated with engineering. For example, quite a few are employed in the Patent and Copyright Office on work having to do with the technical and legal aspects of inventions. Some are also engaged in personnel, job analysis and management units, particularly in the Civil Service Commission, to advise on personnel and management problems arising out of technological development. Others are engaged in administration where the nature of the work is such that it requires a technical background. Also, quite a few engineers are concerned with information activities, particularly in the preparation of technical material for general distribution and in answering specific questions of a technical nature which come to such agencies as the National Research Council, the Forest Products Laboratories, and the mines branch of the Department of Mines and Technical Surveys.

• Library Notes

(*Continued from Page 712*)

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This revised standard deals with safety valves, high and low water alarms, stop valves, feed valves, blow down fittings, water gauges, pressure gauges, test connections and fusible plugs.

It does not provide for fittings for calorifiers or for certain low pressure and hot water boilers. Materials, temperature and pressure limits and methods of construction are specified, together with formulae for determining the minimum aggregate area of safety valves and the sizes of valve springs.

B.S. 775:1956 — Contactors when supplied separately or in combination with other gear. 5/–.

This revision applies to electro-magnetically and electro-pneumatically operated contactors and it covers air-break and oil-break contactors for voltages up to 11 kv. a.c. and 650V d.c.

It should be noted that this standard is closely related to B.S. 587, 'Motor starters and controllers', a new edition of which will shortly be published.

Professional Cards

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London Airport

The Construction of a Modern Civil Airport

A. R. Macrae and C. Heyes

Ministry of Transport and Civil Aviation, London

Of the world's major international airports, London Airport is probably the most up-to-date at present. Its development from a Royal Air Force project is traced by the authors, who comprehensively cover the civil, electrical, and mechanical engineering that is involved. The title illustration shows the central area at night and indicates the effective street lighting without any upward light.

London Airport is situated some 14 miles to the west of the City, a distance which takes 50 minutes by road, even in the best of conditions.

The site occupied by London Airport was selected in 1943 when it was planned to develop an airfield for Royal Air Force transport aircraft of the heaviest types proceeding to the far eastern theatre of war.

The problem of finding a site suitable for development as a major airfield which was within a reasonable distance of the heart of London, yet clear of the built up area of Greater London was, of course, very exacting. Nevertheless, although comparatively close to the built up area of Greater London the site selected enveloped a small airfield, market gardens, small farms, disused gravel pits and a small number of dwelling houses, so that comparatively little demolition of private property was necessary in the development of the site which was practically level and had very good flying approaches in the required directions.

Construction of the airfield for the Royal Air Force started in 1944 and work on the first three runways was well under way when the war ended the following year and it was decided to develop the airport for civil use. In considering the design and development of the airfield as a civil international airport due account had therefore to be taken of the fact that three runways, forming a triangular pattern had already been constructed. In the layout of runways finally adopted, as shown in Fig. 1 and now complete, two of the three original runways are included. Part of the third runway is utilized as a taxi track.

Six runways have been provided in the form of two parallel runways in each of three different directions. The triangular pattern of runways thus formed encloses the central terminal area where passenger handling buildings, control tower, administration and operational buildings are located. Access to the central area for all traffic is by a tunnel which leads under No. 1 runway into the north of the central area.

In the eastern section of the airport is No. 1 maintenance area where main hangars and maintenance bases of British Airways Corporations are situated. No. 2 maintenance area in the southern section of the airfield is to be developed primarily for airlines other than the British Airways Corporations. An area in the south west of the airfield is reserved for future development as No. 3 maintenance area if required. Along the north boundary of the airport are temporary buildings which were provided to handle passenger traffic until the permanent buildings in the central area are complete.

RUNWAYS, TAXI TRACKS AND APRONS

The major engineering works which had to be undertaken on and around the site to permit the construction of runways included: (a) the dewatering and filling in of ponds and disused gravel pits covering a total area of some 100 acres; (b) the diversion of two small rivers over a total length of 4½ miles; and (c) the construction of some 3 miles of roadway outside the boundary of the airfield to replace public roads which had passed through the site.

At the time the runways were designed the indications were that the weight and take-off loads of long distance aircraft would continue to increase and the runways were accordingly designed to carry the largest aircraft then envisaged. The runways, taxi tracks and aprons have been designed to carry an all-up load of approximately 350,000 pounds on four wheels. The actual basis of design was a load of 81,000 pounds on a single independent wheel with a tyre pressure of 120 lb. per sq. inch. The instrument runways numbers 1 and 5 are 300 ft. wide and over 9,000 ft. long.

From an engineering point of view the site selected has many advantages. It is practically level, has a stable gravel formation and is located in what is known as the Taplow Terrace gravel area. The geological formation in that area consists of gravel which is found immediately below the surface top-soil and to a depth of approximately 20 ft. Underneath the gravel is London blue clay. The gravel lends itself very well to compaction and for that reason provides an ideal foundation for the runways and other installations which had to be constructed even though in winter the subsoil water level rises to within 6 ft. of the ground surface.

The construction of the runways varies. A sub-base of high bearing capacity was attained by removing completely the top soil and brick earth and exposing the gravel, and by refilling to required levels in layers not exceeding nine inches with similar gravel. On this the 12 in. pavement quality concrete (minimum strength 4,000 lbs. per sq. in. at 28 days) was laid. Because it was only possible to carry out the compaction of gravel filling under favourable weather conditions, and to protect and seal the subgrade and so permit concreting to continue, it was decided to provide an 8 in. dry lean concrete base slab below the 12 in. pavement quality concrete. By this means continuous progress during wet weather was ensured. The concrete was, in general, laid in bays 20 ft. x 20 ft. with expansion joints every 120 ft. and these have in practice proved adequate.

A view of the central area apron at London Airport.

Stormwater Drainage

The design of the main stormwater drainage system proved difficult because of the flat nature of the site and the lack of suitable water courses into which the large quantities of surface water could be discharged. Owing to the large quantities of surface water to be dealt with, it was decided that the scheme would have to be a gravity system. In spite of the flat nature of the site this has been achieved although in some cases gradients of stormwater drainage pipes are of the order of 1 in 3,000.

The Taplow gravel is extensively used as concrete aggregate. A number of pits from which gravel has been removed exist near the airport and use has been made of some of these as balancing reservoirs; a portion of these reservoirs has been enclosed by a dam which acts as an oil and petrol interceptor. Water passes to the reservoir proper by means of weirs which are furnished with drip boards on the upstream side. Where the reservoirs discharge into rivers this is controlled by means of a weir and rectangular notch.

ELECTRICAL SUPPLY AND DISTRIBUTION

It was decided at the outset to provide an 11 kv. electrical distribution system through the airfield, but the Supply Authority network in the neighbourhood of the airfield was limited in the early days of construction, only 300 kva. being available. The civil use of London Airport increased rapidly after the opening in 1946, and it was necessary to augment this supply from another source. This, however, was only an interim stage as the new capacity was also limited, not more than 2,000 kva. being available.

Meanwhile the design of the ultimate distribution system was put in hand and negotiations opened with the Supply Authority for a permanent electricity supply up to 20,000 kva., the first stage of which was brought into use in 1951 during which year the demand rose to 2,190 kva.

The main electricity supply to the airport is obtained from the local Electricity Board through 22 kv. feeders, from two separate sources; each feeder is taken to a main intake substation within the airport boundary, with a 22 kv. interconnector between these two substations. At each, the 22 kv. switchboard controls two 5,000 kva. 22/11 kv. transformers which feed

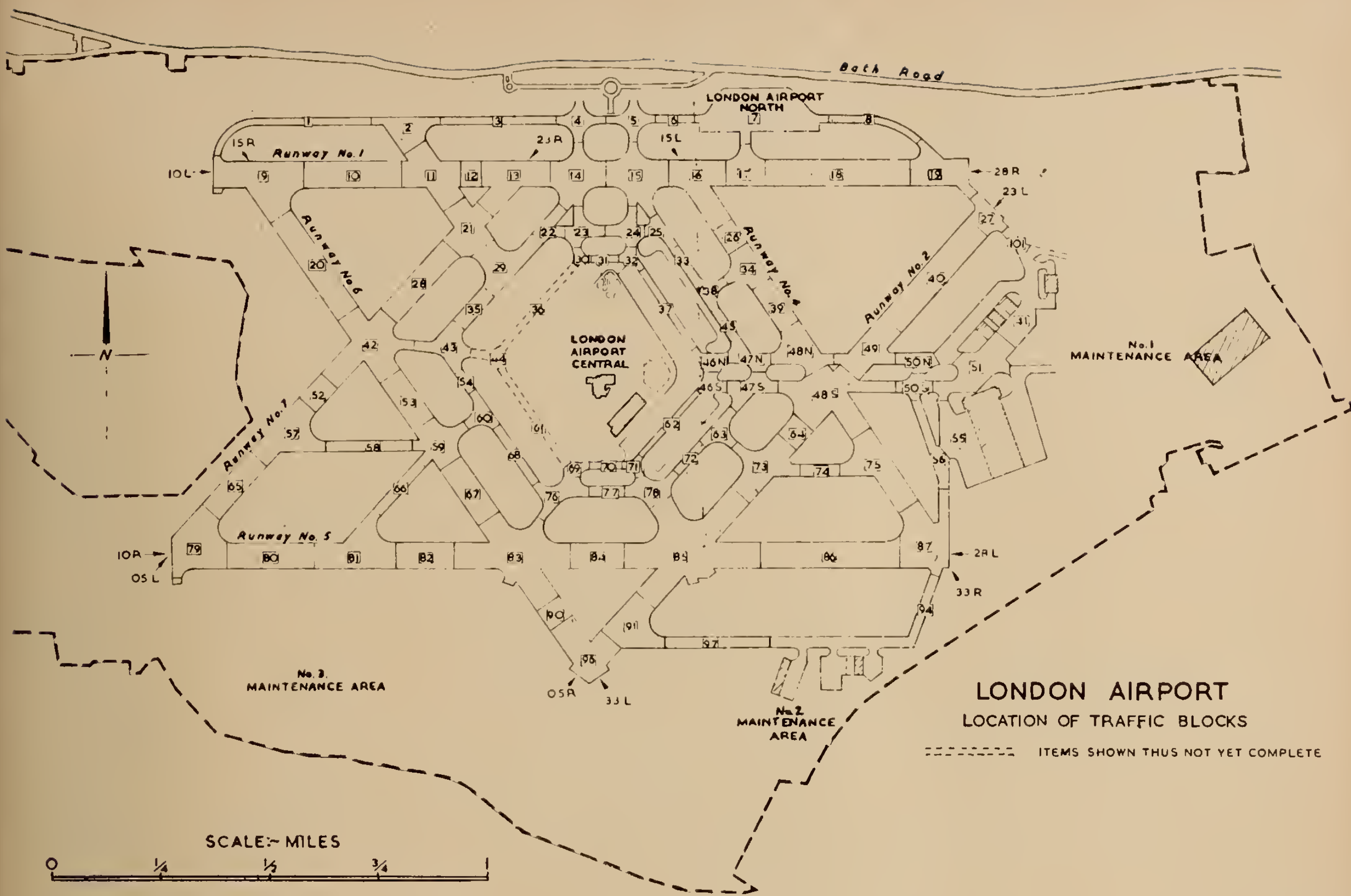


Fig. 1. Layout of runways finally adopted, showing location of traffic blocks. There are six runways.

into the 11 kv. switchboard which has duplicate bus-bars; there is thus a capacity of 10 megawatts available at each intake substation, and provision has been made for this to be extended to 20 megawatts later. The maximum demand at the airport now exceeds 8 megawatts.

Electrical Distribution

The first section of 11 kv. distribution was laid down in 1946-47, providing a supply to the future central terminal area and all three original runways. As the development plan of the airfield unfolded, so the pattern of the ultimate distribution system took shape. This was designed to take all electrical loads within the boundaries of the airport together with certain navigational aids located not more than half a mile from these boundaries. It was foreseen that the industrial load of the airport would become impressive, and the cable layout has been designed with this in mind.

The eventual apparent fault capacity of the 11 kv. system is 250 Mva., hence the majority of the switchgear has been installed to deal with this; however, in order to continue use of certain parts of the system installed in the early days, in which neither the cables nor the switchgear are suitable for this duty, reactors have been inserted at appropriate points.

A number of ring mains are provided between the two intake substations, the basic principle being that operational loads shall be separated from industrial loads, as far as practicable. Thus there are two operational rings serving the airfield proper, an outer which circumscribes the runways, and an inner which is laid outside the central area aprons. These supply power to all navigational aids. The control tower is on a third ring, but in this case all the central area buildings are supplied from the 11 kv. switchboard in the control tower, by means of radial 11 kv. feeders. There is an interconnector between this third ring and the inner operational ring, for use in emergency.

The industrial loads are taken on two further rings, and it is the intention to provide more such rings as the maintenance facilities of the airport increase.

Protection of the main 11 kv. circuits is by comprehensive balanced feeder protection, using pilot cables which have been laid with all the ring main cables, hence a fault is isolated immediately at the nearest circuit breaker on each side of the fault, whilst the rest of the ring continues to function as a spur from each of the main intake substations at which back-up overload protection is provided on each feeder. Transformer substations of which there are forty-one in number, provide the normal 400 volt, 3-phase, 4-wire local systems. These transformers are sized from 100 kva. to 1,000 kva., according to need.

Standby Sets

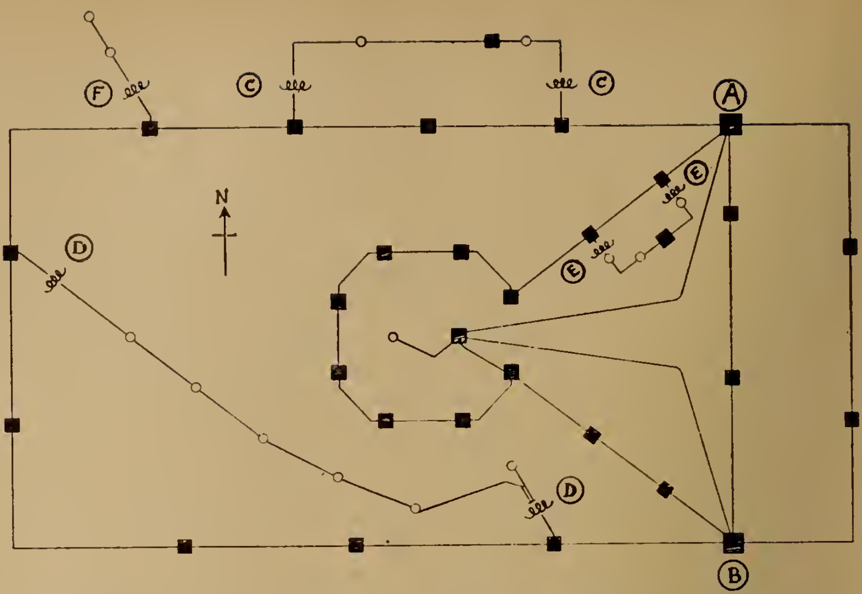
To serve the navigational aids in the event of a mains failure a number of standby sets ranging in size from 2½ kw. up to 250 kw. capable of taking load within two minutes of power failure have been provided. In practice this is usually achieved within 20 seconds by the use of automatic start diesel or petrol driven alternators located near to the aid they serve.

These sets rely on a power failure to initiate starting, consequently they do not meet the requirement for special telecommunications equipment, which will be out of use for more than two minutes if the supply is momentarily interrupted. For this reason a new provision has been continuously running generating sets, normally driven by an induction motor off the mains, but coupled to a diesel engine through a magnetic clutch which is energized from the alternator exciter as soon as a power failure occurs. A heavy flywheel on the motor shaft provides the required inertia to drive the diesel until it has run up to speed, and this is accomplished with a drop in frequency not exceeding 5 per cent.

AIRFIELD LIGHTING AND CONTROL

The first installations of runway and approach lighting were of a type which had been developed for military purposes during the 1939-45 war and represented the most up-to-date pattern at that time. The approach lighting to the main runway was in the form of a divergent funnel, each line being set outwards at an angle of 2° and extending to a distance of 4,500 feet from the threshold. The omni-directional fittings had red filters, and for bad visibility conditions a "box" of four directional sodium lights was provided adjacent to the threshold, two on each side of the runway. The runway lighting was also the wartime flare path, designed to provide the minimum useful source of light against a completely black background, and of little use against a normally lighted airport.

The approach lighting gave way to the modern line and bar system in 1949, London Airport having the first installation of this type in



The 11-kv. supply system. The diagram shows: A, B—22/11 kv. sub-stations. C—750 kva. reactor. D—500 kva. reactor. E—100 kva. reactor. F—50 kva. reactor. Circle—ring main unit and transformer enclosure. Black square—brick-built sub-station.

Great Britain. At the same time the runway lighting was changed to the latest equivalent of the contact lighting system. Taxi lighting has also been developed to meet the requirements of London Airport and so far is unique in this country.

Approach Lighting

The function of the lighting pattern is fourfold; primarily it is to show the pilot the continuation of the centre line lighting into the

The line and bar system of approach lighting; runway lights at end.

approach and across which one or more crossbars are provided at fixed distances from the threshold, these serving the three purposes of giving an indication of distance, providing a horizon by which the attitude of the aircraft can be checked, and showing the pilot that he is on the correct angle of descent. The extended centre line is illuminated to a distance of 3,000 feet from the threshold; the crossbars are also illuminated, and are of lengths proportionate to distance from threshold, so that when on his proper descent path each crossbar appears to the pilot to be of equal length. The lighting of the centre line is coded, one fitting being provided at each position in the first 1,000 feet from the threshold, two fittings in the second 1,000 feet, and three fittings in the third.

High intensity lighting is achieved by using high powered uni-directional fittings, with tungsten lamps. Although the original high intensity fittings at London Airport were comparatively heavy, the modern counterpart is of lightweight construction, about 6 lb. inclusive. On all approaches the fittings in the first 500 ft. from the threshold have been changed to lightweight type, and all fittings throughout new centre line and crossbar systems are lightweight. These fittings have a narrow beam of intensity about 20,000 candelas at full brilliancy, which can be controlled in five stages down to 1 per cent. Since they are uni-directional, such fittings cannot provide an orbiting guide for aircraft in conditions of good visibility, hence a separate system of red omni-directional lights is provided, one fitting corresponding to each position of high intensity fittings.

High intensity lighting is normally only used on instrument approaches, of which there are four at London Airport, three having six bars of lights, the fourth having three bars; in every case omni-directional low intensity lighting is superimposed. The remaining approaches used for night flying are equipped only with low intensity centre line lights, and either one, or two crossbars.

The circuits of all approach lights are duplicated and interleaved, in order that failure of one circuit shall not destroy the lighting pattern. Most of the circuits are parallel, but the newer approach systems have series circuits, which are more economical and, moreover, give uniform brilliance to all lights.

Runway Lighting

The chief criteria for runway lights are that they shall approximate in brilliance to the approach lighting, and that they shall be accurately beamed and provided with brilliancy control. Since the runways are 250 ft. and 300 ft. wide at London Airport, flush or blister type bi-directional fittings have to be used in lines spaced 150 ft. apart, hence approximation in brilliance to approach lighting cannot be attained for the maximum beam of the blister fitting is some 5,000 candelas of white light; they are, however, accurately beamed and provided with brilliancy control. A distance marker is provided in the runway fittings to advise pilots that they have reached a point beyond which it is not safe to touch down; yellow half filters are fitted to these lights, showing in the direction of approach only for the last 2,000 feet of the runway.

Two sets of threshold marking lights are provided, both green; the normal threshold consists of blister type fittings, controlled with the runway lights, but without brilliancy control; these are spaced evenly across the runway. The other threshold is made up of elevated lights, uni-directional towards the approach, and circuited with the approach lights; these are the high intensity markings, spaced at the sides of the threshold only, leaving a gap of 75 feet in the centre of the runway.

Runway lights are interleaved on constant current circuits and brilliancy control is achieved by tapped transformers with chains of contactors or, more recently, saturable core reactors. The existing blister type fittings have a projection of about $1\frac{3}{4}$ in. above runway surface, but a new type having a projection less than 1 in. is now under development.

Taxi Track Lighting

There is a complex system of taxi tracks at this airport, and aircraft may be routed along a number of alternate ways. It was therefore necessary to provide route marking by lights, with control of individual sections; this has been achieved by providing a centre line system of lighting, instead of the usual side lighting, this decision was taken because of the difficulty of seeing edge lighting on the wide tracks in conditions of low visibility.

Blister type fittings, of the same design as the runway lights, but provided with green filters, have been placed along the centre line of all taxi tracks; they are supplied by a number of series circuits, through transductors, which have tertiary windings for D.C. saturation. When a series circuit is energized, all the taxi lights will be illuminated, until D.C. is applied to particular transductors, when the corresponding lights will be extinguished. The series circuits are thus arranged in geographical order, whilst the D.C. control circuits are arranged in order of lighting sections.

The control of the taxi track system is divided into blocks, each junction forming a block on its own, with the interconnecting straight sections forming other blocks (see Fig. 1). At the dividing point of the blocks there is placed a line of red lights across the taxi track, known as a traffic bar; when these lights are extinguished an aircraft has right of passage, but when illuminated the red lights demand that the aircraft shall halt.

It was found in practice that an auxiliary aid is sometimes required to guide aircraft along the selected path, for in certain conditions of sunlight it is not easy to pick out the green centre line. To meet this contingency a system of route indicator boards has been devised, placed at the entrances to all junctions. These boards have mimics painted upon them showing the possible routes available in correct orientation, and each branch is provided with a white light, the lamp on the selected route being illuminated. There are also red lights to denote that the traffic stop bar is illuminated; control of the route lights is effected from the control tower.

A mimic diagram of airfield lighting is used in the control tower.

Control of Airfield Lighting

The fact that navigational aids are spread widely over the surface of an airfield, and indeed beyond its boundaries, had led during the 1939-45 war to consideration of an economic means of exercising control over the switching of a large number of services already growing and with unknown possibilities of expansion. It will be seen that there are many hundred circuits which require to be operated from the control tower, and that these circuits arise at many different points over a large area. To avoid the laying of heavy multi-core cables a system is used whereby almost an infinite number of switching operations may be carried out over a small finite number of telephone-cable cores. This system transmits coded pulses from the control tower, which are received at the appropriate switching centres where they operate a relay tree to effect the required switching operations. Installation was commenced in 1947 and has continued since then as new construction has called for further additions to the system.

To assist the air traffic controller, a mimic is provided in the control tower, indicating the services selected; thus a system of back indication is a vital requirement. This is achieved by the use of a current-actuated device to give evidence that a circuit is alive and current flowing, with the presumption that the lamp is alight. No visual aid depends upon a single lamp, so this presumption is justified.

The exceptionally large number of circuits to be controlled and back-indicated at London Airport has led to consideration of the best means of relieving the air traffic controller of that part of the task he now performs in checking that the control system is, in fact, in order. It has been decided that a form of electronic scanning will meet this situation in the most economical manner, and this equipment is now in the course of manufacture.

It has long been recognized that some means of pin-pointing aircraft, and vehicles, on the runways will prove of great value particularly during periods of bad visibility; to this end experimental work has been proceeding to obtain the indication by using the aircraft or vehicle to upset the coupling between oscillator and receiver coils embedded in the runways. This work is entirely separate from the scanning of the airfield by radar.

Street Lighting

When London Airport was opened as a civil airport there were no street lighting fittings specially designed to obscure upward spill which might cause confusion to pilots. This applied particularly to those lighting the main Bath Road which runs parallel to the instrument runways. These lights were therefore shielded to prevent all egress of light above the horizontal; the street lights erected at that time in the north terminal area were also treated in a like manner; but this has two disadvantages, the appearance is unpleasing and the windage stress is high.

During the past ten years new types of fittings have been evolved, but the overriding criterion insofar as the central area is concerned, is the necessity for shielding upward light completely. There are more than two hundred fittings in the central area, so the importance of shielding light from the controllers in the control tower is paramount. The fittings chosen are an adaptation of a design for street lighting, and consist of inverted troughs containing three 80-watt fluorescent tubes, with two plane mirrors behind. They are mounted on 30 ft. high standards, spaced at approximately 90 feet. The resulting uniformity and intensity of illumination is most satisfactory.

Similar fittings are used on main roads in the airport, usually mounted at 25 ft. height, whilst on subsidiary roads an aero screen type of fitting with 80-watt mercury lamp, mounted at 15 ft., is used.

Airport lighting control equipment (apparatus room).

NON-VISUAL NAVIGATIONAL AIDS

The *Instrument Landing System* enables a pilot to check his position in the approach to a runway during bad visibility, by means of radio signals. Two beams are projected from the ground, one at a fixed bearing in the direction of approach, emitted from a transmitter situated beyond the up-wind threshold of the runway, and the other at a fixed angle of elevation, from a transmitter quite close to, but offset from, the runway centre line at the touch down threshold. There are also up to three location markers which indicate the distance of the aircraft passing over them from the runway threshold. The aircraft carries equipment which indicates to the pilot any deviation to one side or the other of the azimuth beam and above or below the glide path; the markers each of which has its own distinctive signal, enable the pilot to check his height against distance from threshold and so provide a check on the glide path.

The *Ground Controlled Approach System* requires an operator to advise the pilot of his course as he sees it on the dual cathode ray tubes, which present the position of the aircraft in three dimensions. The aerials of this radar device have necessarily to be placed to align with a particular runway, and for the sake of economy the present type of equipment has been mounted in mobile caravans so that it can be moved around the runways as required. The operators have to work inside these caravans, with light excluded as far as possible, and since there is a considerable amount of heat generated by the radar equipment, it has been necessary to introduce refrigeration to cool the ventilation air through the caravans.

Another application of radar is surveillance, or approach control, which plots aircraft in the vicinity of the airfield and can be used for

The control room on the ninth floor of the control building.

speeding up movement rates by marshalling approaching aircraft into closer intervals of space than would otherwise be safely possible, and by giving early separation to aircraft taking off.

The *Airport Surface Movement Indicator* is also a radar device, which plots aircraft and vehicles on the runways and taxi tracks; this is used to assist the ground movement controllers, within the limitations of its indications.

Standard methods for communication between control tower and aircraft are installed, also direction-finding radio. Certain other radio aids are now being evaluated.

APRON SERVICES

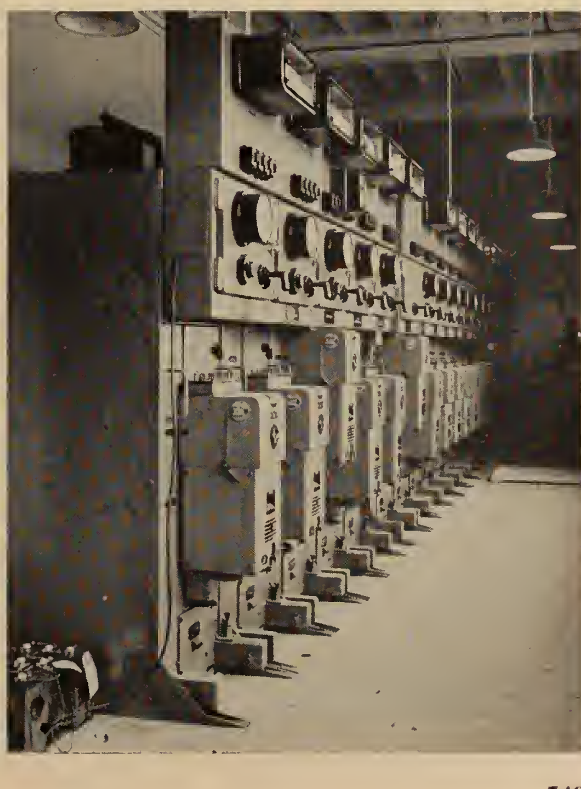
Lighting of aprons is of prime importance, not only to enable passengers and staff to find their way to, and about, the aircraft, but to reduce the danger hazard of rotating propellers. The early lighting by using floodlights at low level was not only ineffective, but dangerous on account of dazzle; this was overcome by using floodlights mounted on low towers, 35 ft. to 40 ft. above apron level, which gave a reasonable illumination to a depth of up to 200 feet.

The central area aprons, however, are nearly 600 feet across; the main taxi route runs through the centre, with parking bays on each side; there is no need to illuminate the taxi track; in fact it is better left dark, hence the problem resolved itself into lighting a strip 150 feet wide from the apron edge towards the taxi track, on both sides of the latter. The factors taken into account in fixing the mounting height were the proximity of runways and taxi tracks on the airfield side of the aprons, the architectural blending of supporting structures with the buildings, and the reduction of glare to taxi-ing pilots, and to the air traffic controllers in the control tower. The chosen height of 60 feet has provided a satisfactory solution to these problems; on each tower up to twelve floodlight fittings of a special design may be mounted, each fitting having a 1,000 w. tungsten lamp. The average intensity of illumination over the 150 ft. strip is 0.5 lumens per sq. ft. Control of the lighting may be effected from the base of the towers, or from the face supervisors control room in the passenger building; power supplies are taken from the local MV network through contactors in the apron sub-stations.

The electrical requirements of an aircraft while on the apron are growing and now represent on the average a load of 20 kw. continuously, with an addition of 60 kw. superimposed momentarily during engine starting. Since the use of engine-driven generators on trucks is expensive and wasteful, a system of mains-fed socket outlets on the aprons is now being installed. Because of the risk of petrol (gasoline) vapour in pits even if flameproof equipment is used it was decided that some form of retractable console was called for, and this has been under development for some time; the final prototype is now undergoing intensive trials.

Since there are approximately seventeen parking bays on each of the central aprons, more than half of which may require power at any one time, and since the engine-starting load is a potential source of bad voltage regulation throughout the electrical system, it was decided to put down a transformer for each pair of retractable consoles, which provide 415 volt 3-phase and 240 volt 1-phase supplies. It was not desirable to house 11 kv. high rupturing capacity switchgear in the congested spaces where the transformers have to be located, consequently a 3.3 kv. ring main has been laid round each apron, and the sub-stations housing the transformers, HV and MV switchgear are of minimum size.

At one time it was expected that



An 11-kv. switchboard in the central area control building, sub-station 23.

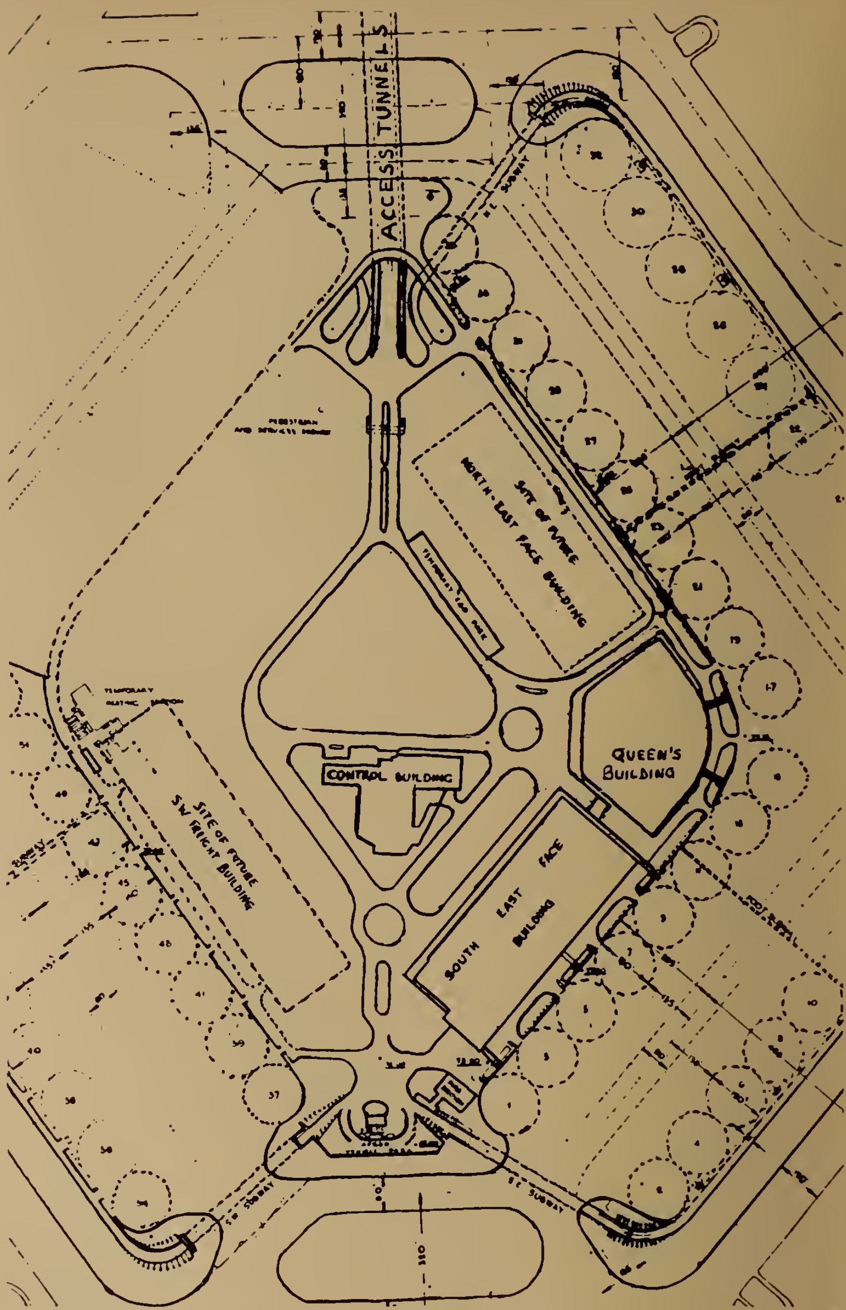


Fig. 2. The central terminal area covers some 160 acres in all.

pilots would need guidance to indicate the parking bay they were to occupy; a system of lead-in and lead-out curves was therefore provided by blister lighting fittings in the apron, and trials have been carried out with illuminated number indicators mounted about 20 feet high denoting the number of the bay. In practice, the curves of light do not seem necessary, and the value of the indicators is now being assessed.

The possibility of installing hydrant refuelling systems on the aprons is discussed in another part of this paper.

TUNNELS AND SUBWAYS

The access to the central area is by tunnel. It is constructed of reinforced concrete, 2,000 ft. long and 86 ft. wide, containing two separate 20 ft. carriageways, two separate cycle tracks and two pedestrian paths. It was constructed on the cut and fill principle and during its construction No. 1 runway was out of commission. Lighting is by cold cathode tubes throughout, the specially designed fittings being triangular in section so as to allow the lighting sources to be mounted at the junction of wall and ceiling on both sides. The lighting is graded down from the portals, and automatic differential switching is provided for day and night use to achieve the maximum economy since the connected lighting load is 130 kw. The tunnel is straight and relatively short, hence no amount of grading can fully compensate for the eye adaptation time.

Apart from the pilot lights (which are mains-supplied through independent circuits) the lighting is fed from both ends of the tunnel, the power being obtained from separate airport rings; the fittings are interleaved on these two main circuits.

The motor carriageways are ventilated from two fan chambers, one serving each way. In each fan chamber are installed two fans each capable of delivering 175,000 cu.ft./min. into the air duct which runs under the cycle subway; from this duct air is fed into the carriageway through grilles spaced at low level along one side; the air finds its own way out of the tunnel. Control of the fans is effected through an automatic gas analyser which determines the amount of carbon monoxide in the tunnel air at one sampling point in each carriageway; this is located at about two-thirds of the length of the tunnel from the entrance.

Drainage of the tunnel is by pumps which deal with the normal drainage of the sub-soil water surrounding the tunnel, which is a continuous process at low rate of flow; and storm water drainage designed to deal with the estimated flow of water into the tunnel from the approaches in the heaviest downpour expected in the district. Both sources of water flow into a common drainage system and then to the pumphouse sump, which is divided into two chambers. There are two normal pumps rated at 625 g.p.m. each, one of which is capable of pumping out the collecting sub-soil water, and four large pumps, of 1,875 g.p.m. delivery each, to deal with the storm water. The latter are brought in automatically, in cascade, on level gauge control in the sumps. In addition, two special sump drainage pumps have been installed to deal with the possibility of petrol spillage finding its way into the sumps; in this case normal pumping will be stopped and the spirit removed into containers. At the same time foam can be introduced into the sumps as a fire precaution.

For purposes of fire and damage control, a number of control points have been established at intervals along the carriageways. At each are fire alarms, telephones, water hydrants, illuminated instruction signs, and traffic lights. These are operated by fire services or police, there is also provision for remote control of the traffic lights, and illuminated signs, which bear the legends "stop" or "stop engines" as required. In ad-

Looking north from the control tower, showing the entrance to the main tunnel connecting the central area to the Bath Road (top of Fig. 2).

dition there are traffic counters at each end of the carriageways, which also indicate the actual number of vehicles in each way at any time; the traffic lights at the tunnel entrances are linked with this differential counter and will turn to red in the event of a sustained concentration of vehicles in a carriageway.

TEMPORARY TERMINAL BUILDINGS AND HANGARS

Prior to the opening of the central terminal buildings all passenger handling was done in buildings erected in a temporary terminal area along the northern boundary of the airport. All the buildings erected in that area, pending development of the central area, are of temporary construction. Temporary hangars and workshops were similarly erected in No. 1 maintenance area.

Since these buildings were constructed rapidly, in many cases from materials no longer required for wartime purposes, the heating arrangements had to follow suit; moreover the plan for the future development of the airport was not formulated. Consequently, it was not possible to design a scheme for district heating nor could the requisite equipment have been obtained at short notice. The immediate demand for heating was met therefore from a number of small boiler houses placed adjacent to the group of buildings and supplying heat by low pressure hot water or steam. The result was unavoidable but wasteful in manpower and less efficient than a large modern central heating plant could be. The arrangement has, however, been perpetuated and indeed added to from time to time to keep pace with growing demands so that today quite a number of small boiler houses exist around the airport. Meanwhile, two interesting modern installations of moderate size have been provided and are described later.

CENTRAL TERMINAL AREA

The central terminal area is diamond shaped (see Fig. 2) and covers approximately 160 acres in all. The area reserved for buildings is bounded by concrete aprons for aircraft stands. These are arranged in two parallel rows on either side of a taxiway which runs through the centre of each apron. Vehicular and pedestrian subways have been provided under each apron to enable vehicles and staff to get to and from the outer aircraft stands without having to cross the surface of the aircraft parking aprons. At the present stage of development the north-east, south-east and the south-west aprons are complete.

The buildings already constructed and to be constructed in the central area are of permanent construction. They are of structural steel framework encased in concrete and faced with hand made rustic bricks.

The electricity supply to all buildings within the central area is taken from the main sub-station at the control building by means of high voltage spur feeders. At present, feeders have been laid to a transformer sub-station constructed underground between the Queen's and the south-east face buildings. From here medium voltage (400 volt, 3-phase, 4-wire) cables are taken to the main low voltage switchboards in each building. An emergency lighting supply for essential lights is obtained from a battery in each building, rated at 30 minutes. Should the emergency last longer than this a supply can be obtained from the control tower standby generating set.

CONTROL BUILDING

In the centre of the central terminal area is the control building which is T-shaped in plan on the ground and first floors with a central tower rising to a height of 126 ft. The control building houses all the aerodrome approach control and ground movement operations rooms, telecommunications and airport administrative staff as well as staff restaurants. All movements of aircraft approaching and departing from the airport and all movements of aircraft and motor vehicles on the aircraft manoeuvring areas are controlled from this building, which is, in consequence, the focal point of a highly complex system of radio and line communication, radar and radio navigational aids, airfield lighting and ground movement control.

The tower in plan consists of two intersecting trapeziums with staircases and a central services core be-

Main access tunnel—interior view of eastern vehicle tunnel looking south.

tween them. The central services core extends to the full height of the tower and contains lifts, ventilation trunking, pneumatic message tubes and cable ducts. The control rooms have a false floor underneath in which cables and tubes are run direct from the services duct to any position in the room; thus ensuring flexibility in the layout and easy maintenance of technical equipment.

On the roof of the nine-storey control tower, in a glass fronted penthouse, is the aerodrome control room which commands an all round view of the airport and its approaches. Movement of all aircraft and vehicles on the airport is controlled from this room. Immediately below is the approach control room which is enclosed by glass on three sides. This room houses radio and radar equipment by which the controllers guide aircraft from distant radio "fixers" on to the airport approach path.

Below the approach control room in the tower are administration offices, conference room, etc. The east wing of the building houses telecommunications equipment and telephone exchange; the west wing accommodates the medical centre, while staff restaurants and rest rooms are located in the south wing.

The control tower is operationally the most important building at the airport; consequently, special precautions have been taken to ensure continuity of electricity supply. The incoming supply is taken from two transformers each of 500 kva. rating, fed from the central substation. On the medium voltage side there are two main switchboards, the division being made here into "essential" and "non-essential" services. This distinction is, of course, applicable only to emergency conditions when in the case of power failure the stand-by set is run up and connected to the "essential" switchboard only. The maximum demand of this building is of the order of 450 kva. but the essential load is about 150 kva. at present. To meet this a 250 kilowatt supercharged diesel engine generating set running at 600 r.p.m. and automatically started has been installed adjacent to the control tower. This set will run up and take this essential load in 20 seconds from a mains failure.

All electrical requirements for navigational purposes are essential loads, together with the lighting and heating of the rooms occupied by the air traffic control personnel.

The lighting of rooms in the control building, with the exceptions noted below, is of a high standard, fluorescent sources being used extensively, whilst in the staff restaurant the lighting is decorative. The exceptions are the aerodrome control room at the top of the tower which has continuous glass windows all round, and the approach control room. In the former any light source above the level of the operating personnel can be annoying by causing reflections on the glass. This has been overcome by placing the light source in a small tube with a narrow slit along one side which can be varied in width and is placed at actual desk level to illuminate instruments (where these are not self-illuminated) and writing pads. In the approach control room with its radar screens normal light is required for certain functions, whilst the viewers must have very little light. These apparently incompatible interests are still under investigation. Most of the areas are provided with forced ventilation to exclude dust and noise. Filters, fans and heating batteries are housed in plant rooms situate at convenient positions, the air systems being similar to those in the passenger building described elsewhere. In addition there is a very large solar gain in the aerodrome control room and somewhat less in the approach and control rooms immediately below. To enable comfortable conditions to be maintained in these areas, air-conditioning plant has been installed. This uses the same air system as for winter ventilation with the addition of cooling coils through which chilled water is circulated, that is, there is temperature control but no humidity control, the condition of the air being arranged to come within the comfort zone as derived from the psychrometric chart.

Apart from the warm air of the plenum systems, other heat is introduced in the building through radiators and convectors as necessary to bring the temperature to 65° F. normal. Domestic hot water is obtained through secondary systems from calorifiers. High pressure hot water is used direct in some of the kitchen cooking equipment, the remainder being electrically heated.

Two lifts have been installed in the centre of the tower proper, one used normally for passengers, having a speed of 300 ft./min., and the other for freight.

A comprehensive automatic routeing message tube system is installed between the air traffic controllers at the top of the control tower and the telecommunication and meteorological staffs below, also from the control tower to the passenger handling buildings. The master clock is housed in this building, from which a number of circuits are run throughout the building and also to the passenger handling and Queen's buildings, all of which are equipped with slave dials of various types. For use by the air traffic controllers there are also cyclometer type clocks registering at 5-second intervals, the figures being half an inch high.

The lightning protection system arranged at the top of the control tower is adequate for coverage of the other buildings at present.

The new Queen's Building from the control tower in the central area.

PASSENGER HANDLING BUILDING AND QUEEN'S BUILDING

The first passenger handling building erected in the central area is sited in front of the south-east terminal apron. The second passenger handling building will, in due course, be erected in front of the north-east terminal apron. In between these, on the eastern corner of the central area, is the Queen's building which is now rapidly approaching completion.

The passenger handling building now in use is some 600 ft. long by

250 ft. wide and three storeys high and handles all short haul passengers passing in and out of London Airport. It is designed so that passengers pass transversely through the building by a number of parallel channels each of which is self-contained with immigration, health, and customs control. Each channel is served by a baggage conveyor belt running beneath the first floor, except in the customs hall where it rises to first floor level to bring the baggage up for inspection. Passengers are thus able to pass easily and quickly through the control formalities. The main feature of the building is the large concourse which runs almost the full length of the building on the first floor. Departing passengers enter on the ground floor and are conveyed by short escalators up to the main concourse on the first floor and then through their appointed channel to customs, immigration, health, final departure waiting room, and thence by a bridge to the aircraft parking aprons. The whole of the lower ground floor of the building is given over to the handling of baggage, the accommodation of technical staff and equipment, kitchens, plant rooms, etc. The first floor is given over to passenger handling and facilities for passengers and on the second floor are restaurant, buffet, lounge, and office accommodation for operating companies. Shopping, banking and other facilities are provided in the main concourse. The roof of the building is planned to accommodate spectators who will gain access by a bridge from the roof of the Queens' building on to the roof of the passenger building.

Passenger Building concourse; line source loudspeakers and chandeliers.

The main electrical distribution cables are run from the medium voltage switchboard to sub-distribution panels throughout the building, and separate cables are taken to the plant rooms for the heating and ventilation equipment. A maximum demand of about 1,000 kva. is expected when the building is operating to its maximum capacity.

The lighting fittings in the south-east face building have been chosen primarily to harmonize with the interior architectural features. There are some very large spaces where good lighting is achieved by fluorescent tubes either concealed in the ceiling as in the main concourse or provided with pleasing fittings as in the customs hall where the level of illumination is of the order of 15 lumens per sq. ft. over the inspection benches. Some lighting is purely architectural as exemplified by the unique chandeliers in the main concourse, and an indirect use of cold cathode tubes round the circular roof lights over the balcony.

Most of the building is sealed against exterior noise; in consequence resort has been made to mechanical ventilation. The air is filtered and heated (when necessary), and the basis of design is six changes of air an hour. The main concourse has seven plenum systems introducing air at low level and extracting at ceiling. All other parts of the building are ventilated from two large plant rooms each containing a number of plenum and recirculation fans together with their heating batteries. Air supplies to kitchens are based on 20 changes an hour with total extraction.

Apart from heating by warming the air there are two large systems of floor heating, one in the main concourse and the other in the customs hall; also to a minor extent radiators are employed. The floor heating is designed to give a constant floor surface temperature of 75° F. The overall effect of heating and warm air is to attain a temperature of 65° F. to 70° F. throughout the building, the various sections being thermostatically controlled.

High temperature hot water is brought into the plant rooms and the air heating batteries are directly connected. The floor heating coils, radiators and domestic water services are all supplied at low temperature through calorifiers which are also housed in the plant rooms. Steam for kitchen purposes is raised in generators directly heated by the high temperature hot water, and in some instances the latter is used direct for heating cooking appliances.

An interesting installation is the baggage conveyors which take passengers' baggage from the ground level up to the customs hall, then drop down again to ground level. A number of endless belts form each conveyor. Provision has been made for emergency stops by customs officers and also at other positions as may prove necessary. In handling baggage of all imaginable kinds, care has been taken to make the transmission from one belt to another and also around bends as proof as is possible against accident by jamming or ripping of the fabric of the containers. In addition to the push button stops, customs have physical barriers which can be lowered by hand across the belts, and there are electric eye installations to stop the belt if an object has not been removed for examination.

Two kitchens are provided, one for the public restaurant and snack bars, and the other for the preparation of aircraft meals; for the former, food and wine lifts are provided to serve the various floors at which meals may be served. Since these lifts are handled by any of the kitchen staff and may have access from either side, care was necessary to ensure that adequate interlocking was incorporated.

The public address systems in the building are quite comprehensive, serving the three main functions of operational instructions, notices to passengers, and entertainment. There are three separate systems all subject to the overriding control of the airport management; the first, notices to passengers, in the main passenger parts of the building; second, the local systems in each of the waiting rooms where outward bound passengers have passed through customs; and third, the entertainment parts which are largely the roof spaces. The feature of interest in these installations is the first use made in this country of the "line source" type of loudspeaker for large areas. In particular the main concourse has two sets of such loudspeakers mounted in vertical line back-to-back at approximately the centre of the concourse which is 480 feet in length. Each "speaker" consists of 10 loudspeakers of 50 watts maximum loading each.

Queen's Building

The Queen's building which is located in a central position between the present and the future passenger handling buildings is designed to cater for aircraft operations and crew rooms as well as providing amenities for the visiting public. The operations accommodation will include aircraft and crew clearance rooms, meteorological forecasting, and flight planning and crew briefing rooms, etc. For the general public it will house an exhibition hall, post office, news cinema, lecture hall, grill room, and buffet. It will also provide access to the roof gardens of all the main buildings where amenities for the visiting general public have been provided. These buildings are connected with one another by bridges at roof level.

Most of the services follow lines similar to those in the main passenger building. The maximum demand on this building is expected to be 600 kva. This building is to be brought into use in the near future.

PERMANENT HANGARS

Two permanent hangar blocks have been built in No. 1 maintenance area as a first stage in the development of the permanent engineering and maintenance bases for British Overseas Airways Corporation and British European Airways. Both these buildings are entirely self-contained in that they include offices, workshops, stores, and all the facilities and services for undertaking major overhaul of aircraft.

The larger of the two permanent hangar blocks has been constructed for B.O.A.C. and measures approximately 860 ft. x 410 ft. overall. It is of reinforced concrete construction throughout and consists of four hangars, separated from one another longitudinally by an engineering hall 126 ft. wide which runs the full length of the building and transversely by stores, workshops and offices which rise to a maximum height of 66 ft. and for which lifts have been installed. Offices at one end of the block provide the main headquarters' accommodation for B.O.A.C.

Central light well in the engineering hall at B.O.A.C. headquarters.

Each hangar has a clear door opening of 300 ft. x 45 ft. and a clear depth of 140 ft. from front to back. The hangar doors are of the folding type the covering being corrugated aluminum sheeting. Normal drive is by electric motors through reduction gearing. Hand operation is also available in case of emergency. The building is constructed on the cantilever principle, and reinforced concrete cantilevers with portal girders over the hangar doors provide the main supports for the roof which is glazed. Each of the counter balance blocks to the 8 cantilevers over the hangar doors weighs 1,000 tons and the total load on the foundation of each of the 8 main pylons is of the order of 4,000 tons dead weight.

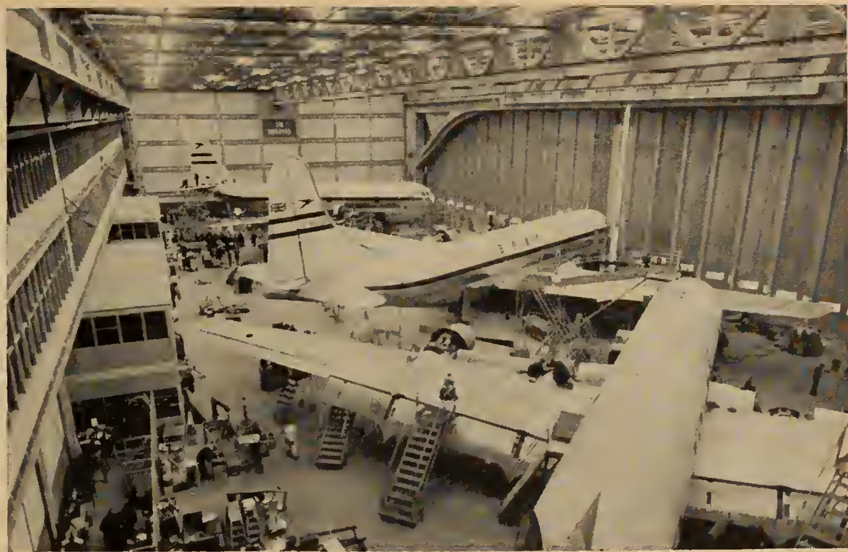
There are five electrical substations within this building, four of which are transformer substations on a ring main, the fifth being a high voltage switching point connected into the airport distribution network. Each medium voltage system is electrically separate but there is provision for linking the systems should one of the HV substations be put out of action. Considerable use has been made of bus-main trunking on the 400 volt 3-phase side to facilitate connection of machine tools and other loads which may be in temporary use. All electrical installations within the hangar pens are required to be of flameproof construction from the floor to a height of 10 feet above the maximum height of the wing of the largest aircraft which can be accepted. Included in these flameproof installations are six floor pits in each pen containing socket outlets for the tools and appliances which are used when working on the aircraft. The maximum demand at present is 2,000 kva. but this expected to rise to over 2,500 kva.

Lighting plays a big part in this building, for much of the space comprising the engineering hall is without natural light. In this area 200 kw. of cold cathode lighting has been installed, producing a minimum intensity of 20 lumens per sq. ft. at working plane. In the hangar pens, which are 55 feet high to the underside of the roof trusses, the lighting fittings combine 750 watt tungsten lamps with 400 watt mercury lamps. Each fitting comprises two inverted glass refractors which concentrate the bulk of the light downwards but allow an appreciable upward spill to illuminate the roof and thus avoid the "dark tunnel" effect. Since the mercury and tungsten lamps in each fitting are spaced within two feet of each other, the colour blending is good and the average intensity of illumination on the floor is 20 lumens per sq. ft. The lighting load in each pen is 124 kw. The remainder of the lighting is largely by fluorescent tubes, although some use is made of tungsten lighting especially in the light workshops where radio interference suppression is required.

Heating of the hangar pens is by floor coils through which flows low temperature hot water giving a design temperature of 77°F. at the floor surface. As some compensation for main door opening, a high velocity unit heater is mounted on each side of the door at 15 feet above floor level; these are brought into use as required. Provision has also been made to install high temperature radiant panels along the back wall 20 feet above floor level, should these be required in the future to provide a higher level of heat to men working on the aircraft. The majority of offices and store areas are ventilated by plenum systems giving four air changes an hour with re-circulation. In most offices there is also a low temperature convector heater to offset the loss of heat through the fabric of the building; some use is made of high temperature hot water pipes suitably guarded for this purpose also. The kitchen which serves a very large canteen is provided with cooking equipment mostly heated by high temperature hot water, and is ventilated by 20 air changes an hour.

Cranes are provided in the hangar pens covering the full depth of 140 feet. These are in two sections each bridge being independent of the other and can be used as a separate crane; the two bridges can be latched together and used as a single unit thus making possible the interchange of the load. The maximum load on any bridge is five tons under any condition of usage. There is also a five ton crane spanning 80 feet over the central workshop.

The workshop services include the provision of compressed air at 120 lb. per square inch gauge from a central plant, a limited supply of air at 3,000 lb. per square inch gauge, and a vacuum plant. Air conditioning has been provided for the radio and instrument workshop to hold the temperature of 68°F., and relative humidity not exceeding 50 percent. Public address systems, electric clocks, and fire alarms are also provided. Sprinkler and "deluge" systems which work in conjunction with the fire alarms are



Interior view of a hangar in the B.O.A.C. hangar block.

described in another part of this paper. A comprehensive lightning conductor network is provided over the roof of the building.

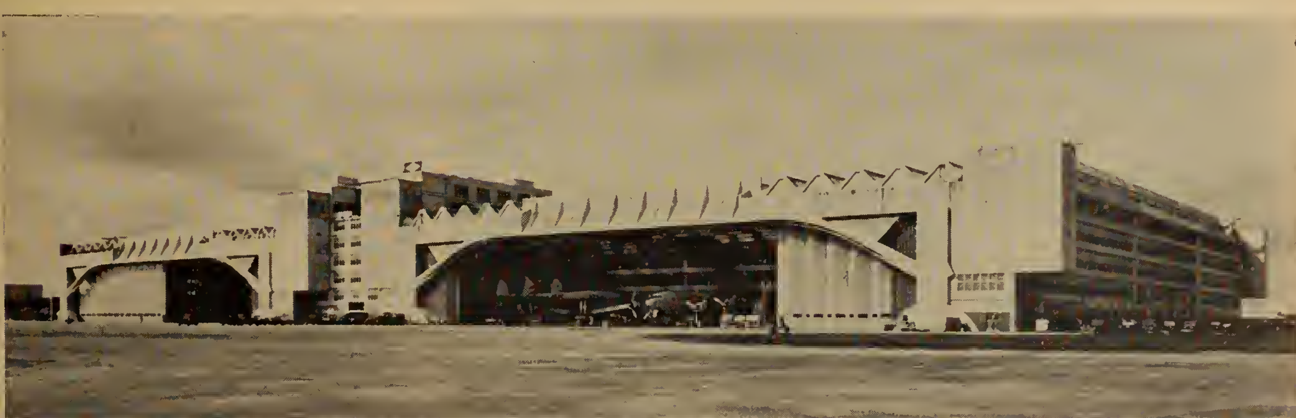
The smaller of the two permanent hangar blocks has been erected for B.E.A. and consists of two hangars each approximately 900 ft. x 110 ft. placed back to back with workshops, offices and service rooms in between. Each hangar has five separate pairs of doors which have a clear opening of 150 ft. x 30 ft. A large stores block flanks one end of the hangars and the overall dimensions of the hangar block are 1,020 ft. x 460 ft. This building is constructed principally of reinforced concrete with prestressed concrete roof beams over the hangars.

The lighting of the hangar pens has been carried out using a cold cathode installation consisting of tubes running fore and aft fixed beneath the roof trusses at 15 feet centres. The tubes are 35 feet above floor level and designed for an average intensity of 20 lumens per sq. ft. on the floor. The lighting load in each hangar (5 pens) is 225 kw. The hangar pens have partial floor heating extending from the main doors to about one third of the depth. The remainder of the required heating is supplied in the form of unit heaters placed along the back wall, these being supplied with high temperature hot water from the main heating plant. The remaining heating throughout the building is by high temperature panels and low temperature radiators and convectors, domestic hot water being obtained through calorifiers.

The electrical requirements of this building are provided through a high tension substation on one of the airport ring mains in which transformers are installed and the main medium voltage switchgear is located. The maximum demand is of the order of 1,500 kva.

HEATING SERVICES

All the buildings of temporary construction are heated by low pressure hot water or steam. The boilers are all small units fired with coal, automatic stokers being fitted to about half of them, and the heating pipelines extend less than a



B.O.A.C. headquarters and hangar block at London Airport.

quarter of a mile from any boiler house.

In 1951 the first high pressure hot water boiler plant was brought into commission to provide heat for the new permanent hangar blocks then under construction in No. 1 maintenance area. The boiler house contains seven economic type boilers, coal-fired, each rated at 10 x 10^6 B.t.u. per hour, and each fitted with an automatic stoker which feeds chain grates in four boilers and underfeed grates in the remaining three. All boilers have induced draught fans.

Water is circulated at 120 lb. per square inch gauge, and 325°F. through the pipelines to the hangar blocks, one of which is situated 400 yards to the east and the other 1,000 yards to the west of the boiler house. A base-exchange water treatment plant has been installed.

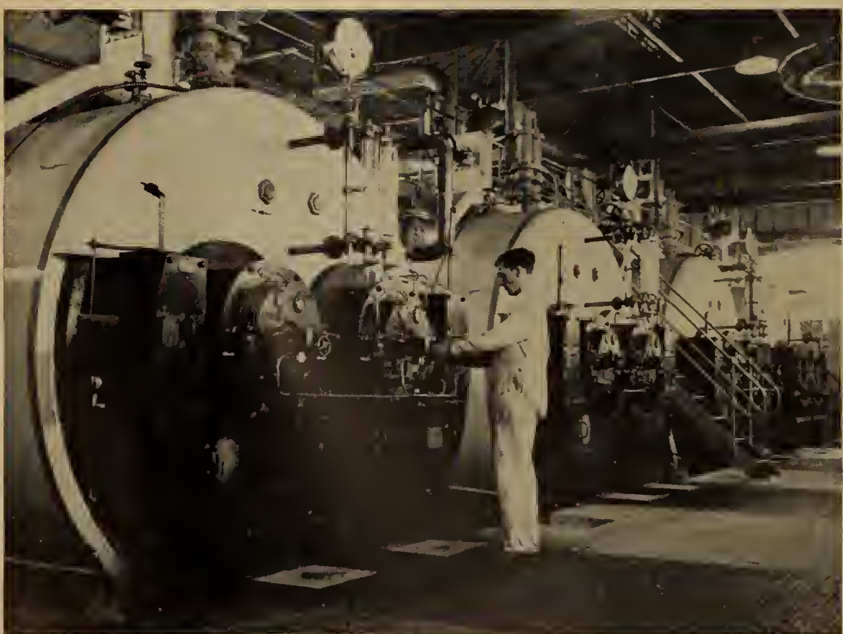
Instrumentation has been carried to the extent of providing automatic control to all boilers, hence a constant watch on efficiency is maintained. The quantity of heat is computed from the readings of the Venturi meter and temperature recorders.

This boiler house has recently been extended by the provision of three new boilers of the LaMont type, which are vertical water tube type boilers of relatively small water capacity, each rated at 10 x 10^6 B.t.u. per hour also. These feed into the common range and are oil fired using 950 seconds fuel oil.

Another high pressure hot water boiler installation has been brought into use in the central area to provide heat for the new terminal area buildings. Because the final development plan for this area was not available, the boiler house was erected in temporary construction and contains four economic type boilers each of 10 x 10^6 B.t.u. per hour, water is circulated at 165 lb. per square inch gauge, and the temperature at the boiler outlet is 350°F. This also is an oil-fired installation using 950 seconds fuel. No automatic control has been installed but instrumentation is adequate to provide a constant watch on efficiency. Induced draught fans are provided. All four boilers emit their flue gases into a common chimney. Since the boiler house is not far from the control tower, the height of this chimney was reduced to 80 feet and the density of smoke is strictly controlled and recorded on a chart. The feed water is treated in an acid softening plant. The water pumps providing the circulation through the pipelines are centrifugal type. The present length of pipeline supplied from this boiler house extends to a distance of 700 yards, and on these pipelines some of the expansion devices are of the bellows type, which have proved very satisfactory.

To meet the heat requirement for the further development of the central area, which cannot be obtained from the temporary boiler plant, a new central heating station is now being designed which will have an ultimate heat output of 100 x 10^6 B.t.u. per hour, and it is proposed that this shall be a pressurized system at 250 lb. per sq. inch gauge. This will, of course, feed into some of the existing pipelines.

A view of the boiler plant in the central area at London Airport.



FIRE SERVICES

A description is given here of the fixed installations which form part of the fire-fighting services but no account is taken of the mobile equipment and its uses since these are not engineering services.

The supply of water for fire fighting has been made completely independent of all other water usage, and the general principle adopted as the basis for design was the simultaneous requirement of fixed quantities of water at three points in the airfield, namely, the runways, the aprons, and a maintenance building.

Surrounding London Airport there are a number of very large gravel pits; some of these are worked out and remain as reservoirs into which storm water from the airport is drained, as previously described. The pumphouse was accordingly located beside the eastern balancing reservoir which is adjacent to the largest maintenance area. The fire mains extend to the central area, a route length of some 5,000 yards, and will later be extended a further 1,000 yards westwards.

The pumphouse floor is constructed below the water level in the reservoir to ensure permanently flooded suctions for the pumps of which there are eleven installed. Seven of these are the main fire pumps each capable of delivering 1,850 gallons per minute against a pressure of 130 lb. per square inch. The 325 b.h.p. driving motors are directly started through the 3.3 kv. switchboard, and are brought into operation automatically in pressure controlled sequence. There are, however, two smaller balance pumps of 100 gallon per minute delivery, which are installed to maintain a static pressure of 130 lb. per square inch in the fire mains. To ensure steady operation and provide the initial quantity required when water is demanded, a 12,000 gallon tank is connected to the delivery lines and maintained half full of water under the mains pressure by compressed air; the two remaining pumps remove any water which may collect inside the pumphouse.

The electricity supply is obtained from the airport distribution system through two 1,000 kva. step-down transformers from 11 kv. to 3.3 kv. In addition a smaller transformer steps down to 400 volts for pumphouse services. The pumphouse is normally not manned, and although the pumps are brought in automatically, they are arranged for

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Automation, Men, and Machines

J. J. Brown,

President, Industrial Automation Limited, Montreal

Suppose you are the owner of a manufacturing plant and a salesman comes up to you and says he can give you a device that will operate your punch presses and other machines automatically. He offers you these operating gadgets for only $22,000 each. You are interested, but in the course of conversation the salesman has to admit that it will take a little time to get the operating gadget properly adjusted, and thereafter it will run for only two hours without a rest. Moreover, it must not be used more than eight hours a day or two thousand hours a year. There also is the drawback that the performance of this gadget varies from hour to hour, it is sometimes inoperative for days, and at least once a year it will fail to work at all for a two-week period. Finally, it turns out that the device has a maintenance cost to you of $1.75 an hour, plus miscellaneous charges which amount to another $1.25 an hour.

Now if this proposition were made seriously to you as a hard-headed plant manager, you would undoubtedly throw the salesman out the door without ceremony. As you ushered him to the door, you might take time to point out that the whole machine his gadget is to operate costs only $1,000, that the machine itself can work 24 hours a day, 365 days a year, with perhaps only 1 per cent of its cost per annum needed as a maintenance charge. Moreover, the whole machine costs only $1.00 a day to operate, including its depreciation.

Although no plant manager in his right mind would buy such an operating device today, the fact is that literally millions of such units are in use in industry. The only reason why we put up with it is that we don't realize we are paying $22,000 for each one we have in our plants.

This machine-operating gadget I have been describing is, of course, a man. Man was not designed by nature to be a machine tender. He does not work well in series with the machine.

Since man is alien to the machine, we have had to devote years of effort to easing his pain. We have large personnel, job evaluation, time study, employee relations, health, education and recreation departments—all designed to make the human machine operator feel better about his job. In the aggregate these departments cost the company more than the entire production department.

For some years I have been advocating a program for solving all these problems at one stroke, by getting the man entirely off the production floor.

Automation represents a belated recognition that to a large extent man is out of place in the factory, and should be removed, in the view of the author. The subject is defined and its history traced; the economic and social effects of automation and its status in Canada are all discussed.

Automation today represents a belated recognition that to a large extent man *is* out of place in the factory, and should be removed. This will make it possible for men to live more satisfying lives, and also allows the factory itself to become more efficient.

The main reasons why the recognition came in 1955 instead of 1935 are four: the development of new technology under forced draft during World War II, new understanding of public relations techniques, the postwar prosperity and concomitant shortage of manpower, and finally, organized labour's need for an issue suitable for boom times.

In all areas of study, psychology as well as architecture, machine design as well as economics, there is something called "cultural lag". Twenty to forty years usually pass before the carefully thought out ideas of the professors finally work their way into the public consciousness. Lord Keynes, whose ideas on monetary policy were alternately laughed at and ignored for a quarter of a century (before being universally adopted) was well aware of cultural lag. So was Sheridan, the man who vainly tried for years to sell his intake ice preventer, as aircraft continued to crash on take-off; so was Biro, the inventor of the ball-point pen; Armstrong, the pioneer in F.M. radio, and a thousand others, known and unknown.

One lesson to be learned from the long history of technology is

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this: that technology alone is not enough. After the discovery is ready for the world, the world must be made ready for the discovery. This publicity, or public relations aspect of the total problem often takes just as long as the scientific aspect.

The history of the rise of automation is a classic example of the general principle I have outlined. On the level of technology, there is nothing in automation that was not known ten years ago. At the level of scientific principles, everything we need for today's level of automation was laid down over two hundred years ago. After World War II, we had available everything required for a rapid development in automation. We had a large body of technicians and engineers who, during the war, had become intimately familiar with the theory and practice of automatic control; we had analogue computers, gun laying devices, electronic controls, and a thousand other equipments refined to a high state of perfection.

And finally, we had, at the end of 1945, a successful automatic factory, (Sargrove's Electronic Circuit Making Equipment) operating in England.

What then was missing? If everything was available, why didn't we all hear about automation in 1945 instead of in 1955? How did we come to lose ten years in this vital race? The missing element, a priceless ingredient, was public relations.

The technical people in the field did not care what the public thought, so in return the public ignored their work.

When the technological history of our time comes to be written, two of the most striking episodes will be Orson Welles's "Invasion from Mars" program, which caused panic in the streets, and the spectacular rise of something called automation. What these seemingly disparate events have in common is their demonstration of the power of publicity. Without modern techniques of communication and propaganda, neither event would have happened; or at least, would not have appeared in the form it did at that particular time.

The rise of automation is a remarkable example of what is needed to arouse society's *interest* in a problem. Each year since 1949, Professor Doriot of the Harvard School of Business Administration has assigned a group to study automatism, particularly as applied to the automatic factory. In 1949 the leader of the group, Philip Zeigler, wrote me for information and a bibliography, since at that time Leaver and I were the only people who had written on automatism. Of course I had to tell him that there was no bibliography—that what we had written was fashioned from whole cloth.

The next year, the leader of the Harvard group was James Bralla, now of Princeton. His group too wrote an excellent report, which, as before, was consigned to oblivion.

But in 1951 the man appointed to lead the group was John Diebold, a man who combined the necessary engineering skills with a keen sense of the value and use of publicity. His group wrote a report that was neither better nor worse than those of its predecessors; in fact, since there was nothing new to say, it was substantially the same. But the report was promoted with remarkable skill, using all the most advanced techniques of publicity, public relations, and management consulting.

A Catchword

One thing needed was a catchword that would sum up the whole area of automatic control. In answer to this need came the word "automation" a horrendous mixture of Greek and Latin roots (thought up, I am sorry to say, by an engineer). But whatever the philologically sensitive may think of the word, it did the job. Pushed as "the latest product of American ingenuity" by the publicity departments of the great automobile companies, by 1955 the word was on everyone's lips. The missing element of publicity, once it was supplied with typical American aggressiveness and imagination, gave the subject of automatic control just the push it needed. Automation became what the general semantics people call "an OK word". Today, when speaking on automation, you enjoy the businessman's confidence. You are no longer labouring under the suspicion of being an impractical dreamer.

As a result of these activities we have today not really much more knowledge of automatism (in fact, some would say that what factual information we *had* is now buried under a mass of false or over-simplified "truths" known to all), but public awareness of the subject has reached a new high. There are three new magazines devoted entirely to automation; older magazines are trying to get into the act by adding the words "and automation" to their titles; conferences by the score have been held; editorial writers have editorialized, pundits have pontificated. By now everybody has had his say on this subject except a few obscure professors of Old Testament theology.

This spectacular change in the public attitude toward a subject in less than ten years cannot, of course, be ascribed entirely to one man. Many factors that were missing in 1945 had come to the fore by 1950.

One basic thing was a change in our attitude toward employment. In 1945 we were most of us still depression minded: we were looking for ways of providing work for everyone who wanted a job. By 1950 people were beginning to see that the labour supply was tight, and was going to remain that way for the foreseeable future. And, of course, when there is a shortage of labour, it is relatively easy to interest businessmen in labour-saving devices.

Again, the labour unions were not interested in automatism in 1945 because they were too busy with what seemed to them more immediate matters. But by 1950 most of the immediate post-war labour-management problems were well on their way to solution. With unprecedented prosperity, and talk once more of two cars in every garage, the union leaders stood badly in need of an issue. Because without a good issue on which to take a stand and make pronouncements, all members of the opinion-manipulating groups are lost. When the word automation began to enter the public consciousness, union leaders were shrewd enough to see that it was a godsend. They immediately jumped in with both feet, painting a frightening picture (à la Norbert Wiener) of thousands of men made jobless by the machine. One union executive has said: "The answer to automation is unionism". However this may be, it is clear that automation has provided the unions with a badly-needed issue, and that the revival of such ideas as the guaranteed annual wage can be traced directly to it. All this talk has been good for the union business, but it has also done much to make the public conscious of automation.

As you see, I am willing to concede that the invention of the word automation played an important role in the development of the field. It provided a convenient, (if messy) peg on which to hang a large number of seemingly unrelated notions about information handling and automatic control.

DEFINITION

But the word is now rapidly losing its usefulness, particularly among technically-trained people. Perhaps now, in 1956, the propitious moment has arrived to bring up once more the unpopular subject of definition. Defining things, so we know what we are talking about, is dull, and I am not going to bore you by any detailed description of classification schemes at this time. But what I want to suggest is that until we have good definitions, clearly understood, there is going to be an immense amount of aimless thrashing about in this important field. Leaver, Sargrove, Amber and others have published elaborate classification schemes covering the whole field of present and future automatic devices. I have even published one myself. I realize that it will take some time for reasonable areas of meaning to be assigned to key words in this field, and even more time to gain public acceptance for these meanings. But my plea is that we should start *now* to give serious consideration to the basic problem of terminology.

The problem of what automation *is* becomes particularly acute when one attempts, as I am about to do, to discuss its effect on individual men and on society. Let's say, you think that the word automation means sulphuric acid, and I think it means brown bread. We don't discuss our private definitions, but plunge immediately into a debate on its effect on the human digestive system. You can see at once that this is an impossible situation.

In view of the current confusion, let me take a few moments to outline briefly what *I* mean when I use the words automation, automatic, mechanized, automatism.

At the risk of oversimplifying a complex subject, I want first to divide all methods of handling information to provide a service, or raw materials to provide a product, into two basic classes: The first class I call mechanization; the second I call automatism, or (under protest and only in order to communicate) automation.

These two classes are characterized by different properties in almost every parameter. For example, in terms of basic design, the first class of machine is designed in terms of the product it makes, while the second is designed in terms of the function it performs. Again, when we look at the type of construction typical of the two classes, mechanization produces machines that tend to be relatively large and monolithic; automatization produces machines that are made up of many small units plugged together. In overall size, the first tend to be relatively large, the second relatively small. In terms of flexibility—the range of products the machine can make—mechanization tends to produce a narrow range; automation a wide range.

When looked at from the point of view of control, mechanization makes use of mechanical means such as cams, or of relatively simple electrical means such as limit switches. Automation, on the other hand, uses either electronic control or more complex electrical means, such as servomechanisms.

The feature that makes an ordinary machine into an automaton is programming. Programming in general is machine control moved up to a higher level of sophistication. Programming a machine consists of making available to it, in some form, the information which tells it what to do next. This information can be built into a machine in one of two ways: the machine can be told (by means of a metal cam, record, or punched tape) to do this, then that, then the other thing. Or, the machine can be made sensitive to what is going on in its surroundings, or to what its product looks like. Then it can make the changes needed to bring its operation back to normal.

This last is usually done by feedback, which might be defined something like this: if, in any manufacturing operation, the tolerances are close, so that variations in the raw material and environment become important, then the program running the machine has to be adjusted automatically from time to time to fit these variations. These program changes must be made in such a way as to keep the product the same.

The use of feedback leads to a more sophisticated type of automatism, one that is self-adjusting, as well as self-operating. For the machine, the program answers the question "what shall I do?": Feedback answers the question "how am I doing?". Feedback systems can be more or less advanced depending on whether they look at the operations themselves, or at the results of the operations, that is, the product.

It is often charged that automatic control is complicated. Far from tending toward complication, the use of feedback can lead in many cases to extreme simplification. Take, for example, a windmill. By means of a very simple feedback device (a vane placed at one extremity of the rotatable top) the blades are always kept pointing in the direction yielding best operating efficiency. Now if a modern industrial efficiency expert, working along conventional lines, came to the farm, he would realize that the farmer has to be working in the barn and fields most of the time, but also he has to be running out periodically to point the windmill into the wind. The efficiency man would gather charts showing the wind direction and velocity for the past twenty years; he would plot the farmer's steps and turnaround time between the barn and the windmill; he would plan optimum intervals between windmill adjustments; he would study perhaps twenty or thirty such contributing factors. Then, when all this was done, he would work out a more efficient system for organizing the farmer's work, dividing his available time between the barn and the windmill. That is, he would develop a complicated plan for fitting the man in with his machines.

But the expert on automatism comes along and eliminates all the above at a single stroke. He makes the simple suggestion that a tail be put on the windmill, thus eliminating the man.

U.S. AND CANADIAN INDUSTRY

To complete this catalogue of the basic differences between mechanization and automatism, let us look for a minute at the three kinds of industry in Canada and the United States today. At the top, in terms of the public's awareness of it, is mass production industry; highly-mechanized, efficiently-run plants designed to produce large runs of one standard product. At the bottom are the custom builders, people set up to make a small number of specially-designed, hand-built, hand-rubbed luxury products that are shipped out to customers in fleece-lined cellophane bags.

In between are the job shops. These comprise by far the largest group in our economy, both in capital invested and number of employees. These plants make the shorter runs of mass-produced goods, often serve the capital rather than the consumer goods market, and carry on their activities in a very large number of relatively small plants.

Of the two basic types of machine organization I have been speaking about, mechanization is the one that fits the top layer, the layer of mass-production industry. Automatism is ideally suited to the second layer, the job shops. Neither type has wide application for the custom builders, except indirectly.

But since the job shops are most numerous, and employ most of our industrial workers, I foresee a better future for automatism than for mechanization. In fact, as far as I am concerned, mechanization is a dead-end street.

This brings me to my main point, which is this: the social and economic effects of automation depend first on what kind of automation you are talking about, and second on the particular area of our economy in which it is applied. Detroit automobile manufacturers have put advanced mechanization into a large mass-production industry and are reaping one kind of social and economic consequence; the small machine tool builders are applying elementary automatism to the job shop, and will cause quite different consequences.

This is not to say that the consequences of mechanization and automatism are different in every respect. There are enough similarities, and the subject as a whole is complicated enough to make it rather easy to confuse the two.

HISTORICAL SKETCH

Only the word automation is new. The fact dates back to the time when the first user of a hand tool wished that the tool would go on performing the work, leaving its owner free to go about more entertaining business. The development of automation has taken place in orderly stages, from the primitive situation when men produced goods by hand, to the high degree of automation that I see for the future, when machines alone will produce and distribute many goods and services. Over the centuries since the invention of the wheel, the trend has been toward less and less work by men, and more and more work by machines. Such ideas as interchangeability of parts, steam power, mass production, standard screw threads, have laid a firm groundwork for the complex industrial society we know today.

The automatic factory grows from the bottom up, rather than from the top down. That is, we do not begin with a computer and then decide to what machines the computer shall feed information. On the contrary, first a few machines are made to control themselves automatically, then later these machines are linked so that the action of one machine controls another. Finally, so many machines have been linked the whole factory is integrated, and you have automatic production of goods.

This series of events has already taken place in some process industries.

Mechanization of work processes, which is the basis of automatism, goes back into pre-history. The Greeks had a form of machine gun, and other fairly high levels of mechanization can be seen in classical times in the works of Hero of Alexandria.

The mediaeval clockmakers played an important role in the advance of mechanization. With the revival of seafaring that came with the Renaissance there was a great need for a method of determining the longitude. The large rewards offered by all European governments during the 17th and 18th centuries, for a method of finding the longitude, encouraged the development of automatic devices.

The earliest example I have been able to find of an automaton that shows a sensitivity to its environment is Leroy's compensated balance wheel. He built this for his marine chronometer about 1734. Programmed automata of various kinds go back at least to the middle of the 18th century. Punched cards were used to program production tools over 200 years ago.

Partly because of the abundance of human labour during the late 18th and early 19th centuries, the growth of mechanization was arrested. If human labour is cheap, there is no particular advantage in machines. It took the Wages and Hours legislation of the early 20th century, plus the vast expansion of consumer demand, and the waste of modern methods of waging war, to produce today's need for more automatic production.

Since the beginning of the 20th century, many highly-mechanized plants have been built both in Europe and America. These automatic factories have appeared chiefly in the industries, such as petroleum, where there are processed very large amounts of a homogeneous material that is difficult to manipulate by hand. The first modern automatic factory was probably John Sargrove's ECME, which was operating in England in 1945. In the winter of 1949-50 the U.S. Navy sent a mission to look at the Sargrove machine, and as a result of this the "Tinker Toy" project came into being. From "Tinker Toy" and similar research activities, has come a long line of circuit-making equipment using printed circuit, modular, dip-soldering, and multiple-station techniques. In short, automation is here.

THEORY

Of course, it is here only in the sense that the motion pictures were here in 1912, and the automobile was here in 1890. That is to say, the essential theory, the necessary fuels and materials, and the practical enginering skills required to make these products were ready at hand. That is the position in automation today. We have enough theory, we have a valuable fund of practical experience, we have the engineering skill, the raw materials, the economic incentive to enable us to go ahead at a rapid pace.

When I say we have enough theory, I do not want to leave the impression that the theoretical side of automatism is solved. Far from it. Such basic problems as the Leaver-Brown theory of process rather than product orientation, and the unit operations concept of Professor Brown of M.I.T.

have, as yet, hardly been discussed by engineers. Such matters as these will provide subjects for debate for many years.

For example, one debate going on right now is over the question of whether the changes now coming into industry will be evolutionary or revolutionary in nature. That is, are they going to change business and industry qualitatively, or merely quantitatively?

This is a difficult area in which to make generalizations. Before I attempt it, let me give you an illustration of what I call a radical or revolutionary approach as opposed to an evolutionary approach. Montreal is a large city, and like most large cities, has a transportation problem. Unluckily, Montreal's problem is made even more horrendous by the fact that it is a northern city, and in the average winter 80 inches of snow fall in the streets. If enough falls at one time, all traffic comes to a halt. Even if the weather is kind, millions of dollars have to be spent each year on snow removal operations.

The evolutionary approach to this problem is to improve the kinds of snowblowers and other types of equipment used to remove snow. You can also experiment with chemicals, with heated sidewalks, and with other means of turning snow into a more fluid substance that will flow down drains. But in every case you wait until the snow has fallen.

The revolutionary approach to this problem is to ask: why not do something about snow before it gets underfoot? In other words, instead of looking at a part of the problem, we look at the whole problem in its social and environmental context.

Using this approach, one suggestion has been to seed the snow clouds outside Montreal, and deposit the snow harmlessly on the farmers' fields. A radically different approach, such as cloud seeding, can, if successful, play a major economic role in many important industries.

But there are problems. Conventional solutions are easier to sell to city authorities. Radical approaches, by definition, were not used by our grandfathers, hence are not proven. Weather control is still not an exact science, and when the inevitable failures come, they are more newsworthy than the steady but unspectacular successes.

Precisely these same generalizations can be made about the revolutionary as opposed to the evolutionary approaches to automation. Radical procedures would undoubtedly get us to where we want to go faster and with more efficiency, but they are less "practical" in the sense that it is very difficult to get management to try them.

For example, people in the field have realized for a long time that it is silly to expect that a product designed to be put together by hand would lend itself to automatic production. If it did, it would be just an accident. The thing to do is start from scratch, and design the product specifically for production by automatic machines. Product designers just do not think in terms of workerless factories. Until they do, we are going to continue to see evolutionary approaches to the problem of production, and many compromises.

ECONOMIC EFFECTS OF AUTOMATION

Going back for a moment to the two general classes of machinery I have described, you will remember that examples of mechanization tend to be large, monolithic, inflexible, and product oriented. Examples of automatism, on the contrary, tend to be small, unitized, flexible, and function oriented.

Since the machines are so different, it is clear that many of their economic effects will be different. For example, take the question of whether the introduction of machines that control machines will require larger capital investment, and therefore tend to close off new areas of industry from all but the largest corporations. Thinking in terms of capital investment per unit output, mechanization seems to be costing not much more than conventional systems when the production runs are very large. But for smaller runs the cost may be prohibitive. With automatism, the opposite is the case. Large runs tend to be costly because a large portion of the cost pays for machine versatility we do not need. For smaller runs, however, that is, at the job-shop level, automatism seems to require lower capital investment than either mechanization or conventional mixtures of machines and men.

The same kinds of answers might be given to the question: does automation lead to greater or less decentralization of industry? To oversimplify, mechanization tends to centralization, and automatism to decentralization. Large inflexible transfer machines, linked to form a factory of the v-8 engine type, are most efficient when they use very large aggregations of machines. Thus their use will tend to make plants larger, and such plants can be financed only by the great corporations.

On the other hand, I would argue that automatism for the first time makes it possible to decentralize efficiently.

Decentralization means integration of all aspects of the business at the lowest possible level. In the past this has been difficult to achieve because our methods of communicating with distant plants and offices were neither fast nor efficient. Today we have the means to tie everything the company owns into one communications network, and it is even possible to run machines in a dozen scattered plants (underground if you like) from a single recorded operation at the head office.

This kind of thinking, if it prevails, will almost certainly lead to decentralization of industry on a scale undreamed of today.

The point I want to make in these two examples is that both mechanization and automatism have economic effects, but these effects are not necessarily the same. In some cases they tend to nullify, and in others to reinforce each other.

Other selected economic effects of automatic control I want to discuss very briefly are: its possible effect on the rate of money flow, and on executive development, the basic problem of management.

Conspicuously missing from this list, you will notice, is the bugaboo of technological unemployment. The reason why I propose to skip this subject is that it is so full of imponderables, it carries such a high emotional charge, and so many people who are neither engineers or economists have pontificated on it, that the whole area is an almost impenetrable jungle. However, one thought is this: Professor Meier of the University of Chicago, a very careful student of the history of technology and its effects on society, has watched the development of automatism very closely for the past 15 years. His recent conclusion is that, because automation affects chiefly mass production industry, and all industry employs only 40 per cent of the total working force, the threat of technological unemployment is negligible for the foreseeable future.

A more subtle consequence of automation is its effect on the flow of money. If I understand Samuelson, the important fact about money to an economy is not how much there is of it, but its rate of flow. Although I am not competent to discuss theories of money flow, it does seem probable that automation will revolutionize it. For example, it looks as if unskilled labour will be the class of labour most seriously affected by automation. It is also well known that unskilled labour is the freest spending group, and also the most numerous single class. If the freest spenders who are also numerically the largest group suffer a loss in take-home pay, it cannot help but have serious economic consequences.

EXECUTIVE DEVELOPMENT

Management as a group is still almost completely ignorant of the techniques and potentialities of automation. Yet, because of developing automation, the day of the intuitive manager is over. Automation demands much higher levels of competence from all echelons of management. This is because it is not merely a new technology, but a new and integrated way of looking at the production and distribution processes.

At first glance, this statement may seem to contradict the remark made earlier, that automation was nothing new. The point is that old technological ideas, when combined with modern techniques of publicity, make a third entity that is different in kind from either of its components. Moreover, something the social scientists call the "self-fulfilling prediction" comes in here. On the stock market, if you predict that certain shares will soon be selling for $10 instead of $2, and then spend enough on publicity to this effect, the shares *will* sell for $10, entirely independent of whether they represent any intrinsic value. This same kind of thing happens with new technology.

This new way of looking at business as a whole has implications affecting marketing, capital investment, design, employee and public relations, accounting, inventory control—in fact, all aspects of business and industry.

With automation, managers will have to know exactly what they are doing and why. To get this result, we are going to be forced to make radical changes in our executive training programs.

AUTOMATION AND SOCIETY

In the broader social sphere, one point I wish to bring up is this: has all the talk about the danger of technological unemployment caused by automation distracted our attention from much more serious threats? For various reasons, which I shall not take time to go into here, I feel that the unemployment problem will solve itself. But I am not so sanguine about the effect of automation on the individual.

Even today, after a relatively short history of rather elementary methods of mass production, modern man is engrossed in consumership. Most of his waking hours are spent in deciding what new products and services he can arrange to consume. Carlyle's epitaph on the country squire could be applied to millions today as the sum total of their accomplishment.

This is sad, because by concentrating on being consumers, we cut ourselves off from the delights and rewards of creative activity.

But automation is going to give us a world in which mass production of products will be vastly improved. This flood of products will have to be sold, and the only way it can be done is through a stepping up of all kinds of promotional activity. Instead of being swamped in advertising and public relations propaganda only part of the time, as he is today, tomorrow's citizen will be drowned in it every waking hour. He will have to be, because with such a flood of products, the only way to get them sold will be by raising marketing and promotional activities to a fever pitch. People will have to be taught to buy, consume, depreciate, write off, and otherwise get rid of products and services at a rate unknown today. What I fear is that this consuming, at the rate needed to keep in balance with really efficient mass production, will be a full-time job. And this, I feel, will be a degrading life for most human beings.

The promise of automation is that it will give a high standard of living for very little work. This means that it will give us leisure, and with leisure we can aspire to higher levels of cultural development in both qualitative and quantitative terms. Other times in history when people enjoyed abundant leisure and wealth were marked by great cultural activity. Perhaps the main reason why the Elizabethan era was so productive of literature and fundamental science was that men had leisure to carry on these activities. They were supported by the somewhat less respectable activities of the Elizabethan freebooters on the high seas and in the colonies.

Given a reasonable basic level of education, it would seem that, on the sheer basis of probability, the more people with leisure the more likely we are to have new developments in science and the humanities. Automation can provide this leisure on a scale hitherto unknown.

It has been said that all civilization is based on slaves. As I see it, one of the great forces making for increased automation today is the fact that human slaves are getting harder and harder to find. Automation, by providing us with millions of non-human slaves to do the menial and degrading work, can provide the society of the future with the leisure for high cultural development, without the attendant degradation that comes to a society based on human slaves.

FREEDOM OF CHOICE

Although, as David Reisman has pointed out, leisure itself carries with it certain threats to the individual's psychological well-being, nevertheless, I think it is fair to say that most of us desire more leisure, or at least more freedom of choice in deciding how we shall spend our time. Automation, correctly handled, can give this freedom of choice.

It is a paradox that automation, while giving us more of one kind of freedom, may take away an even more fundamental kind. A society in which automation has come to full flower might be one in which the maverick, the individualist, and the creative thinker would have no place. One of the beauties of our rather haphazard social organization is that the great power groups: labour, the farmers, business, and the church, impinge on each other at different angles. Thus they leave spaces between them in which an individual can hide without being crushed. Higher degrees of social integration caused by a highly-mechanized society might, if not carefully handled, eliminate these important asylums.

"To reduce a man to nothing, it is only necessary to give his work the character of uselessness". So wrote Dostoevesky in *The House of the Dead.* In our country there is a growing realization of the worth of the individual human being. Political systems, social arrangements, economic advances, are nothing if they do not lead to a fuller and happier life for the individual citizen. Automation, properly directed, can do just this. It can free men forever from degrading, dangerous or monotonous toil.

The Ideal Machine

But we are not at this millennium yet. How far we are from it can be judged by comparing the ideal automatic machine with what we have today. True automatism is reached at the point where the machine's independence of man is the greatest; when the machine has the ability to go on doing its given task, cooperating freely with other automata but also enjoying the greatest possible flexibility. The highest type of automaton might be such that:

(1) its operation can be easily changed;
(2) it is easily linked to other automata and machines;
(3) it checks its own performance;
(4) it modifies its performance with the changing environment;
(5) it maintains itself or requires no maintenance;
(6) it can be modernized from time to time.

An automaton with these properties would produce maximum output with minimum attention.

We have nothing like this. Even the highest automata in use today satisfy only a few of these requirements. In other words, everything is yet to be done. I have given some suggestions on how we might go about the job of developing and applying automation in a rational way. I want to end on a note that may surprise some of my audience, namely that, in my opinion, Canada has all the requirements for leading this field.

AUTOMATION IN CANADA

Canada's status in automation today is briefly this: Examples of high degrees of mechanization can be seen in many Canadian factories. Some of our petroleum and chemical plants have highly automatic continuous-flow processes. Others use a wide variety of electronic and other devices to control specific processes.

But, if we mean by automation a qualitatively different way of looking at all aspects of the production and distribution process, from product design through marketing, then it is no exaggeration to say that automation is unknown in Canada.

This is too bad, because Canada, with her economic situation, her job-shop industry, her tax laws, her high rate of population growth, her strategic location close to the United States, and with the broad nature of her engineering education, is in many ways ideally placed to become a world leader in automation.

In Canada, the gross national product per capita is in the range of 70 to 75 per cent of that in the U.S. This means there is more room for the development of automation here.

I have pointed out that the ideal seed ground for automation is not the large-mass production industry, but the job shop. Here in Canada, virtually all our plants are job shops. Moreover, simply because its plants and businesses are relatively small, Canada provides an area in which new applications of automation to manufacturing, data processing, and so on, can be tried out on a small scale without disrupting large scale, closely-integrated operations.

Thus many Canadian plants that are subsidiaries of U.S. and U.K. companies are in an ideal position to try experimental plant and office automation here. They can draw on the parent company for funds, yet not have to meet all the conditions required for capital expansion in their home countries. Moreover, test runs in Canada would be conducted a little out of the public eye, so that if they failed (as experiments often do), the parent company would avoid bad publicity.

Automation is innovation, and innovation is risky. Canada is an ideal country for the development of inherently risky ventures, because there is no tax on capital gains, and there is a climate of opinion favouring the taking of long odds for a large potential profit.

Canada's high rate of population growth, firmly backed by great raw material resources, is another reason why automation might develop very rapidly here. Between 1939 and 1953 Canada's population increased 30 per cent, as compared with a 20 per cent increase in the U.S. Since we are going to be building new production facilities anyway, it is relatively easy for us to introduce automation.

Our strategic position close to the U.S. means that all the highly professional "engineering of consent" that goes on down there is brought to bear on us through U.S. newspapers and magazines. Reading about what the Americans are doing makes our executives stir uneasily, and wonder if they shouldn't do something too!

We Have the Requirements

Not only do we have the strategic requirements, but we have the people. Perhaps because of the British influence on our educational system, the training of Canadian engineers is somewhat less narrow than in most U.S. schools. This makes graduates more hospitable to imaginative solutions to business and industrial problems, although an offsetting factor is the fact that the Canadian engineer has a less free hand in decision-making than does his opposite number in the U.S.

Canadian scientists developed the first production tool controlled by electronic records; first enunciated the concept of recording complex human skills; published the first discussion of automatism in a national magazine. They have gained international recognition as pioneers in automation over the past ten years. Thus there is no real reason why we should be behind in this field. Quite the contrary. With natural and political advantages on our side, and with well-trained people, we could do work here that would be the wonder of the world.

Trends in Design of Electrical Distribution for Industrial Plants

N. E. Hudak, JR.E.I.C.

Amalgamated Electric Corporation Limited, Toronto

In recent years the amount of power required by industrial plants has increased immensely. Indications are that the industrial requirements have been doubling every ten years and there are no indications of any slackening in this growth. This rapid increase can be attributed to the rapid growth of industry and more extensive uses of electrical energy.

In looking back it appears that many plants tended to skimp on power facilities. Today the trend is the other way, particularly in the better new plants. Management is realizing that adequate reliable power facilities are of paramount importance to the successful operation of any plant. And management today is more prepared to invest early into a suitable distribution system rather than risk the shortcomings.

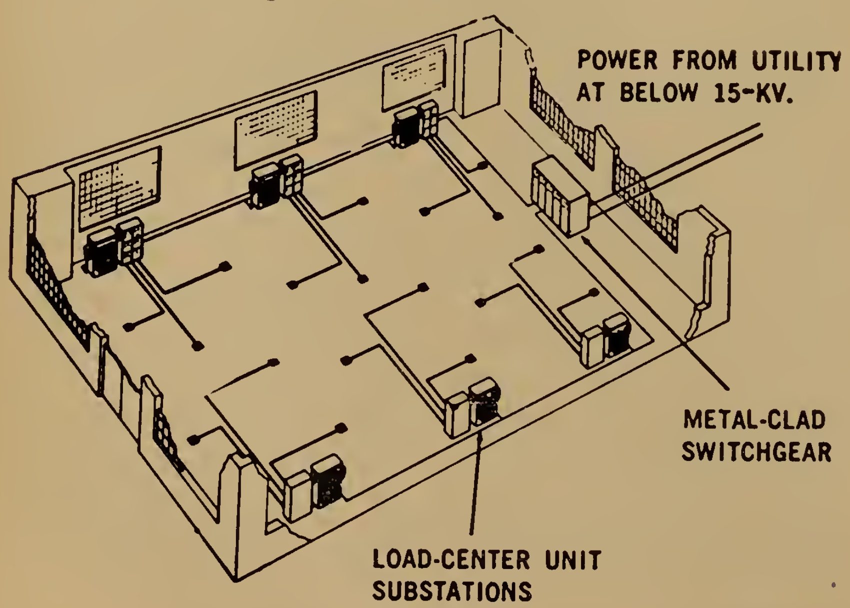
In the majority of the cases the first cost of power system is less than 10 per cent of the building cost and wise management will consider investing extra capital to get a system that is more reliable, more flexible and more economical to operate.

Planning

In planning for a new plant, the first question to be asked is, is the power to be generated or purchased, or both? In majority of the cases the power will be purchased, but in a few cases it may be generated, particularly if the electrical power becomes a by-product of the steam plant as in some chemical and paper plants. The trend, however, is away from industrial generation. Primarily because many industrialists believe that capital invested in manufacturing facilities yields a greater return. Also in many cases they feel that the problems of operating and maintaining electrical generating equipment should be left to the experts in the utilities.

If buying power, the utility should be brought into the picture as early as possible. The utility will wish to know the power demand, the load factor, the probable future growth, continuous flow processes, if any, and special services, if any, that may be required. For large plants, and plants having continuous flow processes, it is most desirable to have at least two lines of service from the utility so that in case of one supply line failure, or supply line maintenance, the plant may be switched to the other line.

Fig. 1. Load-centre distribution



Voltage

In laying out a plant distribution system there are usually three voltages to be considered. These are the plant supply, distribution, and the utilization voltages.

Plant Supply Voltage

The plant supply voltage is usually based on the ultimate plant load and the utility voltage available in the area. Each power utility has its own policy regarding the voltage for new services. For most utilities the plant supply voltages are as follows:

Volts	Loads, kva.
575	up to 75
2300/4160	75 to 300
13,800 and above	above 300

Read at a joint meeting of E.I.C. and A.I.E.E., Montreal, November 1955.

In most cases the first cost of a power system is less than a tenth of the building cost, and it is wise to consider extra investment in the power installation to get the most reliable and, eventually, economical system.

For the loads above 300 kva. the supply voltage depends pretty much upon the utility voltage in the area, the block of power to be delivered and the distance of the plant to the supply point. Some utilities such as the Toronto Hydro are attempting to standardize at 575 v. and 13,200 v., whereas utilities such as North York Hydro are standardizing on three voltage levels, 575 v., 2400/4160 v., and 27,600 v. Oshawa Hydro is providing power at 2400/4160 v. to most industrial plants, but for heavy blocks of power such as the new General Motors plant the supply voltage is 44,000. There are also areas where the supply voltages are 6,900 and 2,300.

From the foregoing it is seen that the supply voltage depends primarily on plant load, distance to supply and the available utility voltage.

Distribution Voltage

The voltage at which power is distributed within the plant is determined principally by the size of the load, the distances that the power is to be transmitted within the plant and the voltage rating of the equipment. For example, for loads of 10,000 kva. and less the common distribution voltage is 4,160, but if there should be a considerable motor load of 200 h.p. rating or higher requiring 2,300 v. it may prove more economical to distribute at 2,400 v. In many plants for loads of 10,000 to 20,000 kva. the distribution voltages are either 2400/4160 or 13,800. For loads greater than 20,000 kva., 13,800-v. distribution is usually the more economical. It is advisable to distribute at 2,400 v., 4,160 v. or 13,800 v. as these voltages permit the most economical use of standard voltage rating equipment—2.5 kv., 5 kv., and 15 kv. respectively. Voltages such as 6,900 and 7,600 offer problems in that the equipment required is on non-standard voltage rating.

In cases where the load is small, mostly lighting, small motors, and power driven hand tools, the power may be brought in and distributed at 575 v. or 120/208 v. In such cases there is no substation, but the amount of power available is usually limited and often the distribution within the plant is uneconomical.

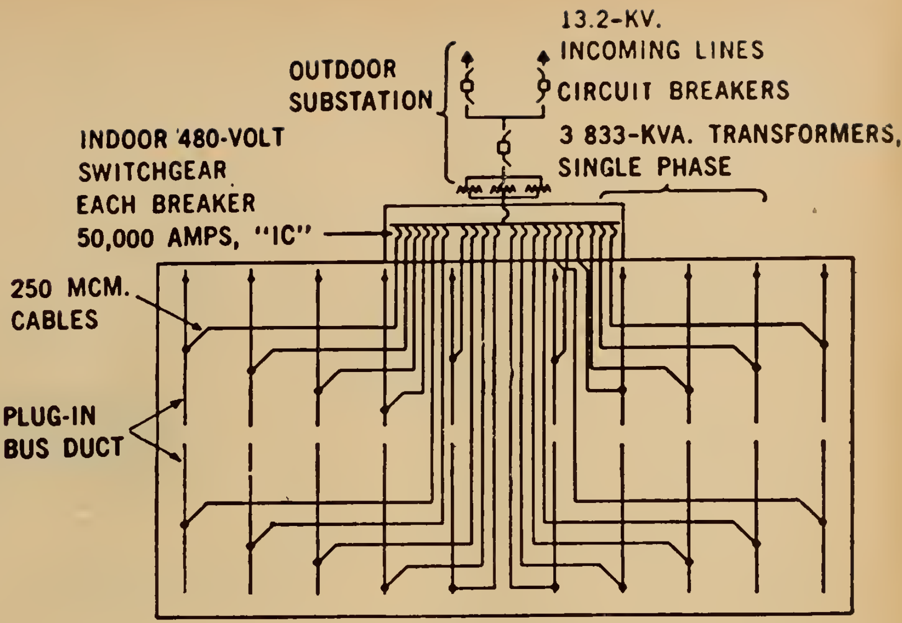


Fig. 2. Load-centre distribution

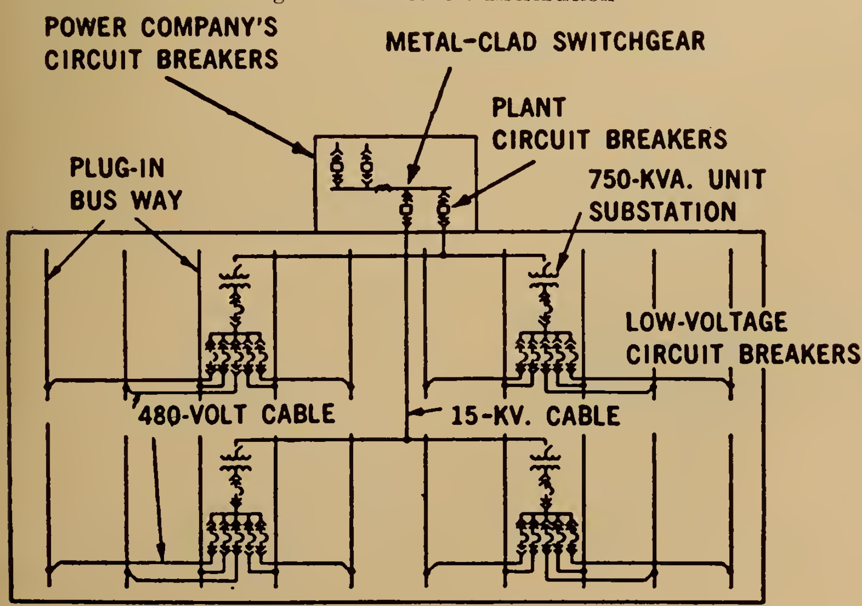


Fig. 3. Load-centre distribution

Utilization Voltage

The final phase of the plant electrical system is utilization. Most of the plant electrical equipment is rated 575 v. and less. In the United States the most common utilization voltage is 440 but the trend is toward 480/277 v. This trend permits the use of electrical equipment originally designed for 440 v. and permits the combination of fluorescent lighting circuits with power circuits. Equipment having a nominal voltage of 440 has a safety margin of greater than 10 per cent and therefore will operate quite satisfactorily at 480 v. Many American plants are taking advantage of this safety margin. Some plants, mainly the textile plant, use 550-v. equipment but the use of 550 v. is fairly well limited to plants already having 550 distribution as 550-v. equipment is not readily available in U.S.A.

In Canada some plants are favouring the American practice of 480/277 v. distribution and combining lighting and power circuits, but there are far more plants favouring the 575-v. distribution.

In recent years there have been many articles advocating the 480/277 v. system combining the power and lighting circuits, yet the number of such installations in Canada have been relatively few. However, it is expected that this trend will continue.

Load-Centre Distribution

There are two common ways of distributing power within a plant. One method is the substation method where the supply voltage is stepped down to utilization value, 575 v. or 230 v., at the incoming point and distributed throughout the plant at this value. The other method, and now becoming the more common method, is the load-centre distribution method. In this system power is distributed at higher voltage (13,800 or 2400/4160 v.) to unit substations located in the centre of the load area and the voltage is stepped down to utilization voltage at the load-centre substation. This latter arrangement enables the higher voltage to be brought nearer to the load thereby shortening the low-voltage feeder runs and permitting a considerable saving in cable cost. Also the power loss will be lower and the voltage drop will be less. In case of expansion, an additional unit substation may be added to the system without increasing the short circuit rating on the existing substations.

With the one-substation system, adding transformer capacity to the substation increases the interrupting rating on all the feeder breakers. Once the interrupting rating of the breakers has been reached additional expansion means another substation requiring a large capital investment.

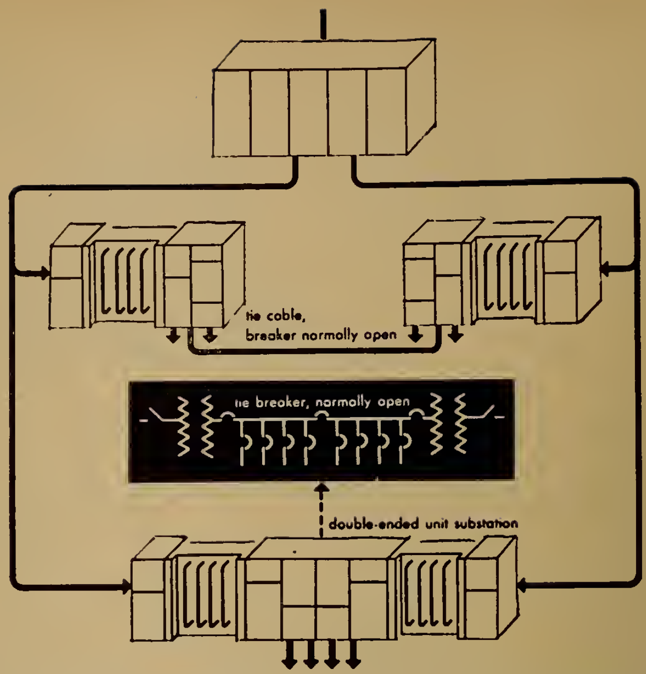


Fig. 4. Unit substations or load centres may be single-ended or double-ended. Secondary selective system.

Also the load-centre system offers greater continuity and flexibility. A substation outage affects only the area served by the particular load-centre substation and not the whole plant. In case of a load-centre outage arrangement can readily be made to have the load picked up by the other substations. (Fig. 1, 2, and 3.)

Choice and Location of Unit Substations

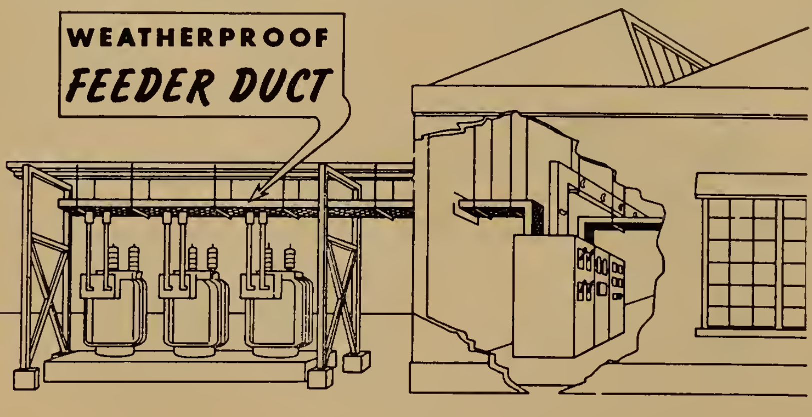
Unit substations or load centres are of two general classes, single-ended and double ended (Fig. 4). For most plants the single ended substation fulfils the requirements. The double ended substation finds use primarily in secondary selective circuits, network arrangements, and in areas where the load is heavily concentrated and the choice is between two smaller substations or one large single unit.

The choice of a substation should be based on the installed cost taking into consideration the cost of cables, bus duct, and the circuit breakers.

Circuit breakers come in five standard interrupting ratings — 15,000 amp., 25,000 amp., 50,000 amp., 75,000 amp., and 100,000 amp. The 15,000 amp. interrupting capacity breaker will conveniently carry a 200 kva. substation, the 25,000 amp. breaker a 500 kva. substation, and a 50,000 amp. breaker a 1,500 kva. station. In most cases it is not considered economical to go to unit substations beyond 1,500 kva. as this requires switchgear of 75,000 or 100,000 amp. interrupting capacity which is very costly. Often it proves more economical to install two smaller substations or a double ended substation rather than a large single unit. For example, two 750 kva. substations or two 1,000 kva. substations may in the overall analysis prove more economical than a single 1,500 kva. or 2,000 kva. substation respectively.

The ideal location of a unit substation is in the centre of the load area. This is usually not possible as the substation would occupy

Fig. 5. Transformers outside building wall, with switchgear inside.



valuable manufacturing space or would interfere with production lines. In many of the newer plants the substations are spotted on the roof and the distribution is overhead by means of bus duct. With this arrangement the substations are out of the way and close to the distribution duct. The substations can be either weatherproofed and exposed, or of indoor construction and located in penthouses. The latter is more popular as indoor equipment is less costly, easier to maintain, and less susceptible to breakdown during rain or blizzards. Roof-mounted substations have dry type transformers and air circuit breakers to permit more economical roof construction and to reduce fire hazard.

Another common arrangement is to place the transformer outdoors adjacent to the building wall and the switchgear just inside the building wall (Fig. 5). This arrangement permits the use of lower cost oil transformers and places the transformers where they do not occupy valuable factory space.

Other probable locations for unit substations may be balconies — often over washrooms, basements, and other low-value areas near the load centres.

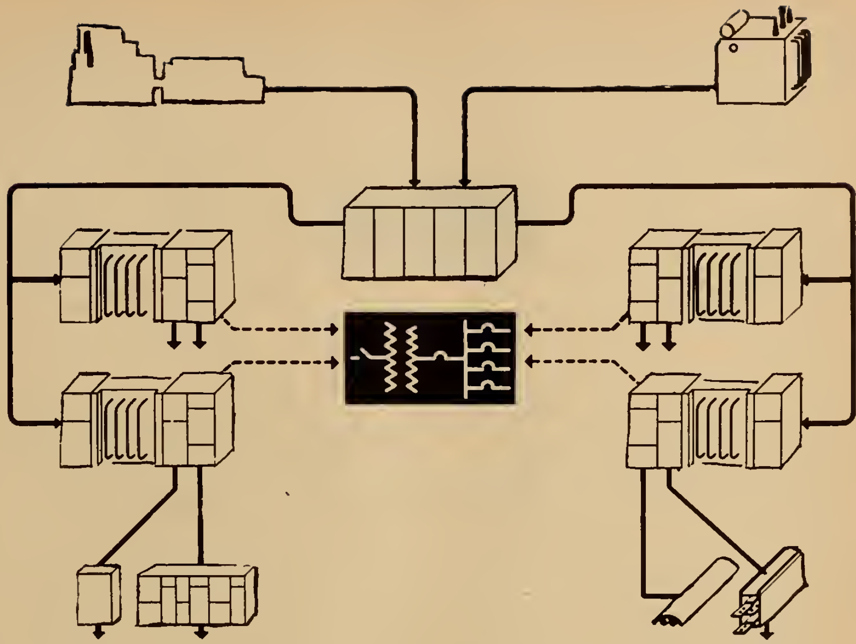


Fig. 6. Simple radial (or "tree") system is simple and low in cost.

Circuit Arrangements

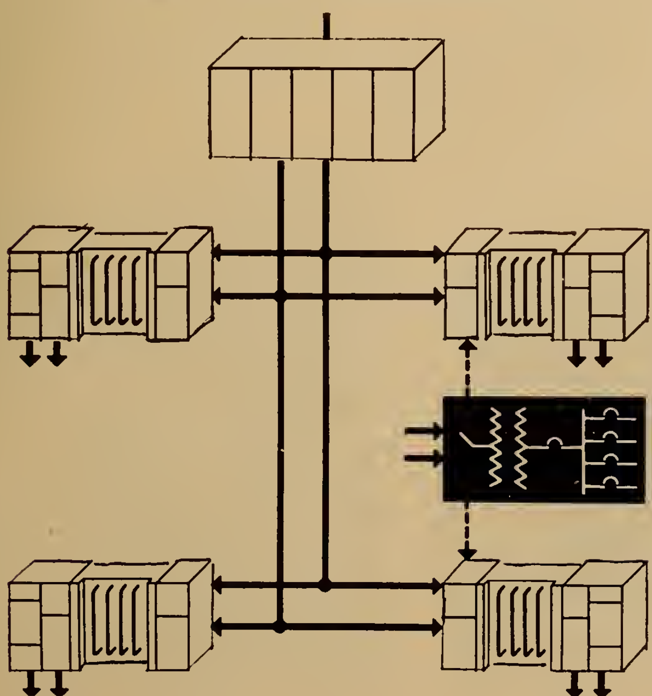
There are approximately 11 basic circuit arrangements and these range from the simple radial system to the more complex selective spot-network systems. Only the three most commonly used will be considered here. These are the simple radial system, the selective radial system, and the secondary network arrangement.

Simple Radial System

The simple radial system, or the "tree" system as it is sometimes referred to (Fig. 6), has gained maximum popularity because of its simplicity, adequate reliability, and low initial cost. The low first-cost and simplicity are derived from the fact that there is no duplication of equipment—one feeder and one transformer serve a given area.

The inherent disadvantages are lack of flexibility and service continuity. Should a fault occur on the primary feeder or transformer, the area serviced by the unit substation will be shut down until such time as service is restored or emergency arrangements can be provided. The down-time will depend upon how long it takes to restore normal service or to provide an emergency supply. Also, every time that maintenance is to be carried out on the supply equipment the load area will have to be completely shut down.

Fig. 7. The selective radial system.



Selective Radial System

The selective radial system (Fig. 7) is essentially a radial system with an alternative source. This alternative source may be either on the primary or the secondary side of the unit substation. If on the primary side of the unit substation transformer the system is called a "primary-selective" system, and if on the secondary side of the unit substation transformer the system is called a "secondary-selective" system. The primary-selective system has two feeders to each substation with either feeder capable of supplying the load, whereas the secondary-selective system may have one of several forms. But, basically, the secondary-selective system (Fig. 4) is made up of two simple radial systems with normally open tie

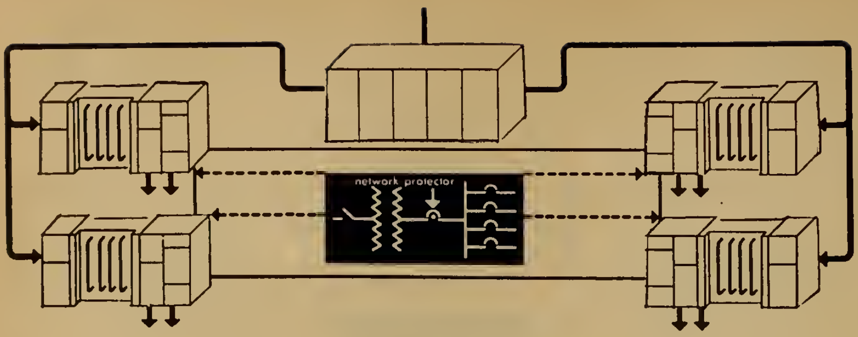


Fig. 8. A secondary network system.

breakers between them. The cost of a selective radial system is usually slightly more than the simple radial system but the selective-radial system is more reliable. In case of a fault or when maintenance is required, power can be obtained in a matter of minutes by switching to the alternative source. However, in switching to the alternative source it should be remembered to drop non-essential load in order to prevent overloading the transformer which will be called upon to service a new area as well as its own load area.

Secondary Network

Network systems are of several varieties but all are designed to provide uninterrupted service. The network systems are the most costly but offer the greatest reliability. They are used in plants where a power outage would prove exceedingly costly by disrupting an assembly line or upsetting a continuous flow process. In a secondary network system (Fig. 8) all load-centre substations have their secondaries tied together in a loop or network and each transformer feeds into the network through a network protector. In a network system all transformers co-operate so that when a load is added anywhere to the network it will be shared collectively by all the transformers. This arrangement permits the removal of any transformer or primary feeder without disrupting service to any load area. As a word of caution, the interrupting rating of the secondary breaker should be closely considered as the transformers are paralleled and the available short circuit current is high.

Bus Duct

Basically, bus duct is a system of bus bars supported on insulators and metal enclosed in standard prefabricated sections. The sections include factory assembled elbows, tees, crosses, plug-in devices, etc., which make it easy and simple to install bus duct in the field.

Bus ducts can be divided into two general types—"feeder duct" and "plug-in duct".

Feeder duct is primarily used to carry heavy currents from one point to another, whereas plug-in duct is used primarily to distribute current to many small loads in the load area. Feeder duct is commonly available in sizes from 800 amp. to 4,000 amp., whereas plug-in duct is commonly available from 250 amp. to 1,000 amp.

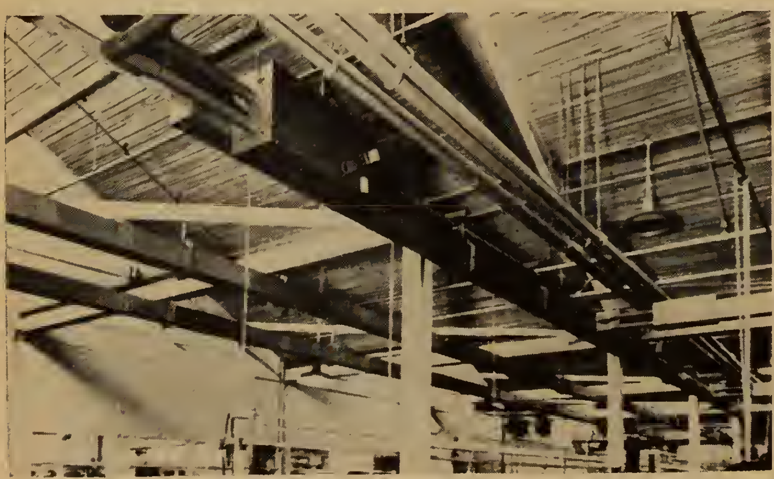
The bus bar arrangement of the feeder duct is considerably different to that of plug-in duct. In feeder duct there are at least two conductors per phase and the phase conductors are paired a-b, b-c, and c-a. The phase conductors are held in close proximity to one another in order to obtain the maximum flux neutralization and so keep the reactance and volt drop low.

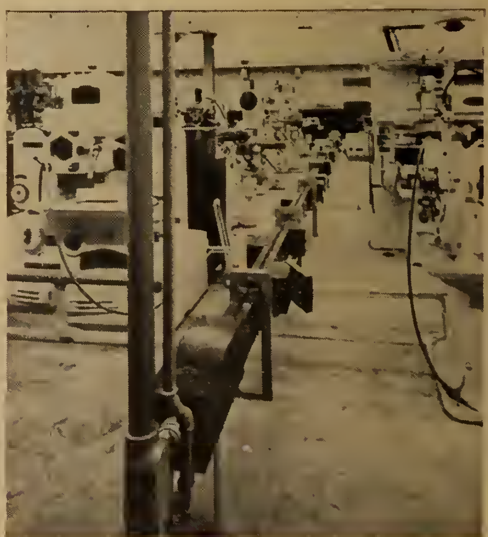
In the "plug-in" duct, the emphasis is not on low reactance, since the currents are relatively light, but on providing readily available power outlets. Usually there is only one bar per phase and the bars are so arranged that a plug-in device may be inserted from either side of the duct enclosure. The plug-in outlets are spaced every 24 inches on either side of the enclosure thus making one power outlet available every 12 inches. The outlets are polarized so as to avoid the danger of plugging in a machine on reversed polarity.

Plug-in duct is particularly suited in machine shop areas where it is desired to frequently add or move machines to meet changing manufacturing methods, as there are no modifications required to the bus duct. Plug-in bus duct has often been termed an "elongated switchboard", and rightly so, since the plug-in devices include such equipment as circuit breakers, switches, fuses, transformers, meters, capacitors, temperature indicators, and ground detectors.

(*Continued on page 780*)

Fig. 9. Plug-in duct installations may be mounted near the ceiling (below) or at a convenient height just above the floor (right).





The Kaplan Turbine in Canada

G. Dugan Johnson, MEM. ASME

Chief Hydraulic Engineer, S. Morgan Smith Company, York, Pa.

The physical arrangement and blade operating mechanism of the Kaplan turbine are described, the history of its development is outlined with emphasis on laboratory research, and its outstanding performance characteristics are discussed briefly together with the attendant problems of cavitation, thrust, and runaway speed. The present use of Kaplan turbines for capacities up to 150,000 h.p. in the United States and heads up to 200 feet in Europe indicates the broad field for potential application in Canada.

To THE BEST OF the author's knowledge, a complete list of the Kaplan automatic adjustable-blade propeller turbine installations in Canada is given in Table I. The installations are in chronological order to indicate the general trend toward larger unit capacities. However, the combined capacity of all the Kaplans in operation is less than one per cent of Canada's total hydro-electric development.

By contrast, Kaplan turbines account for approximately 20 per cent of the installed hydro capacity in the United States. It is the purpose of this paper to describe the physical appearance and operation of the Kaplan turbine, to outline its development in Canada and the United States, to point out its advantages, and mention some of the problems encountered.

Propeller Turbines

The over-all arrangement and appearance of propeller turbines are quite similar to the usual vertical-shaft Francis units. From the spiral case or flume (Fig. 1), water flows between widely spaced stationary stay vanes to the adjustable guide vanes or wicket gates, which give it a whirling motion as it passes to the runner and also regulate the amount required for varying loads. In a Francis runner, the water is guided by the buckets, usually about 15, the crown and the band or shroud ring into the draught tube. By means of progressively increasing cross-sectional area, the draught tube gradually and efficiently reduces the velocity of the water discharged from the runner and converts a large portion of this residual kinetic energy into effective head by reducing the pressure against which the runner discharges.

The wicket gates, which regulate the amount of water required as the load on the turbine varies, are normally under the control of a constant-speed or tachometric governor in Canadian and United States installations. Utilizing a sensitive set of flyballs or a frequency pickup for the basic impulse, a carefully manufactured mechanism quickly opens the gates by means of servomotors operated by oil under pressure to increase the output of the turbine when the speed starts to drop as a result of an increase in load and closes the gates when the speed starts to increase due to a reduction in load on the unit.

Although they may be installed with either vertical or horizontal main shafts, practically all propeller turbines are vertical-shaft units. They differ from Francis wheels mainly in the location and shape of the runner, the intermediate head cover and discharge ring. A propeller runner has only a few, usually four to eight, wing-like blades attached to a central hub, somewhat similar to a ship propeller, with no peripheral band or shroud ring. The runner is located well below the wicket gates with a large vane-free space immediately above it. Water leaves the gates with the usual whirling motion, forming a vortex in this transition space and being guided to the runner by the intermediate head cover and the bottom ring or upper portion of the discharge ring. It flows through the propeller, essentially parallel to the shaft (axial-flow) confined by the blades, the hub and the lower portion of the discharge ring, into the top of the draught tube.

A Kaplan turbine is a propeller wheel with angularly adjustable blades, the inclination of which can be automatically controlled during operation. Physically, it is exactly like a propeller turbine except for the adjustable feature of the runner blades with the resulting changes required in the main shaft plus the blade control mechanism. The simultaneous adjustment of

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the blades to maintain optimum flow conditions through the runner for any position of the wicket gates results in exceptionally high part-load efficiencies and very flat efficiency-horsepower curves. In order to obtain the highest possible efficiencies under all conditions of load and head, the runner blade control system is interlocked with the wicket gate governing mechanism, so that for every position of the gates the blades automatically assume their optimum position. Load changes actuate the gate mechanism through the governor in the usual way, and the mechanical motion of the gates is simultaneously transmitted to the blade pitch control, causing the proper change in the inclination of the runner blades.

The Kaplan Mechanism

The "standard" method of actuating the runner blades also utilizes oil under pressure automatically controlled by the Kaplan or blade-control valve, which receives its actuating impulse from the governor mechanism and directs the flow of oil accordingly (Fig. 2). An oil supply head, normally mounted on top of the generator, receives the oil from the blade-control valve and properly directs its flow to and from the two concentric revolving pipes which lead down through the hollow generator shaft to the blade-actuating servomotor. The piston of this servomotor is connected to the upper end of an operating rod which moves up and down within the hollow turbine shaft and revolves with it. This rod extends down into the runner hub and its lower end is fitted with a cross-head which utilizes the up and down motion of the servomotor piston to change the inclination of the blades by means of a link and lever connection to each blade trunnion.

Complete and continuous lubrication of the various moving parts in the runner hub is accomplished by filling it with high quality oil through an opening in the hollow main shaft, conveniently located as high as possible in order to maintain some positive oil pressure inside the hub at all times. Each blade trunnion is equipped with a double seal where it passes through the runner hub to minimize the escape of oil and entrance of water. In spite of these seals, considerable leakage of water into the hub has been experienced but without detrimental effects, probably because of the formation of an emulsion by the water and the oil with its rust and oxidation inhibitors. Nevertheless, some of the larger units have been equipped with automatically-recharged air pressure tanks to maintain definite pressures inside the hubs.

The shape of the cam, which is the adjustable unit in the connection between the gate governing mechanism and the blade-control valve, depends upon the variable hydraulic conditions of each job. It is designed to obtain the maximum possible efficiency at each gate opening for any given head range, but it must be adjusted manually if the prevailing head changes appreciably. Since many of the smaller installations are not entirely homologous to the "standard" laboratory test models used for the original cam designs, it is advisable to check each cam in the field and revise if necessary, in order to obtain the absolute maximum in efficiency and smoothness of operation. A field "index" test[1] is an inexpensive method of determining the shape of the efficiency-horsepower curve and establishing the correct relationship between the blades and gates without the difficulty and expense of actually measuring the water flow rates.

The Kaplan Development

The idea of the axial-flow turbine was evidenced as early as 1865 by many patents on wheels of this type equipped with adjustable wicket or cylinder gates. Moreover, in 1867 a United States patent was issued to O. W. Ludlow for his design of an inward-flow turbine, having adjustable wicket gate type runner buckets, the wheel case being equipped only with stationary guide vanes. However, there is no evidence that the advantages of simultaneous adjustment of the runner vanes and wicket gates were realized until many years later.

Credit for the simultaneous independent development of the modern high speed fixed-blade propeller runner goes to Forrest Nagler, of the Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin, in the United States, and to Dr. Viktor Kaplan, of Brunn, Czechoslovakia, in Europe. Nagler designed his runner in 1913 and the first installation went into operation about 1917. Kaplan may have been no earlier with his fixed-blade design, but during his laboratory tests in 1913 he discovered the marked advantages obtainable by simultaneous adjust-

Table I — List of Kaplan Turbine Installations in Canada

Company or Government Agency	Prov.	Name of Project	Date of Operation	No. of Units	Turbine Manufacturer*	Rated HP per Unit	Speed RPM	Rated Head Feet	Head Range Feet	Specific Speed at Rating
Nova Scotia Pr. Comm.	N.S.	Tusket Falls	1930	3	MSC	1,050	225	20	18–27	172.4
Mattawa El. Lt. & Pr. Co.	Ont.	....	1938	1	MSC	830	257	22	18–22	155.4
Dryden Paper Company	Ont.	McKenzie Falls	1939	1	MSC	1,485	240	26	17–26	157.6
H-E Pr. Comm. of Ont.	Ont.	Ragged Rapids	1939	2	MSC	5,200	200	38	38–40	152.9
Nova Scotia Pr. Comm.	N.S.	Cowie Falls	1939	2	MSC	5,100	200	43	40–43	129.7
Town of Bridgewater	N.S.	....	1941	1	MSC	600	450	30	30	157.0
H-E Pr. Comm. of Ont.	Ont.	Ear Falls	1941–8	2	MSC	7,500	150	36	28–44	147.3
Town of Jonquiere	Que.	....	1949	1	MSC	4,030	257	47	47	132.6
Nova Scotia Pr. Comm.	N.S.	Deep Brook	1950	2	MSC	6,400	200	46	46	133.5
Orillia W, L & P Comm.	Ont.	....	1950	1	MSC	3,770	257	42	42	147.6
Great Lakes Pr. Co.	Ont.	Scott Falls	1952	2	MSC	10,000	225	70	59–75	111.1
N.B. El. Power Comm.	N.B.	Tobique Narrows	1953	2	MSC	13,500	225	75	60–75	118.5
Great Lakes Pr. Co.	Ont.	McPhail Falls	1954	2	MSC	7,500	200	48	44–50	137.1
Calgary Power Company	Alta.	Bear's Paw	1955	1	KMW	21,600	128.6	48	34–56	149.7
Nova Scotia Pr. Comm.	N.S.	Lower Gt. Brook	1955	2	MSC	3,120	128.6	22	22	150.7
N.B. El. Power Comm.	N.B.	Beechwood	?	2	DEW	45,000	109.1	57	20–61	147.8
H-E Pr. Comm. of Ont.	Ont.	Sir Adam Beck	?	6	EEC	45,500	92.3	83	40–87	78.6

*DEW—Dominion Engineering Works Ltd.
EEC—English Electric Company of Canada, Ltd.
KMW—Karlstads Mekaniska Werkstad (Sweden).
MSC—S. Morgan Smith, Canada, Ltd.

ment of the runner blades and wicket gates. No practical use was made of this discovery during the European war, but in 1919 the J. M. Voith Company of Heidenheim, Germany, began building Kaplan turbines under an exclusive licensing arrangement.

In 1927 the author's company acquired from Dr. Kaplan and the Voith Company exclusive rights for the United States, and in 1928 for Canada, to manufacture adjustable-blade turbines under the Kaplan patents, which provide for automatic simultaneous controlled adjustment of the runner blades and wicket gates while the unit is in operation.

The first fully automatic Kaplan adjustable-blade turbine in the United States was installed in the Lake Walk Plant of the Central Power and Light Company of San Antonio, Texas. This unit, containing a 70 inch four-bladed runner rated to deliver 1900 h.p. at 277 r.p.m. under a head of 33 feet, went into operation in 1929. As may be seen in Table I, the first fully automatic Kaplan turbines in Canada were installed in 1930 at the Tusket Falls Plant of the Nova Scotia Power Commission. Each of the three units contains a 72-inch four-bladed runner rated to deliver 1050 h.p. at 225 r.p.m. under a head of 20 feet. These first North American Kaplan wheels have been giving satisfactory service for over 25 years, with only routine maintenance.

The first large project in North America to be equipped with fully automatic Kaplan turbines was built on the Susquehanna River at Safe Harbor, Pennsylvania, in 1932. The original installation consisted of six units, each of which contains a 220-inch five-bladed runner rated to deliver 42,000 h.p. at 100 r.p.m. for 25 cycles/sec. current, or 109.1 r.p.m. for 60 cycles, under a head of 55 feet. Because of the magnitude of this development at that time, three units only were built by the author's company. The remaining three were built by the Baldwin-Southwark Corporation in Philadelphia, Pennsylvania, who had obtained a United States sublicense from the author's company in 1931, as had the Allis-Chalmers Manufacturing Company.

The highest head under which large Kaplan turbines have been installed in this hemisphere is 105 feet at the Rincon del Bonete Project on the Rio Negro in Uruguay. The 190-inch six-bladed runners of this installation are rated to deliver 40,000 h.p. at 125 r.p.m. from the design head of 69 feet up to the maximum of 105 feet, and the first unit went into operation in 1945. However, two small Kaplan wheels rated 12,800 h.p., 300 r.p.m., 116 feet head with 90-inch eight-bladed runners have recently been installed at El Oviachic plant in Mexico with a maximum head of 156 feet.

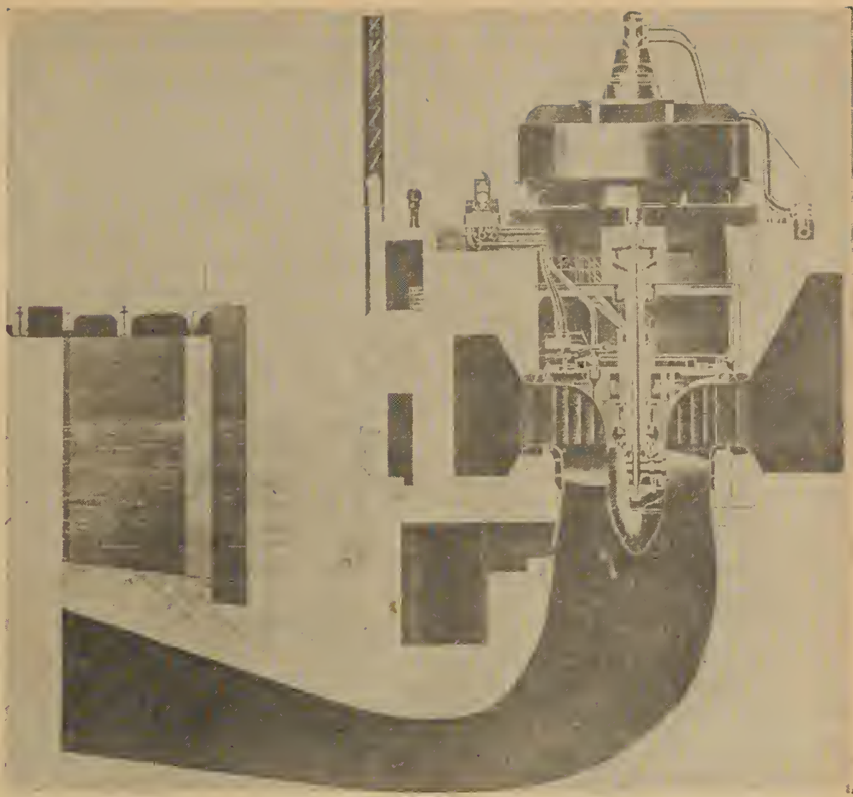


Fig. 1. Sectional elevation of Safe Harbor Kaplan turbine and generator.

The highest head Kaplan turbines operating in Canada are the two 104-inch five-bladed 13,500 h.p., 225 r.p.m., 75-feet head units in the Tobique Narrows Plant of the New Brunswick Electric Power Commission. The highest powered Kaplan turbine in Canada is the 21,600 h.p., 128.6 r.p.m., 48-feet head unit at the Bear's Paw Development of the Calgary Power Company in Alberta. It will shortly be eclipsed in capacity by the two 45,000 h.p., 109.1 r.p.m., 57-feet head Kaplans now under construction for the Beechwood Development of the New Brunswick Electric Power Commission.

Also worthy of note will be the six diagonal-flow adjustable-blade pump-turbines of the Sir Adam Beck Niagara No. 2 project, rated to develop 45,500 h.p. at 92.3 r.p.m. when operating as turbines under 83 feet head. Two 138-inch diameter axial-flow pump-turbines were furnished to the Canadian and General Finance Company of Toronto in 1938 and 1946 for installation in the Traicao plant in Brazil.

The highest capacity Kaplan units in the world were built for the U.S. Army Corps of Engineers' McNary project on the Columbia River between Washington and Oregon, where twelve 280-inch six-bladed units rated 111,300 h.p. at 85.7 r.p.m. under 80 feet head are presently in operation. A real record for capacity was established during the field tests of unit number two in 1954, which actually developed 138,000 h.p. (100,000 kw.) under an effective head of 89 feet[2]. The rated capacity of these turbines will be exceeded by the fourteen 123,800 h.p., 85.7 r.p.m., 81-feet head units now being installed for the Dalles project of the U.S. Army Corps of Engineers on the Columbia River just above Bonneville Dam, where ten 74,000 h.p., 75 r.p.m., 60-feet head Kaplan turbines also held the world record at one time for unit and plant capacity. However, another new record for unit capacity will be set when the three 143,000 h.p., 90 r.p.m., 89-feet head Kaplan turbines recently ordered from the author's company go into operation at the Ice Harbor plant of the U.S. Army Corps of Engineers on the Snake River in Washington.

No account of the development and principal features of the Kaplan turbine would be complete without some mention of the late R. V. Terry's brilliant alternative to the Kaplan patents with his automatic adjustable-blade propeller[3]. In 1928, shortly after the author's company had acquired exclusive rights to use the Kaplan patents in North America, Terry began studies and tests to develop an adjustable-blade propeller runner, so arranged that the blades would automatically adjust themselves to the optimum efficiency position for any combination of flow and head. By 1931, Terry's experiments had progressed to the point where he was convinced that his company could build runners with the blades so pivoted with respect to their centres of pressure that they would automatically follow the movements of the wicket gates and maintain the most efficient relationship for any load.

Apparently, this ingenious arrangement functioned quite satisfactorily in a number of installations, but it has never been accepted by the industry as a satisfactory substitute for the Kaplan with its positive control of the blade positions at all times. Moreover, within the last few years the company with which Mr. Terry was associated has begun to manufacture adjustable-blade turbines of the "true" Kaplan type.

Advantages of the Kaplan Turbine

The specific speed (N_s) of any hydraulic turbine may be defined as the best efficiency speed (in r.p.m.) for a geometrically homologous unit capable of developing one horsepower (h.p.) under a head (H) of one foot. It is calculated by the formula,

$$N_s = \frac{\text{r.p.m.}\sqrt{\text{h.p.}}}{H^{5/4}} \quad \ldots\ldots(1)$$

Since it involves speed, output and head, specific speed is really an index of the class to which any particular turbine belongs. In selecting the units for any installation, it is more economical to obtain the required unit output at the highest practicable speed, which permits the use of physically smaller turbines and generators with resulting savings in equipment cost and powerhouse construction.

However, the most suitable number, size and type of units for a given development depend upon the available supply of water, its distribution throughout the year and/or the amount of storage available, as well as the characteristics of the connected load. Within reasonable limits, larger machines favour lower capital and maintenance costs but single-unit plants may not provide sufficient guarantee of continuous power supply or satisfactory part-load efficiencies. For a plant with a variable load, a number of small Francis or propeller wheels would be required to obtain good average operating efficiencies, which could justify the increased costs. In this connection, due consideration must be given to the well-known fact that the average part-load efficiencies of these types decrease as the specific speeds increase.

Two of the greatest assets of the Kaplan turbine are its very high specific speed and its high efficiencies over an extremely wide load range. Because of the resulting high average operating efficiencies the use of Kaplan runners instead of Francis or propeller wheels permits a considerable reduction in the number of units in any particular powerhouse without any reduction in the total annual power output from the available supply of water.

The "index" tests of the McNary turbines (Fig. 3) illustrate

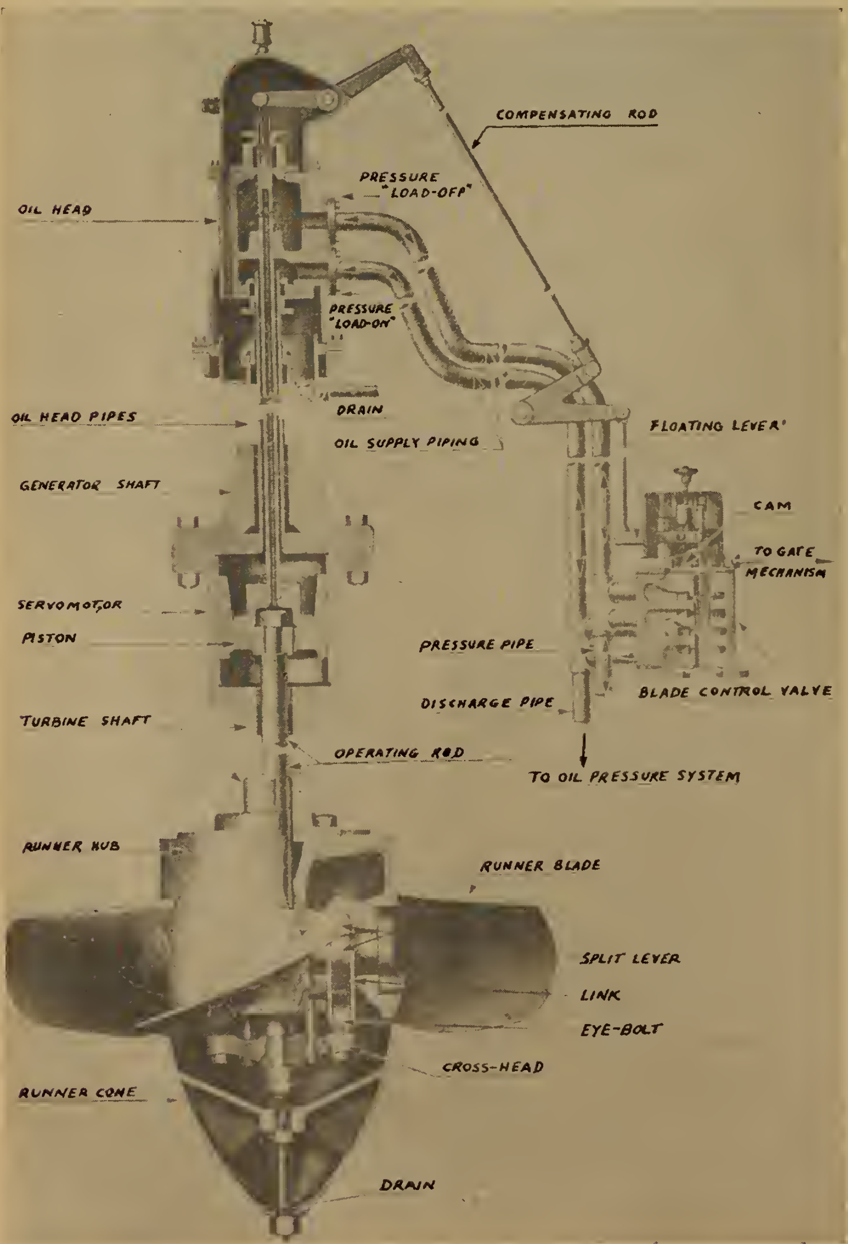


Fig. 2. Schematic sectional arrangement of Kaplan mechanism.

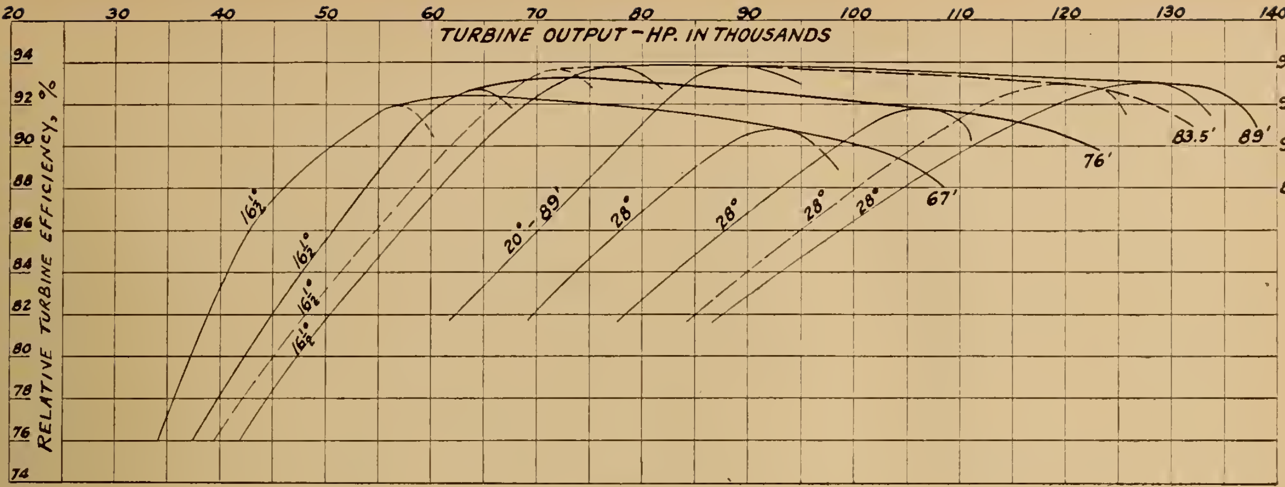


Fig. 3. Field index test curves for McNary Kaplan turbines.

the extremely flat efficiency-horsepower curves achieved by modern Kaplan turbines. The individual blade pitch curves indicate how narrow the load range is for satisfactory efficiencies with high specific speed propellers, which can therefore be used economically only where load and head variations are small or of short duration.

Another very valuable asset of the Kaplan turbine is its ability to provide high power output under heads considerably below the normal or rated head. The capacities of Francis and propeller wheels are selected for the rated heads, and their outputs under low-head high-tailwater conditions are limited. However, by increasing the pitch of the Kaplan runner blades well beyond that required for the normal rating, substantial "extra" full gate capacity can be realized under low head conditions without adversely affecting the high operating efficiencies under normal heads.

Because of its flat efficiency-horsepower characteristics and its ability to supply "extra" capacity at reduced heads, a one- or two-unit Kaplan plant, like almost all of the Canadian installations, is especially well suited to run-of-river developments with wide variations of flow and head and little or no storage. At the higher heads and lower rates of flow, the high part-load efficiencies of the Kaplans result in much greater power outputs than could be realized with the same number of Francis or propeller turbines. At the lower heads and high rates of flow, beyond the full gate capacity of the plant in most cases where efficiency has no real significance, the "full-tilt" overload capacity of the Kaplans results in further marked increases in output.

Obviously, the substitution of an equal number of Kaplans for Francis or propeller wheels of the same rating results in higher turbine costs. However, the price of the turbine equipment is only a small percentage of the complete development cost, and evaluation of the increase in yearly output, as well as in firm and peaking capacity, will usually indicate a handsome return on the increased investment.

The actual advantages of Kaplan turbines over Francis and propeller units are even greater than calculated because of the instantaneous automatic reaction of the Kaplan control to changing loads, whereas in the operation of plants with Francis or propeller wheels the attendants must distribute the loads manually, and they cannot follow the changes as closely. Even in a plant with a large number of Francis or propeller turbines operating under a moderate range of head so that the units could be operated continuously at or near peak efficiency, the total annual output can usually be increased sufficiently to more than pay for the increased cost of one or two Kaplans to take care of the small load variations automatically and at maximum efficiency.

An all-Kaplan installation is economically justified, even for a plant with a large number of units when the head range is considerable, as in a run-of-river plant with negligible storage or in a plant with considerable storage but with a sizable drawdown. In such cases, evaluation would emphasize the high average efficiency of the Kaplans leading to increased annual outputs, as well as operating flexibility and peaking capacity, especially at low heads.

The Kaplan turbine plant lends itself to automatic and remote control just as well as any other type of hydro plant. The only additional complication is the simple adjustment of the cams in the blade-control valves if the head changes appreciably; remote operation of this adjustment is quite simple, and even completely automatic control is feasible but has not yet been required in Canada or the United States.

Modernization of Existing Plants

In addition to their value for the development of new low-head power sites, the performance characteristics of the Kaplan turbine make it an obvious choice for the replacement of obsolete equipment. The increased annual power output that can be realized with Kaplan units more than pays for the changeover, even though the existing wheels may still be in fair operating condition. If such is the case, they may be retained for operation only during periods of high water flow when efficiency is not important, provided that this additional low-head capacity has sufficient value to justify the plant extension for the Kaplan installation.

Particularly spectacular are the results that have been realized by replacing groups of multiple-runner horizontal Francis units by one or two vertical Kaplans. In the early years of this century, many low-head installations consisted of two-, four- and six-runner horizontal units, each pair of wheels discharging into a common draught chest. The main reasons for such arrangements were to increase the over-all unit specific speed with resulting savings in electrical equipment and to minimize the hydraulic thrust by balancing each pair of runners.

This multiple-runner scheme was also applied to vertical-shaft machines[4] for the same reasons, although three runners on a single shaft seems to have been the limit. The combination of a vertical-shaft Kaplan turbine and a high-speed generator with a reliable thrust bearing has been the answer for many worthwhile plant improvements.

Hydraulic Laboratory Investigations

The role of carefully conducted laboratory tests in the inception and development of the Kaplan turbine has already been mentioned. The fundamentals of turbine theory, such as the Eulerian theorem (1754), are important in turbine design but in actual practice no important installation is consummated without confirming the calculations by complete laboratory tests on a homologous model. A sound theoretical basis of design cannot be dispensed with, but the complexity of flow conditions in any hydraulic turbine renders model testing necessary to assure the successful performance of the prototype installation. Current practice is to model the complete inlet and discharge water passages as well as the turbine proper.

In addition to determining performance characteristics under conservative operating conditions, critical cavitation data are also determined in all modern hydraulic turbine laboratories. Cavitation begins when the absolute pressure at any point on the back (low pressure side) of the runner blades drops below the vapour pressure of the water, resulting in the formation of numerous tiny bubbles filled with water vapour. These bubbles are carried quickly to areas of higher pressure where they collapse suddenly, producing shock pressure concentrations of terrific intensity which eventually destroy the metal surface and cause pitting.

The Thoma cavitation index, sigma (σ), may be defined as the ratio of the barometric head (H_b) minus the static suction head (H_s) at any point, usually taken for convenience as the elevation of the blade pivot axes for Kaplan runners, to the total operating head (H) on the turbine:

$$\sigma = \frac{H_b - H_s}{H} \quad \text{........(2)}$$

To determine the minimum allowable or critical sigma in the laboratory, the model is usually tested with a constant blade angle and gate opening at a constant speed under a constant head while the elevations of headwater and tailwater are lowered step by step for successive runs until a definite break or change in performance is observed. In practice, a reasonable margin of safety above this break determines the operating limit for the corresponding head and load on the prototype. When the plant sigma drops below the critical sigma for any head and load, pitting, vibration and loss of output will result, but the suction head should not be reduced unnecessarily since that would result in excessive excavation costs.

In addition to its effect on efficiency and output, cavitation also has considerable influence on the runaway speed data for Kaplan turbines. Runaway speed may be defined as the speed which the prototype turbine would attain if the generator were completely disconnected from its load and the governor failed to close the wicket gates. Prototype values for all types of turbines are calculated from the results of no-load tests on homologous models under various head conditions. Kaplan overspeeds not only depend upon wicket gate openings and runner blade angles but also vary with sigma[5].

Another important characteristic of prototype hydraulic turbines that must be determined from laboratory tests is the downward hydraulic thrust load to be supported by the generator thrust bearing. For Kaplan runners this thrust, like the overspeeds, depends upon the various runner blade angles and wicket gate openings.

Many turbine development programs include model tests without spiral or semi-spiral cases although they are required on all contract tests. However, since they are concerned with accelerating flow, losses are almost negligible in any reasonably well-designed case and corrections to the so-called open-flume tests are minor.

But the same considerations do not apply to draught tubes, except possibly for very low specific speed Francis units. Many Kaplan and propeller units are installed with the runners below tailwater level, under positive back-pressure or negative suction head, in order to exploit relatively high capacities and/or effective heads. Under such conditions, the over-all dimensions of the draught tube are of prime importance. Depth of excavation is kept to a reasonable minimum by the use of a quarter-turn elbow formed in the concrete substructure of the powerhouse. Many years of designing and testing model tubes of this type have resulted in a number of highly efficient shapes, which compare so favourably with the more expensive and complicated White hydraucone and Moody spreading tube[6] that elbows are almost universally specified for modern installations.

Because of the large rates of flow and high runner discharge velocities associated with Kaplan and propeller turbines under relatively low operating heads, an efficient draught tube capable of regaining most of the kinetic energy is especially important. Because the flow is decelerating, losses tend to be considerable and to be critically affected by the various runner discharge velocity and whirl patterns. Consequently, Kaplan and propeller models must be tested with draught tubes essentially homologous to the prototype installations in order to approximate closely to expected field performance characteristics.

Cavitation Laboratories

Dr. Kaplan's original research began about 1910 when a hydraulic turbine laboratory was established at the Technical University of Brunn, Czechoslovakia, but his open-flume testing program did not include cavitation tests. The first turbine cavitation laboratory was built in 1924 by Dr. D. Thoma as an addition to the laboratory of the Hydraulic Institute of the Technical University at Munich, Germany. Dr. Thoma's early work was concentrated on Kaplan and propeller turbine models, and it was here that he developed the universally accepted index, sigma, which permits correlation of cavitation data on models and prototypes.

The first hydraulic turbine cavitation laboratory in North Amer-

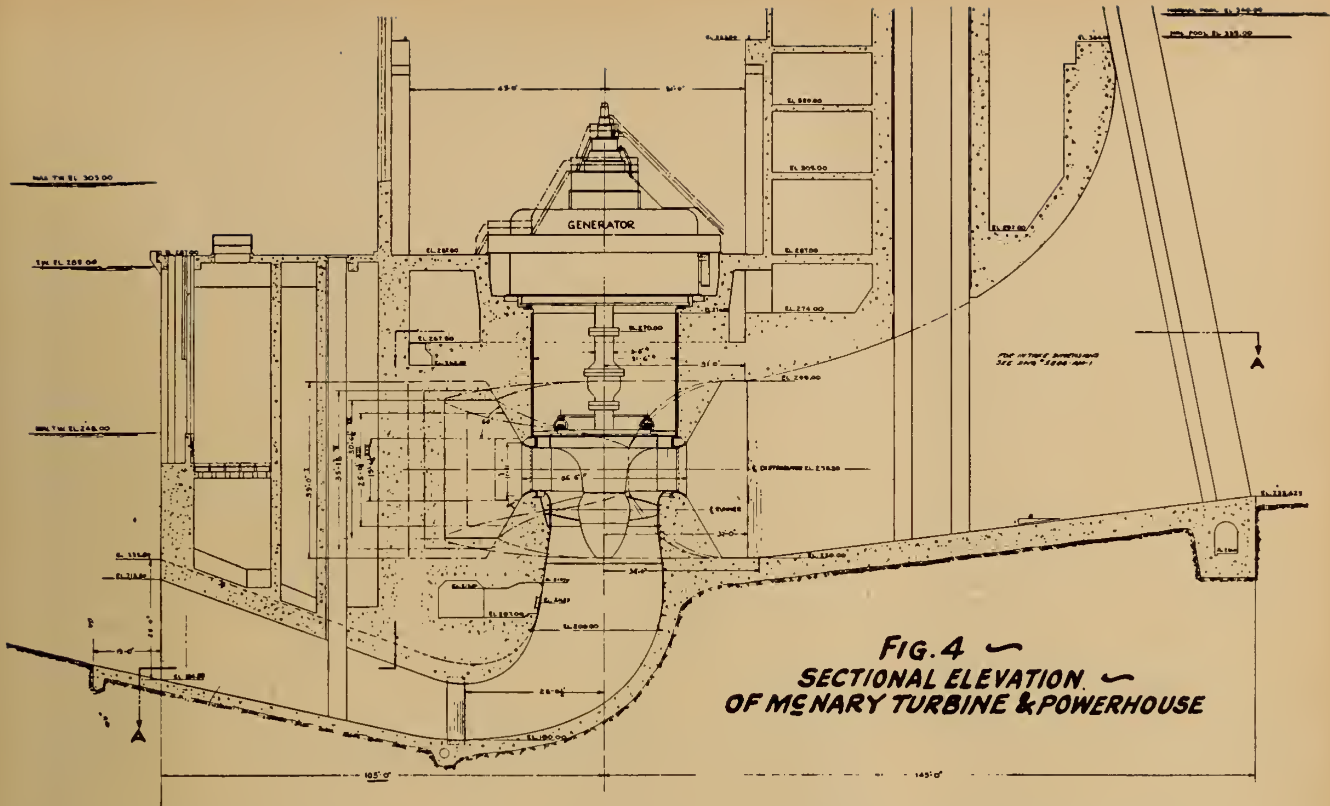


Fig. 4. Sectional elevation of McNary turbine and powerhouse.

ica was established about 1925 at the Shawinigan Falls plant of the Shawinigan Water and Power Company of Montreal, where propeller turbine models with sixteen-inch diameter runners were tested under gravity heads up to 60 feet.

The first Kaplan turbine cavitation laboratory in the United States went into operation in 1930 at the Holtwood plant of the Pennsylvania Water & Power Company. It was built to assist with the design of the Safe Harbor plant of the same company, where six 42,000 h.p. Kaplans were installed in 1932. The author's company participated in the establishment of this laboratory and, because of its proximity to the main manufacturing plant only 25 miles away, continued to utilize it for Kaplan model cavitation tests until 1940. Sixteen-inch diameter runners were tested with homologous semi-spiral cases and elbow draught tubes under gravity heads of 50 to 60 feet. The same models were also tested for comparison of performance under high sigma values in the open-flume test stand at the hydraulic turbine laboratory of the author's company which had been built in 1921.

The company built its first turbine cavitation stand in 1941 to test models for the high head (105 feet) development on the Rio Negro in Uruguay. Test heads of 30 to 50 feet were provided by pumping, and ten-inch diameter runners were tested with complete spiral cases and elbow draught tubes. In 1954, a new high head turbine test stand was installed in an extension to the original laboratory building. Utilizing centrifugal pumps to create heads up to 325 feet, Francis turbine models can be tested conveniently at very low values of sigma and ten-or twelve-inch Kaplan and propeller models can be tested under prototype head conditions with homologous spiral or semi-spiral cases and elbow draught tubes.

The only existing turbine cavitation laboratory in Canada was built in 1951 by the Dominion Engineering Works, in Montreal.[7] Sixteen-inch diameter runners are tested under heads of 25 to 80 feet provided by adjustable-blade propeller pumps arranged for two- or three-stage operation.

Contract Model Tests and Field Tests

Most large prototype Kaplan and propeller turbines operate under heads of less than 100 feet and are installed with the powerhouse forming part of the dam structure (Fig. 4). Under these conditions, the circular penstock and complete spiral case of the usual Francis turbine plant are replaced by a relatively short intake and semi-spiral case. With this type of plant, it is practically impossible to conduct a reasonably accurate field acceptance test in accordance with any approved test code.[8, 9] The effective head and the horsepower output present no special problems, but accurate measurement of the large quantities of water involved is not economically feasible.

Consequently, current practice is to specify accurately conducted laboratory tests on homologous models including inlet and discharge water passages, and the contract guarantees are based on model performance. The various turbine manufacturers make their guarantees on the basis of previous tests on similar models, but they must be confirmed on a completely homologous model before the prototype structure and turbine-generator equipment are actually processed. The major items to be settled are the draught tube and spiral case details and dimensions, the elevation of the distributor centre-line, the actual turbine design, including speed and size required to achieve the specified outputs and efficiencies under the various heads and flow rates without exceeding the critical cavitation limits, as well as the maximum runaway speed and hydraulic thrust for which the generator must be designed.

After the turbines have been installed and placed in satisfactory operation, "index" tests are conducted in accordance with the ASME test code (1953) to determine the shapes of the efficiency-horsepower curves, to confirm the guaranteed output capacities and cavitation limits under various head and tailwater conditions and to determine whether the blade-gate cams need to be modified from the shapes based on the model tests (Fig. 5). In order to draw actual prototype efficiency-horsepower curves (Fig. 3), the maximum model test efficiency is "stepped-up" to prototype size by the Moody formula[10] in Canada and the United States, and by the Ackeret formula in Europe.[11]

Only in very rare cases are Kaplan or propeller turbines installed under sufficiently "ideal" test code conditions to permit fairly accurate efficiency determinations to be made. One such case was the 81-inch manually adjustable five-bladed propeller of the Bonneville service unit, which is essentially a large model of the 280-inch main unit Kaplan turbines. It was tested by the Allen salt-velocity method in 1938 with excellent results (Fig. 6). It is hoped that more units will be installed under favourable test conditions so that they can be accurately field tested at reasonable expense for comparison with laboratory tests on homologous models.

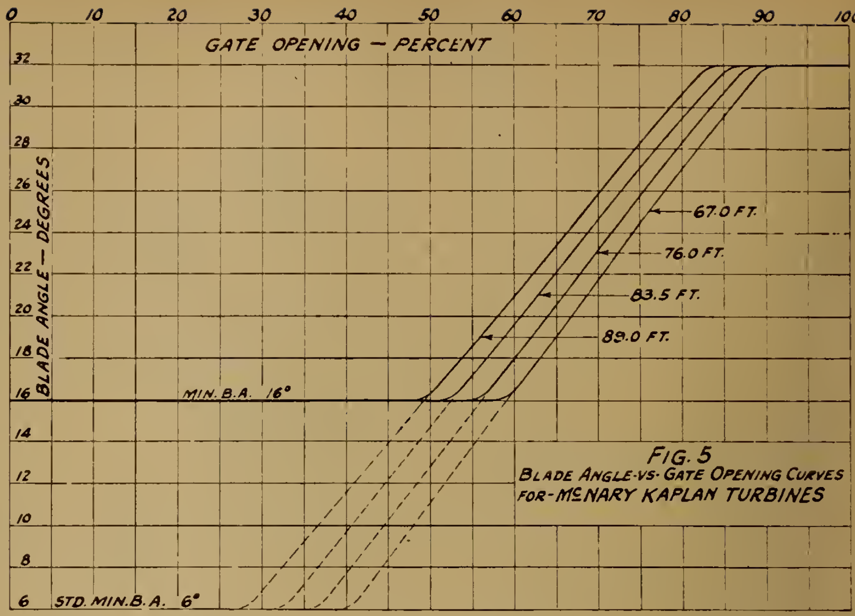


Fig. 5. Blade angle v. gate opening curves for McNary turbines.

Control of Cavitation Pitting

An interesting feature of the two 5200 h.p. units in the Ragged Rapids plant of the Hydro-Electric Power Commission of Ontario is that for the 104-inch five-bladed runners the blade surfaces were accurately machine finished to design templates. Although this is still rather general practice in Europe very few runners in North America have been so manufactured, since operating results have failed to justify the additional expense as compared to blades merely hand finished to approximate templates by chipping and grinding. This expensive machining of the water surfaces is not required for hydraulic efficiency but was considered to be of value in minimizing the inception of local cavitation damage to the mild steel blade castings.

After sufficient field experience had been obtained to establish the approximate locations of areas likely to experience cavitation pitting, even while operating above the critical sigma limits, such damage was minimized on larger wheels by precoating these areas (Fig. 7) with a thickness of one-eighth to one-quarter inch of stainless steel, which is highly resistant to pitting. This coating may be applied as a weld, deposited either manually or by machine,[12] or it may consist of small stainless steel plates or strips attached by welding. The entire periphery is also protected, preferably by means of solid stainless steel bars welded to the blade.

Because the relatively thin sections of smaller blades make these procedures impractical, the area to be protected is frequently made up of solid stainless steel inserts welded to the basic blade, and very small blades are often made as solid stainless castings. As a matter of fact, the blades of the 110-inch diameter Lower Great Brook runners of the Nova Scotia Power Commission are solid stainless steel castings. Various types of stainless steels and some non-ferrous materials, such as aluminum bronze, are suitable for cavitation prevention, their relative resistance values being the subject of numerous discussions as well as accelerated pitting tests in several laboratories.[13]

One of the greatest advantages of the Kaplan turbine is its ability to provide "extra" output capacity under low head conditions. Reduced heads frequently occur when excess water is available, as in run-of-river plants with negligible storage, and efficiency is then meaningless. The only deterrent to opening the runner blades in order to obtain absolute maximum output is general cavitation, evidenced by rough operation and vibration accompanied by reduced efficiency and eventual pitting. Depending upon the actual setting in any particular case, maximum output may be obtained at a blade pitch somewhat less than wide open because of advanced cavitation. Under these conditions, the attainment of the desired maximum output, regardless of the contract cavitation limit, should be restricted only by vibration and roughness[14]. Unless stainless steel has been used to prevent it, some pitting will occur even at outputs below the cavitation limit and any increase in pitting repair costs due to such overload operation would represent a small fraction of the revenue realized from the additional output.

Runaway Speed

The runaway speeds of propeller turbines tend to be relatively higher than Francis or impulse wheels, and Kaplan units could attain even higher relative values as a result of the blades being adjustable. The maximum runaway speed of a Francis or propeller turbine would occur under the maximum operating head with the wicket gates wide open. For a propeller or Kaplan turbine the maximum runaway speed tends to decrease as the blade pitch is increased, and with full tilt of the blades most Kaplans would not even attain a 100 per cent overspeed. At lower blade inclinations, and especially in the higher portions of their head ranges, even if the "on-cam" relationships with the wicket gates are maintained, most Kaplan wheels could attain overspeeds approaching 125 per cent. But if the "on-cam" relationships are not maintained for any reason, large wicket gate openings with low blade pitches would result in calculated "off-cam" overspeeds of 150 to 200 per cent, the higher values tending to apply where the maximum head is large compared to the design head.

"Standard" hydro-generators are designed without undue difficulty and expense for 100 per cent overspeed (twice normal speed) up to 50,000 kva. and for 85 per cent overspeed above that capacity, either value being satisfactory for normal Francis and impulse turbine installations. For large generators, specified overspeeds approaching 200 per cent would require abnormal and extremely expensive construction to maintain the usual factors of safety. Present practice seems to indicate acceptance of the idea that the generator should be designed for a specified overspeed slightly greater than the calculated maximum "on-cam" value so that there would still be a small margin of safety even if the calculated maximum "off-cam" overspeed should occur. For small and medium sized generators, design for specified maximum "off-cam" overspeeds apparently has presented no unusual difficulties, and that has been the usual practice.

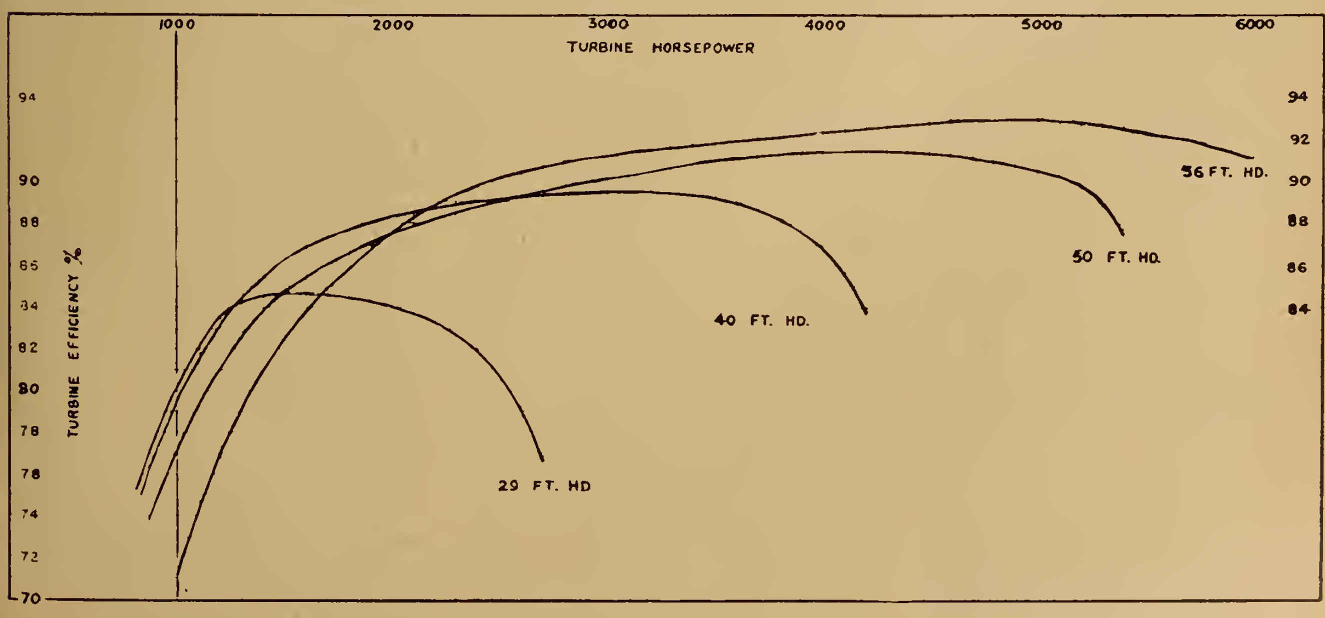
Actually, an accidental "off-cam" runaway has never been reported for a Kaplan unit, and it may be impossible for such an event to occur[5]. In normal designs, loss of governor oil pressure with the control valves "off-centre" or mechanical disconnection from the control system would allow the wicket gates to drift rapidly to a small opening and the runner blades would move rapidly to their maximum pitch position, both of which tend to reduce the overspeeds substantially.

At least two specific measures based on these tendencies have been employed to limit the maximum possible "off-cam" overspeed in actual installations[15]. One is a gate servo-motor stop-nut mechanism which automatically limits the maximum wicket gate opening as the head increases, thereby serving a two-fold purpose. It prevents dangerous overloading of the generator at the higher heads and also reduces the maximum "off-cam" runaway speed by 5 to 10 per cent depending upon the head range. The other is more positive and effective and consists of limiting the minimum blade inclination to approximately normal mid-position, which would reduce the maximum possible "off-cam" runaway by approximately 15 per cent.

This limiting of the minimum blade angle would not be suitable for the turbines in a plant with a small number of units properly sized by consideration of the minimum flow rate and the normal minimum blade position. It actually reduces the effectiveness of the Kaplan principle and should be applied only to installations where the number of units is much larger than would be indicated by low flow considerations. In some of the huge Columbia River installations, for example, the large numbers of units seem to have been determined primarily by the maximum capacity of the available generator thrust bearing designs.

Actually, some scheme to uncouple the blades from the control system when a predetermined overspeed has been attained, thereby permitting them to open and effectively limit the maximum overspeed even in the event of simultaneous loss of governor oil pressure, appears to have more practical possibilities than the addition of a separate set of braking blades as proposed by an English manufacturer.[16] The author's company has already conducted tests at several installations to determine the effectiveness of a bypass around the blade servo-motor piston for limiting the maximum overspeed. These tests indicate that rapidly opening the bypass as the unit speeds up will limit the maximum overspeed to less than 85 per cent. Canadian and United States patent applications were filed several years ago, and a very simple dependable automatic device is

Fig 6a. Field test curves for Bonneville service unit.



available that may be installed on several units now on order.

Hydraulic Thrust

Another turbine characteristic that seriously affects generator design is the downward hydraulic thrust load that must be supported by the generator thrust bearing in addition to the dead weight of the rotating elements of the turbine-generator combination. In the case of Francis turbines, especially for low specific speeds, internal construction details may be arranged to minimize this hydraulic thrust, but for propeller and Kaplan wheels no reductions are possible. Since these axial-flow runners consist only of blades and a relatively small central hub, there are no balancing chambers or areas that can be designed to limit the maximum thrust.

As in the case of overspeed for Kaplan runners, the thrust tends to increase as the blade inclination is decreased, approaching a maximum essentially equal to the weight of a cylindrical column of water of the same diameter as the runner and of a height equal to the head acting on the turbine. The normal maximum hydraulic thrust of a Kaplan turbine amounts to approximately one-half of the total load for which the thrust bearing must be designed. The design of the high capacity thrust bearing required for a large Kaplan unit is also significantly affected by the specified turbine runaway speed. Unfortunately, the same "off-cam" blade-gate relationship that would produce maximum calculated overspeed also corresponds to a continued high hydraulic thrust load as the speed increases, whereas the thrust as well as the runaway speed would be substantially reduced if the "on-cam" relationship could be guaranteed.This indicates another advantage accruing to the blade servomotor bypass devices that may be employed to minimize maximum overspeed values, since the successful design of a maximum capacity thrust bearing depends to a large extent on the specified maximum overspeed and the maximum thrust at that overspeed.

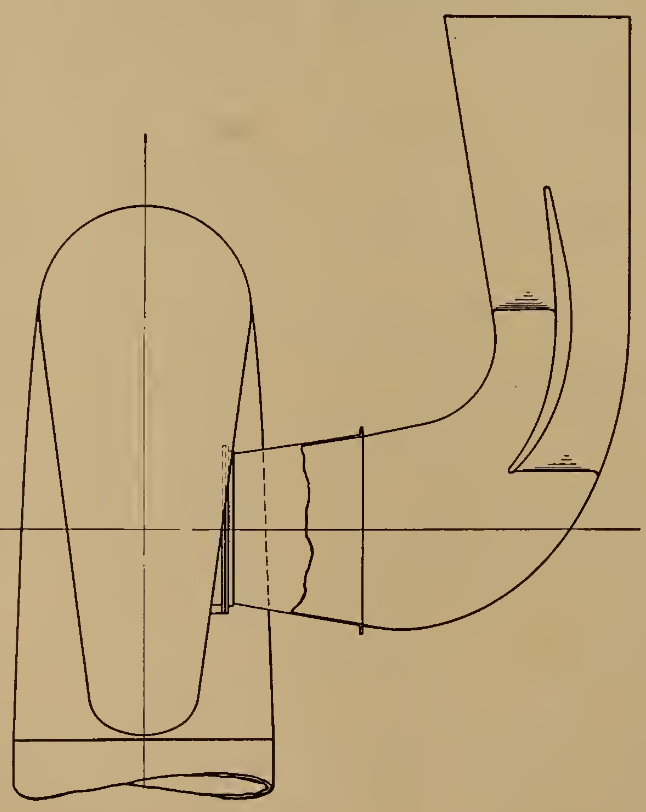
Kaplan Turbines for High Heads

Although the heads under which Kaplan turbines are operating in Canada and the United States are almost all under 100 feet, there are a number of European installations with heads approaching 200 feet and at least one with a head well over 200 feet[11]. There has been a great deal of speculation and discussion regarding the maximum head under which a Kaplan unit can be installed. Actually, there is no definite theoretical limit and the practical limit depends upon evaluation of the advantages in performance against the disadvantages of setting and expensive turbine-generator construction. As always, the detailed conditions at any particular site, as well as individual preferences, will determine whether or not Kaplan wheels are selected.

In general, Kaplans will show to advantage when a substantial variation in head exists. In addition, a well-integrated hydraulic and mechanical turbine design and arrangement is required for optimum performance at minimum cost. The hydraulic designs are improving as more and more field experience is effectively correlated with model research and analysis. Revised blade shapes and the smallest practicable hub diameters will permit higher settings than were previously feasible, but the mechanical problems of space limitations and high stresses require ingenious designs and high strength materials.

One obvious difference in the high head Kaplans will undoubtedly be the use of steel plate spiral casings instead of the very popular concrete semi-spiral casings for heads up to 100 feet.

Fig. 6b. Sketch of setting—Bonneville service unit.



Conclusion

One of the aims of this paper has been to indicate that the economically feasible range of applicability for the Kaplan turbine already extends from unit capacities of a few hundred horsepower up to 150,000 h.p. and from operating heads of 20 feet or less up to 200 feet or more. As it becomes expedient to develop more and more Canadian hydro sites with heads of 200 feet or less, the use of Kaplan turbines should receive serious consideration.

This is particularly desirable for installations with a small number of units or with a large number of units and a considerable range in operating head. Even in the case of an almost constant operating head and a large number of units, a combination of fixed-blade propellers and a few Kaplans should be considered because the automatic adjustment to load changes and the flat efficiency curve simplify plant operation and increase annual output. Similarly, the advantages of a Kaplan extension to an existing multi-unit propeller or Francis development with only limited variations in head should be investigated.

Since these low head projects tend to be more expensive than high head Francis and impulse installations, every means should be employed to reduce costs in their development. The modern trend is toward larger and larger units[17] in all types of prime movers. This indicates over-all savings by the use of a smaller number of larger turbine-generator sets for most developments. The Kaplan turbine permits effective exploitation of available water powers even with single unit installations, although a minimum of two will usually be selected to guarantee uninterrupted service, especially in isolated plants or small interconnected systems.

Optimum results at minimum cost should be realized in these large units, and in smaller ones also, by considering the turbine and generator as basic parts of the same machine rather than as two separate entities both custom-built for each particular project. Some "standardization" of physical sizes and major components, such as thrust bearings, should be feasible and can be expected to result in simplification and improvement of overall designs. However, the European scheme of locating the thrust bearing on the turbine head cover[11] is not considered by the author to have any real advantages over conventional Canadian and United States practice.

Simplification and elimination of non-essential parts in equipment designs should also be extended to powerhouse structures and operating procedures[18]. The increased use of outdoor and semi-outdoor stations as well as of automatic and remote control equipment will reduce construction and operating costs, thereby encouraging the development of otherwise marginal sites.

It is essential to realize that hydro power is not competitive with thermal power but that the two are complementary. Coordination of run-of-river and storage hydro with interconnected thermal plants has become almost a science in itself. Effective integration of the various types is just as beneficial as the installation of substantial additional capacity. The specific roles of the different plants depend upon the character of the various installations as well as upon that of the connected load and will vary in accordance with changes in these conditions. At present, thermal plants usually carry block load at best economy and hydro plants follow load changes and take care of peak requirements.

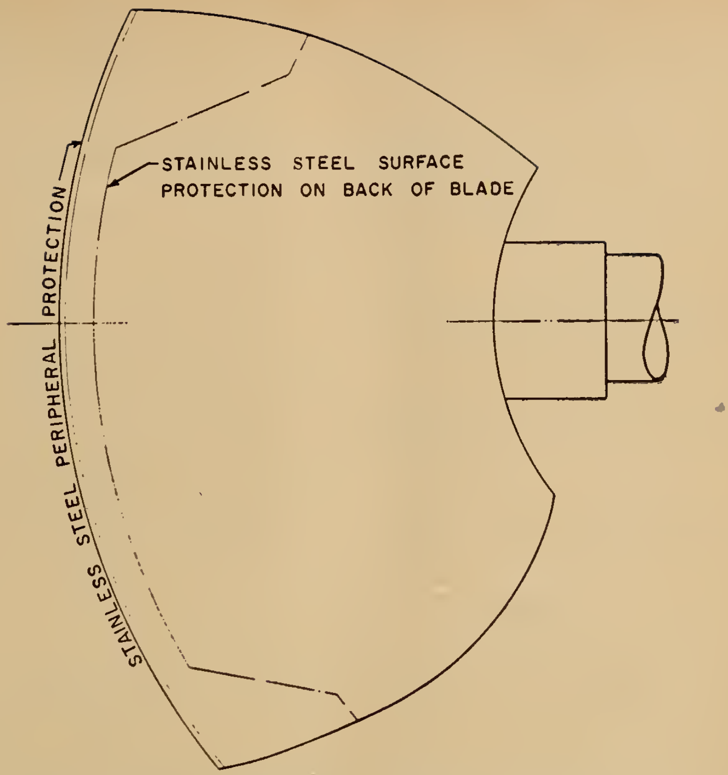


Fig. 7. Cavitation protection on periphery and back of Kaplan turbine blade.

The ability of a hydro-generator unit to be started cold and be fully loaded in several minutes eliminates the need for the expensive "spinning reserve" of an all-steam system and gives a much greater value to the hydro than its actual production or peaking capacity. A hydro unit is also capable of instantly dropping any load up to full load without damage, which adds to its "flexibility" value in a combined system.

The advent of nuclear power plants as system components will probably intensify the use of hydro for regulating to suit changing load requirements and taking care of peak demands. Any hydraulic turbine is flexible and valuable for this type of service, but the Kaplan is obviously the most flexible and therefore the most valuable. Water power is not obsolete, especially in Canada; with free fuel and efficient designs the future potential is almost unlimited, particularly for plants intended for regulating and peaking purposes. For peaking and load regulation over a wide range, the Kaplan turbine is in a class by itself; continued development and improvement of hydraulic and mechanical designs should make it economically attractive in Canada for many years to come.

Acknowledgement

The author wishes to acknowledge the assistance and cooperation of his colleagues at the S. Morgan Smith Company of York, Pennsylvania and at S. Morgan Smith, Canada, Limited of Toronto, Ontario.

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LONDON AIRPORT *(Continued from page 756)*

manual shut-down. The operation of the pumps is reported back over the airport electrical control system to the control engineer when arrangements for manning are immediately made.

Water is delivered from the pumphouse into the airport proper through two 30-inch water mains. The distribution pipework is then graduated throughout the airport to hydrants. In the case of the new permanent buildings in the central area there are also hydrants fixed inside the buildings with standard hoses in readiness.

The permanent maintenance blocks are very comprehensively equipped for fire fighting. In each of the hangar pens a "deluge" system has been installed to give a drenching water supply. The "deluge" system is designed on the basis of zones, each one covering about 50 feet length of the hangar pen, and being provided with an automatic water control valve which is held closed by an air pressure of 80 lb. per square inch. The water pipelines are run at high level beneath the roof and are provided with open drencher heads evenly spaced over the zone. Two methods of fire detection are employed, one being the well-known bulb type which fractures on heating, thereby releasing the air, and the other being an electrical system in which two wires, one bare and the other insulated, traverse the zone, operation being effected by the resultant unbalance in an electrical bridge circuit when the bare wire heats up more rapidly than the insulated wire. This also reduces the air pressure and the water valve opens. The resultant water spray is as intense as very heavy rain and will contain a petrol fire and allow firemen to approach very closely with their chemical equipment. There are safeguards provided by warning devices should the air supply pressure drop to low levels. In addition to the "deluge" systems which cover only the hangar pens, normal sprinkler systems have been installed in all offices, workshops and stores in these buildings.

Alarm signals are given in the fire station of the operation of any "deluge" or sprinkler system in the permanent maintenance buildings. With the exception of the main tunnel there is no external system of fire alarms, reliance being placed on telephone calls to the fire station.

AVIATION FUEL INSTALLATIONS

The standard method of refuelling aircraft in the United Kingdom is to provide a limited storage at some remote part of the airfield to which aviation fuel is brought by tanker and from which airport or operators' bowsers are filled. The bowser itself dispenses the fuel into the aircraft tanks on the apron or in the maintenance areas. This method is still in use at London Airport hence the following description must serve to indicate proposals and not installations now in being.

It is intended that contracting oil companies shall put down tank farms at the west side of the airport, and pump aviation fuel through a number of pipelines to the west side of the central area where relatively small capacity depots will be built. These depots will supply bowsers operating in the central area. Bowsers which supply fuel to other parts of the airport will draw direct from the main tank farms, thus avoiding the necessity to run tankers through the main tunnel.

The main tank farms will have a capacity of some 2,875 tons of fuel. Pumps located here will deliver fuel at relatively low rates of flow to the central area depots through the pipelines to be laid below the surface of the ground and under runways and aprons to a number of 12,000 gallon tanks. At these depots expense pumps will fill the local bowsers.

Proposals are also under consideration to provide a piped supply of fuel to hydrants to be installed in the aprons, and the pipelines would be run beneath the concrete aprons and branches would be brought into pits in which the hydrant heads would be located. Details of this scheme have not yet been finalized. One of the principal difficulties is the location of the hydrants to suit any type of aircraft which may be using a particular parking stand.

ELECTRICAL DISTRIBUTION

(Continued from page 768)

which can be inserted at any convenient spot along the bus duct.

Usually the bus duct is suspended from the roof at reasonable height above the work area but should this arrangement interfere with the overhead cranes the duct could be supported approximately 36 in. above the floor as has been done in several recent installations (Fig. 9).

Bus duct, besides providing a highly efficient and reliable means of distributing power is easy to install, easy to expand and to re-arrange to meet changing plant conditions. Bus duct is 100 per cent salvable so that it can be taken down and moved to another area without difficulty. It is rapidly finding its way into industry replacing the cable and rigid conduit systems and also in many cases replacing the conventional switchgear and motor control centres.

In concluding it can be said that the foregoing are only a few of the trends in the electrical distribution system for industrial plants. ✓

Figures 1, 2, and 3, are taken from *Factory Management and Maintenance*, May 1953 ("Electrical Distribution"); Fig. 4 to 8 are from *Power*, Oct. 1953 ("To-day's Electrical Practice").

DISCUSSION

Is Effective Town Planning Possible?

S. D. Lash, M.E.I.C., ***Head, Department of Civil Engineering, Queen's University, Kingston, Ont.***

***The Engineering Journal,* 1956, Feb., p. 116, Discussion p. 137; Mar. p. 238.**

Author's Reply to Discussion

I am most grateful to those who have added so much to my paper by their thoughtful contributions.

A number of contributors questioned my statement that town planning in Canada has been relatively ineffective. I suppose this depends on what one means by *relatively*. There is no doubt that many Canadian towns are better today than they would have been without the efforts of town planners. On the other hand, one cannot but be aware of the tremendous amount of bad town building that has gone on during the postwar decade. In this period of unparalleled urban growth planners have had little influence in most Canadian cities. D. H. Lawrence's comment "that as builders of towns the English are as ignominious as rabbits," could surely apply with equal force to Canada. Mr. Thrift takes exception to my description of planners as a "pretty motley crew". According to my dictionary the word motley means "composed of diverse parts." There are undoubtedly many highly competent planners in Canada but it is questionable if planning has yet reached the status of a recognized profession. The Town Planning Institute of Canada is working towards this goal and there can be no doubt about its ultimate success but in the meantime the situation is confused. There are some who represent themselves as planners but who have had little or no professional training. The general public has difficultiy in separating the competent from those who are not qualified in this field.

Town Planning and Government

Possibly the most controversial part of my paper was concerned with the position of a planning agency in the structure of local government. Mr. Miller, if I understand him correctly, believes that in the smaller cities and towns planning should be regarded as an activity of the city engineer's department. In some small towns this may be the best way, but wherever possible I believe that the planning function should be independent. The planner's job involves co-ordinating proposals arising in various branches of local government. Such co-ordination is lacking in authority if the planner is too closely associated with any one department. Mr. Brown strongly supports my recommendation that the planning agency should be an integral part of local government. On the other hand Mr. Bunnell believes that "it would not seem possible for the planning agency to be a normal department of the local government". Professor Lee believes that planning will never be successful "unless we divorce the primary control from the strictly local government". In this connection I think it is instructive to consider experience in other countries. In Great Britain, planning only became a normal function of local government during the nineteen-forties. The change from special planning committees to regular standing committees was made after thirty years experience with the former had shown them to be unsatisfactory. In Sweden, planning has been a normal function of local government for many years and the system has worked well. In Puerto Rico, according to a recent book by Rexford Tugwell[1] "There is a planning agency to envisage the future. That agency is part of the governmental process". Coming back to Canada, in Edmonton and Vancouver the trend has been towards emphasizing planning as part of city government and relegating the independent planning commission to a relatively minor role.

Mr. Bunnell and Mr. Thrift take exception to my view that "Planning should be compulsory in all areas where any substantial amount of development is taking place". Compulsion is an ugly word but surely it is no great hardship to require local governments to think ahead. For example, the British Education Act of 1944 required local education authorities to look ahead and estimate their requirements for new schools during a twenty year period. It would have saved a great deal of trouble in Ontario if a similar provision had been in effect. Planning must surely lead to the more effective spending of public money and it is therefore not unreasonable to require that proper plans be made. It should be remembered that most municipalities obtain substantial revenues from provincial governments. It is generally considered that the local planning surveys and development plans required by the British Planning Act of 1947 have constituted a very great step forward towards effective planning.

Mr. Faludi and Professor Lee rightly emphasize the need for regional planning. This is the most difficult kind of planning unit to establish, largely because there are seldom any local governments at the regional level. Recent developments in Alberta and British Columbia show that progress is not impossible and we can profit from the experiences of Tennessee Valley Authority and the County of Cumberland, New South Wales.

Mr. Campeau is concerned about over-emphasis upon the aesthetic aspects of town planning. I can find little evidence of such over-emphasis in the Canadian towns with which I am familiar. It is true of course that in the City Beautiful movement at the beginning of this century too little emphasis was placed on the more practical aspects of town building but it seems to me that the pendulum swung too far in the opposite direction and that town design as an art was lost at the time when it was most needed. Frederick Gibberd[2] has recently written, "The town must work properly and be economically sound, but it should also give pleasure to those who look at it; the technical solutions to the functional problems must be fused with aesthetic feeling".

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[1] Rexford Tugwell "The Place of Planning in Society" page 40.

[2] Frederick Gibberd "Town Design" page 9.

ABSTRACTS . . .

OF RECENTLY PUBLISHED ENGINEERING LITERATURE

MECHANICAL-ENGINEERING PROGRESS IN THE PETROLEUM INDUSTRY

By Emory N. Kemler, Professor of Mechanical Engineering, University of Minnesota, Minneapolis, Minn., U.S.A. from *Mechanical Engineering,* v. 77, n. 12, December 1955, pp. 1043-1046.

During the period 1915 to 1930, the petroleum industry began to employ and understand the importance and use of technology on an industrywide basis. One major step taken by the industry was the establishment of the American Petroleum Institute in 1919. This industry-sponsored Institute has been very active in the standardization of oil-field equipment. Prior to the API standards, there were over 400 sizes, styles, and types of derricks without interchangeability, whereas the number was reduced to less than 10 after standardization. During the period there also appeared in this country for the first time, technical books relating to the petroleum industry.

During this period a number of major oil companies established separate research laboratories to serve the technical needs of their industry. Companies supplying equipment and services to the industry went through similar changes. Sales and service engineers were employed by these organizations and many of them organized research departments and expanded their design and development staffs. By the start of the 1930's we find that technology had demonstrated to management of the industry what it could offer.

Recent Progress

Both the size of the petroleum industry and complexity of its operations make it difficult to evaluate its progress briefly. Since the early 1920's, the production of natural gasoline and LPG products serve to remind us that during this period the industry has made much progress in the direction of conservation. Prior to this period these were essentially waste products.

The petroleum industry's technical problems cut across many areas of science. The engineer in the industry is, in general, responsible for a technical area much broader than covered by any given professional group. The following discussion, therefore, attempts merely to point out the accomplishments, particularly in areas of general interest to mechanical engineering, but also including major areas of technological accomplishment.

Exploration

In the area associated with location of petroleum the mechanical engineer has, in recent years, been actively engaged in designing and developing new types of transportation to make it possible to explore such areas as swamps of the south and the muskegs of the Canadian plains. He also has had a part in the design of some of the instrumentation utilized for exploration work.

Drilling

The developments in drilling have been in the direction of permitting drilling to greater depth, reduced cost, increased drilling rates and, more recently, the adaptation of drilling to offshore development. The deepest well to date is the Ohio Oil Company well in California of 21,482 ft., abandoned this year. In addition to heavier-duty equipment for deeper drilling, much attention has been given in the past decade to increased drilling rates. The jet bit has been developed for Gulf Coast operations and has given exceedingly high drilling rates. A large part of the successful operation of rotary drilling for general use resulted from the development of bits for hard formations. The drilling rates for hard formations are still very low. Current developments aimed to improve rates for harder formations include rotary percussion and sonic methods, and use of magnetostriction units.

The pressures encountered in drilling are normally about ½ psi per ft., or 10,000 psi for a 20,000 ft. well. Equipment manufacturers have developed wellhead equipment to withstand these pressures. Manufacturers of casing and drill pipe also have developed alloy materials to handle these depths. The development of muds to fit a wide range of drilling conditions has likewise been an important factor without which it would be impossible to drill many formations.

Production

The basic methods in pumping show little change since the early wells. The walking-beam mechanism of Watt is still used on modern pumping methods, and sucker-rod pumping is used on most of the 514,000 producing wells requiring artificial lift. Hydraulic pumping systems have been developed which are adaptable to a wide range of production requirements. In this system power oil under pressure is transmitted to the bottom-hole pump, thereby doing away with the sucker rods.

Considerable attention has been given to automatic operations of production equipment. Automatic operation of offshore installations becomes important from a safety as well as an operating standpoint. Some consideration has been given to piping oil and gas from the well to shore before separation.

Conservation has received increasing attention. Early production practices involved getting out the oil as rapidly as possible. Superstition, lack of knowledge of how a reservoir behaves, and the desire to convert the oil to money as rapidly as possible, all lead to the use of this uneconomical practice. The development of rational conservation practices has closely followed the expansion of our knowledge of reservoir performance.

Research on the flow of fluids in reservoirs was well under way by 1930. The area of reservoir engineering has extended greatly since that time and has been the most important factor in bringing about better practices. The application of modern reservoir practices has resulted in greater recovery, lower gas-oil ratios, longer flowing life, and lower lifting costs, as well as greater conservation.

The increase in knowledge of reservoir behaviour and in the properties of reservoir fluids has also brought about other practices which lead to greater recovery. These include rational application of waterflooding, repressuring, pressure maintenance both through gas and water return to the reservoir, hydraulic fracturing of the reservoir rocks, and *in situ* combustion.

Transportation

Pipe lines and tankers, in early use in the history of the petroleum industry, continue to be the important means of petroleum transportation. The past quarter century has seen much attention being given to the transportation of products. Perhaps the most attention has been given to the automatic operation of pumping stations and in the automatic metering and control of the product at the delivery point.

The natural-gas industry has shown a tremendous growth since 1930. The development of high-yield-strength thin-walled pipe has made it possible to transport the gas economically.

The transportation of crude shows little general change, except for the introduction of automatic operation. The transportation of refinery products has expanded greatly during recent years. The handling of a variety of products in a line has necessitated developing techniques for identifying the products en route. Radio-active techniques have been successful for this purpose.

The Inter-Provincial-Lakehead crude line from Edmonton, Alberta to Sarnia, Ontario, is a recent installation which illustrates some of the problems of modern crude trunk lines. This line is 1765 miles long, the world's longest. Oil can be transported from Edmonton to Sarnia at a cost of 64 cents per barrel. The 645-mile Lakehead portion is 30-in. diam., and cost $74,000,000. It involved laying two 20-in. 21,000-ft.-long lines under the Straits of Mackinac at depths as great as 230 ft. below the surface. It requires a total of 2,800,000 bbl. of oil just to fill this 645-mile section.

Refining

The developments in refining include processes to give greater gasoline yields, lower costs, automatic operation, and generally improved products. The petrochemical industry—an extension of refining—is just in its infancy.

Cracking was first used to give an increase in gasoline yield. As demand for gasoline increased, more attention has been given to processing techniques which would give better utilization to the crude. These processes are quite complex and in general utilize a catalyst. They operate at high pressures and temperatures, i.e. pressures up to about 800 psi and temperatures as high as 1000 F.

The use of fluidized catalytic beds represents a significant development. This makes it possible to replace batch processing with continuous-flow processes. The batch or cyclic processes also have been improved through introduction of controls, and through combination with other processes to reduce intermediate storage and heat losses.

Distribution

The markets for petroleum products present a continually changing pattern. Gasoline continues to be a major one, accounting for about half the demand. Use of petroleum products for fuel purposes has been on the increase. In 1954 there were 7,600,000 homes using oil burners and 22,000,000 natural-gas customers. A total of 58,100,000 motor vehicles, together with 4,700,000 tractors were using petroleum products. The number of railroad diesels had increased to 23,700 by the end of 1954. The supplying of diesel and fuel oil for marine uses, use of fuel oil and gas for industrial plants, and supplying of road oils represent other large uses. The delivery, storage, and marketing of these products involves many engineering problems.

The Mechanical Engineer's Role

The problems of the various phases of the petroleum industry with which the mechanical engineer is associated require the application of the principles, techniques, and information from essentially all the areas of applied science. Drilling, production, transportation, and refining operating groups all need information from such areas as mechanics, applied elasticity, fluid mechanics, heat transfer, thermodynamics, machine design, automatic control, servomechanisms, electronics, electrical design, chemical-process design, instrumentation, soil mechanics, structural design, mettallography, and corrosion.

BUILDING TOMORROW'S MANAGEMENT

by Nathanel Stewart, Director Management Development Program, Government Employees Insurance Company. In *Dun's Review and Modern Industry,* January 1956.

Executive talent is not a commodity one can find in profusion on the open market, and an operating company in need of it faces a major problem. One answer is to develop abilities available in the organization.

The search for and development of executive talent should begin within a company's own ranks. The program is based on the following essentials:—

(1) Monthly series of case studies, discussions and presentations at dinner sections of the executive group.

(2) Top management's genuine interest in looking over personnel for potential executives.

(3) Participation of senior officers in the operating management team and other staff groups where problems are identified and solved.

(4) Development of a valuable executive's library.

(5) Emphasis on the man's capacity to perform as a company official in daily administration of his division.

(6) The acid test will be not what the company can do for these potential administrators but what they can . . . do for themselves, through conscious and deliberate self development and self education in the art and science of management. This investment in the development of its younger executives and managers will pay off as it enters the periods of transition and expansion.

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NEW VISCOSITY CLASSIFICATION

by William S. James, Research Consultant, in *ASE Journal* v. 64, n. 1, January 1956, p. 55.

If experience with the multi-grade type of oil designation does not clarify its use, it may be wise to consider changing the viscosity classification into terms more generally understood by the car owner and service station attendant.

One way to do it would be to designate oil viscosity characteristics by two temperatures: the lowest expected temperature at which a start is desired and the temperature setting of the water thermostat in the cooling system. Both of these temperatures the car owner has.

The advantage of this system is that whenever automotive engineering or petroleum technology or both improve their products, the new oils could easily be fitted into the designation system. Car owners and service station attendants would have no need to learn a new system.

For complete paper (in multilith form) on which this abridgment is based, write SAE Special Publications. Price: 35c to members, 60c to non-members.

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ENGINEERING PROGRESS IN BRITAIN 1955

The Engineer, v. 201, n. 5215, January 6, 1956.

The Engineer, in the January 6th, 1956 issue, gives in retrospect a summary of progress for the year under the following general headings:— Aeronautics, atomic energy, civil engineering, continental engineering, electrical engineering, national boat show, naval construction, ports engineering, Royal Navy, shipbuilding and marine engineering and turbine airliners.

Additional articles are included on "Power from Niagara Falls," and "American Water Power Schemes in 1955". Sixteen art plates illustrate the various subjects covered, as well as steam and diesel electric locomotives, automobile engineering, water-supply schemes, collieries, United States gas turbines, bucket excavators for a German lignite mine, and U.S. machine tool automation.

An editorial entitled "Retrospect," deals in a general way with railway plans, road construction, nuclear energy, automation, education, economics and labour.

The following issue, dated January 13th, 1956, gives a summary of progress in unification of standards, British Railways, coal, continental engineering II, electrical engineering II, gas turbines I, and generating plant commissioned by the C.E.A.

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URANIUM IN CANADA-1955

Canadian Mining Journal, v. 77, n. 2, February 1956, p. 81/82.

The estimated Canadian production for 1955 has now been valued at the Dominion Bureau of Statistics at $23,000,000, compared with $26,467,574 for 1954. This figure came as a surprise to most people who had been led to expect something in the order of $40 million to $48 million. These higher estimates were based on the increased capacity of the Beaverlodge mill from 400 to 700 tons per day, and on the new production from the Gunnar and the Pronto mines which started up at the end of August.

The discrepancy however arises from the closing down of the Port Hope Refinery for a period of several months for the purpose of extending and improving the process. Since mine production figures are still on the secret list, calculations of uranium production are made at the smelter level which means the value of shipments of uranium products from the Port Hope Refinery. Thus with the refinery closed down, there was a considerable gap between mine production and smelter output.

1955 was a significant one in many respects for the metal which first rose to prominence as the powerful force behind the atomic bomb and which subsequently became the quest of every prospector and would-be-prospector, and caused unprecedented speculation on the stock markets. The government set a definite time limit up to which it would purchase uranium in an acceptable concentrate as agent for the U.S. Atomic Energy Commission, the ultimate buyer of our concentrates, by giving a deadline of March 31, 1956, for the signing of all purchase contracts at a premium above the regular price schedule; by insisting on reasonable assurance that production commence not later than April 1, 1957; and by stipulating that all deliveries are to be made before March 31, 1962. Provided that a concentrate has a minimum uranium content of 10 per cent by weight, it will qualify for purchase by the Government, through Eldorado Mining and Refining (1944) Limited, in accordance with the sliding scale of prices up to a maximum of $6.00 per pound of uranium until the deadline of March 31, 1962. In addition, a development allowance of $1.25 per pound is allowed during the first three years of production. To qualify for a special premium price, each contract, subject to the above-mentioned time limits, is negotiated on its own.

The end of the year saw a letting-up of the intense prospecting and staking activity which followed the original discoveries in the Beaverlodge, Blind River, Bancroft and other districts. Developments may best be described in terms of new sales contracts to which Eldorado committed itself. During 1954 a contract was signed with Gunnar Mines for the delivery of concentrates to the value of $76,950,000 and another with Pronto Uranium for the amount of $55,000,000 making a total of almost $132 million. The first units of both the 1,250 ton mill of Gunnar and the 1,500 ton mill of Pronto started production in August and were to be brought up to full capacity early in the next year. In 1955 three separate contracts were negotiated amounting to slightly over $425 million. These were for $270,000,000 with Algom Uranium, $182,250,000 with Consolidated Denison, and $38,805,000 with Bicroft Uranium. Algom's two 3,000-ton mills are scheduled for completion by mid-1956 and the beginning of 1957; the large 5,700-ton plant at Consolidated Denison should be in production by the middle of 1957; and the 1000-ton mill of Bicroft is being constructed to be ready by the end of 1956. In addition to these plants, the Beaverlodge operation of Eldorado is being expanded to handle 2000 tons per day by 1957.

Shortly after the end of the year Faraday also received a contract for $29,754,800 and is preparing for a 750-ton operation. Extensive exploration both by diamond drilling and by underground was carried on by a large number of other companies in an effort to meet the deadline, and there appears little doubt but that a number of these will also qualify either individually, or by groups. Custom mills would solve the problem for mines having insufficient tonnage to warrant individual milling plants of their own, and at least one of these in the Beaverlodge area is being planned.

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POROUS SOLUTION

Flight—and Aircraft Engineer, n. 2452, v. 69, Friday, 20 January, 1956, p. 68.

Aircraft which "perspire" may prove to be the answer to heating problems at supersonic speed, according to Mr. C. E. Pappas, chief of aerodynamics and thermodynamics at the Republic Aviation Corporation. Mr. Pappas said in New York recently that he believed that within two years aircraft could by flying at a Mach number of 4 at 50,000 ft., under which conditions the airframe surfaces would heat to 900 deg. F. in not much more than a minute's flying time. For such speeds, he said, new metals would be used—and so might "transpiration." For example, water could be forced out through pores in the skin, being emitted as steam and carrying off a good deal of the heat. Mr. Pappas added that aircraft flying at 100,000 ft. at a Mach number of 10 could become a reality in five years if appropriate structural materials and power plants were developed. Temperatures at such speeds would be about 3,000 deg F, and flight could last no longer than five minutes because of fuel and temperature limitations.

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TRANSISTOR CHARACTERISTICS FOR CIRCUIT DESIGNERS

by Seymour Schwartz, *Electronics*, v. 29, n. 1, January 1956, p. 161

Successful transistor circuit design requires not only familiarity with transistor equivalent circuits and characteristic curves but also an understanding of the behaviour of the parameters describing the transistor and the variation of these parameters with bias and temperature.

Tables I to VI have been compiled as a systematic presentation of data necessary for transistor circuit design. Tables indicate physical properties, maximum electrical ratings, small-signal low-frequency parameters and average characterstics for grounded-base, grounded-emitter, grounded-collector and switching circuits for 218 transistor types: 106 junction triodes, 46 high-frequency triodes, 6 tetrodes, 23 high-power units, 25 point-contact and 12 phototransistors.

The characteristics peculiar to the high-power transistor are the lower values of input resistance, output resistance and α, resulting from the higher values of bias currents employed. Bias stability techniques are used to minimize the effect of runaway due to self-heating of the collector.

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DIFFERENTIAL ANNEALING

by G. A. Maeder, Aluminum Laboratories Ltd., Banbury, Oxfordshire,
in *Eng.neering* v. 181, n. 4694, January 13th, 1956, p. 48.

The author shows theoretically that a deep-drawing "circle" (i.e. a sheet-metal disc prepared for deep drawing) in which the temper varies radially in a controlled manner can be cupped and redrawn to a substantially greater extent than a uniform circle and that the resulting product is more satisfactory. The effect of variation in temper across the blank is examined in detail. A differential-annealing machine is described which has enabled the theory to be confirmed by the production of shells with 60 per cent cupping reductions.

Any shape of blank can be differentially annealed, if a suitable annealing apparatus can be developed. In fact, to anneal only the four corners of a rectangular blank does not present any great difficulties. For a heat-treatable metal, the inverse process is feasible, namely, to commence from a soft blank and heat-treat the centre portion only. No theoretical super-deep drawing alloy, however refined, can ever give the advantages of differential annealing because, for a circle of even temper, the drawing ratio cannot be exceeded, in fact it is necessary to keep well below it to allow for friction and bending.

The 70th Annual General Meeting

Sheraton-Mt. Royal Hotel, Montreal, May 23-25

A Review of the Main Proceedings and Events

"The best meeting ever held in the history of the Institute" was the opinion of at least one senior member. Certainly foremost in quantity, with a highest-ever registration of nearly 1,700 delegates and visitors, the 70th Annual Meeting lacked nothing in the quality of the proceedings. That the gathering in Montreal during the week ending 26th May was an outstanding success was also the general opinion of those who took part in the extensive program of business, technical, and social affairs. Even the unseasonably cold weather was fair enough not to mar the occasion.

The record attendance was made up not only of members of the Institute from all the Canadian territories, but was augmented by the welcome presence of members of the American Society of Mechanical Engineers and the American Rocket Society, both of which bodies were actively associated with the meeting, as well as by representatives of engineering institutions in Britain and France.

The general proceedings are recorded here, and more detailed reports of individual events will be given in subsequent issues of the Engineering Journal.

The Annual General Meeting

On the morning of 23rd May, the Annual General Meeting got under way at 10.30 a.m. to open the business program.

The president, Dr. R. E. Heartz, was in the chair and the meeting proceeded smoothly through the agenda, which included the announcement of honorary membership, the awards of honours, prizes, and medals, the reports of council, finance committee, and treasurer, reports of other committees and the branches, a report on progress towards confederation, and the election of new officers.

The medal and prize awards are only summarized here, but further biographical details and a pictorial record of the presentations will be published later.

Honours, Awards and Medals

Honorary Membership—C. E. Davies, New York, N.Y.; A. R. Decary, Quebec, Que.; F. W. Gray, Victoria, B.C.; J. A. McCrory, Montreal, Que.; H. W. McKiel, Sackville, N.B.

Julian C. Smith Medals—Maj.-Gen. Howard Kennedy, Ottawa, Ont.; Adrien Pouliot, Quebec, Que.

Duggan Medal and Prize—J. Dubuc, T. A. Monti, G. F. Welter (joint authors) Montreal, Que.

Leonard Medal—F. R. Joubin, Toronto, Ont.

Plummer Medal—M. Katz, Ottawa, Ont.

Ross Medal—G. W. Holbrook, Kingston, Ont.

John Galbraith Prize—H. J. Saaltink, Niagara Falls, Ont.

Phelps Johnson Prize—R. R. Real, Montreal, Que.

Election of Officers

The newly elected officers of the Institute were announced by the general secretary, and those present were introduced to the meeting. The induction of the new president and officers was to take place at the annual banquet.

President—V. A. McKillop, London, Ont.

Vice-Presidents—H. R. Sills, Peterborough, Ont.; G. M. Dick, Sherbrooke, Que.; H. W. L. Doane, Halifax, N.S.

Councillors—Listed below are the names of the councillors and the Branches they represent.

E. L. Hartley	Vancouver
H. L. Roblin	Edmonton
J. M. Campbell	Lethbridge
W. A. Smith	Calgary
J. B. Mantle	Saskatchewan
R. T. Harland	Winnipeg
D. C. Holgate	Sault Ste. Marie
G.G.M. Eastwood	North East. Ontario
H. C. Bates	Huronia
L. C. Sentance	Hamilton
Wm. R. Roberts	Kitchener
Paul E. Buss	Niagara Peninsula
W. M. Huggins	Toronto
A. J. Bonney	Peterborough
R. F. Legget	Ottawa
John M. Hawkes	Cornwall
Roger Brais	Montreal
C. E. Frost	Montreal
H. A. Mullins	Montreal
C. H. Boisvert	Quebec
R. C. Eddy	North. New Brunswick
M. F. K. Leighton	Moncton
D. J. MacNeil	North. Nova Scotia
O. Nelson Mann	Halifax
J. R. Wallace	Cape Breton
R. A. McGeachy	Sarnia

Confederation

Dr. I. R. Tait outlined the progress of the work that had been done by the Institute and Dominion Council committees on Confederation. A full joint report had been prepared, dealing with the major issues involved. This report had been circulated to all members of council for study and had been discussed in detail at the meeting of council on 22nd May. As a result, the report had been approved in principle both by council and by the branch officers. Dr. Tait explained that the next step was for the report to be considered at the meeting of the Dominion Council on 30th May.

A motion from the floor endorsed the action taken by council on the issue of Confederation.

Vote of Thanks to Retiring Officers

Dr. I. P. Macnab moved that a vote of thanks be accorded to the retiring president and members of council in appreciation of the work they had done for the Institute during their term of office. The motion was seconded by Dr. D. M. Stephens, and a personal note of appreciation was added by Dr. H. W. McKiel, the senior past-president at the meeting.

The Professional Meeting

The Annual General Meeting was followed by a well-attended luncheon at which Dr. Heartz, the retiring president, spoke on the future of the Institute. His address will be found on page 792 of this issue.

After the luncheon the professional meeting got under way with the first of a fine program of technical papers, which continued through the next two days. In all there were thirty-one technical papers and three panel discussions covering a wide range of interesting and timely subjects. The professional societies already mentioned as being associated with this meeting — the American Society of Mechanical Engineers and the American Rocket Society — contributed to the program of papers, as did two visitors from the United Kingdom.

The interest aroused by the subjects covered was shown by the generally good attendance at technical sessions, and many animated discussions had to be closed to keep within the program schedule. Some of the papers have already appeared in the Journal; the remainder will be published in later issues and it is hoped that further discussion will be forthcoming to round off the subjects. Except for minor details, the program of papers and panels followed that published on pp. 437-440 of the April issue.

To complete a successful opening day of the professional meeting, there was a particularly enjoyable gesture by the City of Montreal in the form of a buffet supper at the Chalet on Mount Royal. His Worship, Mayor Jean Drapeau welcomed a large gathering of delegates and ladies, who spent a delightful evening overlooking the welcoming city and even a part of the St. Lawrence Seaway development that had been discussed that afternoon.

Other Activities

On the following day, Thursday, the afternoon was devoted to a most interesting visit to the Cartierville plant of Canadair Limited, where some 600 members and other visitors were shown many of the latest developments and techniques involved in Canada's air defence program. The developments went beyond the phases of design and production —far and fast, too, in the form of an exhilarating air display put on by Canadair and elements of Air Defence Command of the Royal Canadian Air Force. Sincere thanks are due to J. G. Notman, M.E.I.C., president of Canadair Limited, and to his staff, who made this visit possible and provided an outstanding and memorable event.

The conclusion of this visit and air show was by no means the end of the day's activities. The

Dr. I. R. Tait reports to the annual general meeting on the progress made by the joint committee on Confederation. Also present, from the left, are: V. A. McKillop, president-elect; R. L. Dunsmore, chairman, finance committee; B. G. Ballard, retiring vice-president; R. E. Heartz, retiring president; L. Austin Wright, general secretary; Miss M. McLaren, E.I.C. headquarters; M. A. Montgomery, vice-president; and J. O. Martineau, retiring vice-president.

The Students' Conference was a great success. The delegates seen here are, from the left: (front row) E. J. Korhonen, Queen's University; M. A. Laughton, University of Toronto; J. F. Riel, Ecole Polytechnique; J. L. René, Laval University; L. J. Schneider, University of Alberta; G. M. Ranger, University of Ottawa; (standing) T. D. Rooke, University of Manitoba; C. Day, University of British Columbia; D. E. McKercher (observer), P. M. Arsenault, McGill University; D. J. McColm, University of New Brunswick; L. Morrison, University of Saskatchewan; K. L. McIntyre (observer), University of Toronto; D. E. Stothers, Royal Military College.

annual dinner of the Association of Consulting Engineers of Canada, at which the chairman was J. G. Chenevert, M.E.I.C., was well attended by many members and visitors who were addressed by Sir George H. Nelson, president of the Institution of Electrical Engineers.

The junior panel discussion "What can a young engineer do in developing professionally?" was held on this evening, while other members enjoyed an interesting film show. Finally, there were many who found time from all these activities to spend a sociable hour or two visiting E.I.C. headquarters, where "open house" was held, to meet friends and members of the staff.

On Friday a luncheon was held under the auspices of ASME, at which the chairman was G. Ross Lord, chairman of the Ontario section of that society. Those who attended heard a vigorous address by ASME president Dr. J. W. Barker on international co-operation among engineers.

The President's Dinner

On the evening of 22nd May, the president's annual dinner was held and was a notable gathering of past-presidents and other officers of the Institute together with such distinguished visitors as president Sir George H. Nelson and general secretary K. Brasher of the Institution of Electrical Engineers, and Joseph W. Barker, president of ASME, with Clarence Davies, general secretary.

The president of the Institute, Dr. Heartz, paid particular tribute to the deans of engineering, who were attending the special conference on engineering education. Every degree-granting Canadian university was represented at the dinner by its dean of engineering, except for one who was unavoidably absent because of convocation ceremonies.

The president also presented certificates of honorary membership to John Armstrong and de Gaspé Beaubien, who had been elected the previous year but had been unable to be present at the 1955 dinner.

In accordance with established custom, all past-presidents were called upon in turn to contribute their views and reminiscences to the occasion, and those who spoke were: F. P. Shearwood, H. W. McKiel, C. J. Mackenzie, de Gaspé Beaubien, L. F. Grant, J. E. Armstrong, I. P. Macnab, J. A. Vance, J. B. Stirling, Ross Dobbin, and D. M. Stephens.

To conclude the occasion the president-elect, V. A. McKillop,

The E.I.C. Employment Department opened a special office in the hotel for the convenience of members attending the meeting.

was introduced and made an informal response.

The Special Conferences

Starting on 22nd May, other important conferences and meetings were held. It is hoped that further reports of these, together with photographs, will be included in later issues.

These events included the annual student's conference, branch officers' conference, meetings of council, and a unique gathering of senior engineering faculty members, from every degree-granting university in Canada, at a special conference on engineering education.

It is customary for the ASME-EIC International Council to convene during the annual meetings of E.I.C. and ASME. A meeting was held on 23rd May, and will be reported later.

During the visit to Canadair Limited, J. G. Notman, M.E.I.C., president of the company, is seen with Mrs. Notman, Lady Nelson, and Dr. R. E. Heartz.

Council Meetings

At the council meeting on 22nd May the outstanding item was the discussion on Confederation. This started at the morning session and continued in the afternoon with the branch officers' conference present. The joint report of the E.I.C. and Dominion Council committees was adopted and approved in principle. A lot of useful and instructive discussion took place, and it was evident that the whole subject is paramount in the minds of a large body of the E.I.C. membership. Dr. Tait, chairman of the E.I.C. committee, stressed the point that the report submitted to council was a joint one, and identical with that to be presented to the meeting of Dominion Council on 30th May.

The feeling of E.I.C. council members present, in general, was that the committee on Confederation had done an excellent job, that their work should be endorsed, and that they looked forward to the further progressive steps to be taken—possibly by a joint committee of the E.I.C. and the Dominion Council.

This opinion was extended at the first meeting of the new council, on 24th May, when the principal item of business was the adoption of a two-point motion to the following effect: (a) that Irving R. Tait be authorized to proceed as the E.I.C. representative to the Dominion Council meeting in Saskatoon, 30th May; and (b) that council should take further steps, as appropriate, to participate with Dominion Council in the formation of a joint committee to develop further the details of Confederation, if that is Dominion Council's wish.

Some of the many members and ladies, who were the guests of the City of Montreal at a buffet supper, on the steps of the Chalet, on Mount Royal. Mayor Jean Drapeau (left of centre) speaks to Mrs. C. G. Kingsmill; to his right are Mrs. Heartz and Dr. R. E. Heartz.

A section of the group who visited the Canadair plant watch an F-86 Sabre make a slow pass overhead during the air show which was a highlight of the tour.

More details of the joint report will be published later.

The Ladies' Program

The ladies represented a considerable proportion of the record attendance at the meeting and they took part in many of the functions on the general program. However, their prime interest must have been in the excellent ladies' program arranged so successfully by Mrs. C. G. Kingsmill and her able committee.

The Banquet and Dance

At the close of the technical sessions on Friday afternoon, this annual meeting was already assured of a resounding success, but the events of the evening, the banquet, followed by the reception and dance, undoubtedly formed a climax that crowned the whole program with distinction. Certainly the gathering was distinguished, from the impressive banquet head table through the rest of the company present, and the attendance was such that tables overflowed from the huge ball room into the foyer and balcony.

The winners of awards and medals were received with real enthusiasm, and there could be no doubt that the guest speaker, Dr. David L. Thomson, of McGill University, made a vivid and favourable impression on his audience with his discourse on engineering education from a university viewpoint.

The new members of council having been introduced, the proceedings of the banquet closed with the induction of the new president, Vernon Archibald McKillop.

There followed an informal and pleasant reception at which members and guests were able to meet President McKillop and Mrs. McKillop, the retiring president, R. E. Heartz, and Mrs. Heartz, and E. D. Gray-Donald, chairman Montreal Branch, with Mrs. Gray-Donald. For many of the banquet guests, joined by numerous others who arrived later, the day ended happily to the music of the annual dance.

The Seaway Tours

Though the events of Friday evening formed the grand finale of a memorable annual meeting, there were many who took advantage of the arrangements made on the following day, 26th May, to visit the main works of the St. Lawrence Seaway development. Two tours were offered, one covering the developments in the Montreal area, and the other taking in the extensive projects near Cornwall and Iroquois (Ont.) and Massena (N.Y.). Further news of these tours should make an interesting addition to our regular reports on the seaway and power developments.

The Meeting Arrangements

There are many factors which go to make a meeting such as

C. G. Kingsmill, chairman of the annual meeting committee, and Mrs. Kingsmill, who led the ladies' committee, seem to be pleased with the progress of the meeting.

this a success. However, it is certain that a special tribute must be paid to the work of the annual meeting committee under their chairman C. G. Kingsmill. Everyone realizes how untrue is the old platitude about "everything ran smoothly"; in a program of the scope covered at this annual meeting there must be many snags and real problems. That these difficulties were all resolved with such satisfying results seems to be the best witness to the efforts of the committee and the excellent liaison established with the headquarters staff.

This annual meeting was international in scope and representation. Above, Dr. R. E. Heartz (left) greets his successor as president of The Engineering Institute of Canada, Dr. V. A. McKillop, while Sir George H. Nelson, president of the Institution of Electrical Engineers, looks on. Left, Dr. J. W. Barker, president, headed the attending members of the American Society of Mechanical Engineers, while the American Rocket Society were represented by Rear-Admiral F. R. Furth, seen (below left) with Air Vice-Marshal A. Ferrier.

Photographic Exhibition

An innovation at the 1956 annual meeting was a photographic exhibition to which Canadian industry contributed a wide selection of studies of engineering subjects. Altogether, 135 photographs were displayed and a ballot was held so that members could express their opinions of the exhibits.

On the results of this ballot, certificates of merit will be awarded to the contributors of the five photographs that aroused the greatest interest.

The results of the ballot and reproductions of the leading entries will be published in a subsequent issue of the *Journal*. A general view of the exhibition is shown here.

The Engineering Institute
What of the Future?

Address by Dr. R. E. Heartz, the retiring President, at the Annual Meeting luncheon, 23rd May, 1956

It has been my privilege to have served The Engineering Institute as its president. During my term of office I have visited 37 branches from Newfoundland to British Columbia, including Whitehorse in the Yukon, conferred with executive committees, addressed the engineering students of 17 universities, attended all 10 council meetings held in 6 cities from Charlottetown to Winnipeg, and spoken to several Rotary Clubs and other organizations.

Two weeks were spent in England visiting the Institutions of Civil, Mechanical and Electrical Engineers. Meetings of the American Societies were attended in Boston, New York and Chicago.

In discharging my responsibilities, I have travelled 32,600 miles, attended some 250 meetings and spent about 7 months of my term of office on the work of the Institute.

While such a schedule places a heavy burden on the President, it does give him an insight into the problems, the activities and the importance of the Institute, which he could not favourably obtain otherwise.

It has given me the opportunity of observing the Institute in action, of discussing its work with its leaders throughout Canada, and of conferring with engineering organizations in this and other countries. The gracious hospitality of the fine people I have met and their keen interest in the Institute have made lasting impressions. It has been a thrilling and rewarding experience.

International Relations

The Engineering Institute, in addition to being a national body, has valuable connections in other countries through which mutual interests are developed.

The Conference of Commonwealth Engineering Institutions is made up of three representatives from the United Kingdom—The Institutions of Civil, Mechanical and Electrical Engineers, the leading Institutions in Australia, New Zealand, South Africa, India, Northern Rhodesia, and The Engineering Institute of Canada. The conference meets every four years to discuss ways and means of improving communications between the parts of the Commonwealth and the members of the engineering profession. There is also an exchange of speakers and technical papers, some of which are published in whole or in part in *The Engineering Journal.*

The Institute also participates in engineering projects of an international nature. For instance, in collaboration with the British Institution of Electrical Engineers and the American Institute of Electrical Engineers, the Institute will take part in the inauguration of the new Trans-Atlantic cable next spring.

The Union of Pan-American Engineering Societies (UPADI) is made up of The Engineers' Joint Council, in the United States, the Engineering Institute of Canada, and 18 separate engineering societies from different countries in South America. Its meetings, held every two years, are attended by several members of The Engineering Institute. This is a splendid medium by which to promote better relations with the many countries in South America. Also, an organization of this kind should be able to do a lot to assist the developing of trade relations between Canada and the South American countries.

The Engineers' Council for Professional Development (ECPD) is an organization made up of eight major engineering institutions in North America, seven in the United States, and the eighth, The Engineering Institute of Canada. As you will deduce from its title, the main purpose of this organization is to promote professional development among engineers. This is a powerful body, doing work not previously attempted by any other engineering organization. Through ECPD, The Engineering Institute has made a vast number of friends and, through them, has received great help in many of the problems which we have had to face.

The International Association for the Exchange of Students for Technical Experience (IAESTE) has as its object the exchange of engineering students between nations. Its membership is made up of 22 nations, with one organization in each country. The Engineering Institute is the representative from Canada. Students are exchanged in the year preceding graduation and return to their own countries to finish their courses. Last year 5,200 students were exchanged—50 came to Canada, 11 Canadians went abroad. The organization finances itself, and is entirely free from governmental influence.

The close collaboration between some of the American societies and the Institute, over many years, has been of mutual benefit by way of exchange of views and information, special rates for each other's publications, and frequent attendance at each other's meetings. This 70th Annual Meeting of the Institute in association with The American Society of Mechanical Engineers, the co-operative agreement between ASME and EIC, and our joint participation at their conference on engineering education at Potsdam, New York, and the proposed next conference at London, Ontario, this fall, are but further indications of the valuable benefits that accrue when men of good-will get together.

The Institute also collaborates with the National Committee of The World Power Conference (WPC), The International Electrotechnical Commission (IEC), The International Committee for Scientific Management (CIOS) and with many other organizations.

With the improved means of communication and the interweaving of the interests of nations, the relations of one nation to another have become increasingly important. In this international relations development, The Engineering Institute can and does perform an important part. The work which is done by the members of the Institute, with the members of organizations in other countries in the professional field, must be a real influence in establishing and maintaining the desirable good relationships.

As an example of how our interests overlap, let me remind you that at this 70th Annual Meeting we have with us senior members of seven engineering societies outside of Canada, five from the United States, one from England and one from France. The presence of these distinguished visitors will not only add colour to our conference but, at the same time, will do something towards improving the relationships between our countries.

International Privileges

Another of the good things that has come to the members of the Institute by virtue of the Institute's international connections, is the privileges which are extended to our members in almost any country of the world when they carry letters of introduction from us to an officer of the engineering society in that country.

These international relations have been fostered to a large extent by the efforts of our general secretary. I would recommend to those who follow me that they make certain to maintain these contacts. Only those who have served as president can fully appreciate the valuable work the general secretary does, his breadth of vision, and the great volume of friends he has made for the Institute throughout the world.

I feel you should also know that the annual conference of university students, which takes place just before our annual meeting, and the conference of deans of our degree-granting engineering universities, now in progress, are his original ideas.

I would like to express my genuine thanks to Dr. Wright and his entire headquarters' staff, including Colonel Thompson, Colonel Grant, Mr. Luke, and Miss McLaren for the splendid assistance they have given me during my term of office.

Institute Problems

In planning for the future, the Institute will have to find answers to many important problems. I would like to comment briefly on three of them.

The first problem is confederation, which was discussed by Council yesterday and reported on at your annual meeting this morning. We are fortunate in having the work in the hands of such a highly competent committee. The joint report by the Institute and Dominion Council committees is an excellent indication of the close co-operation between these two groups. While progress has been good, every effort must be made to expedite the remaining portion of the work. From what the committees have reported, it will be evident to you, as it is to me, we have little need for worry on this point. As stated some time ago, I am hopeful of the outcome.

The second problem is the result of our dynamic age and its rapidly expanding technology. In order to meet the situation, Council appointed a committee on technical operations, whose report recommending a comprehensive technical programme was approved yesterday. As many of you know, technical divisions have been in operation in some branches with great success, and it is now proposed to extend them across the country. An assistant has been added to the headquarters staff to help in setting up these activities.

The success of this proposal is vital to the interests of the Institute. The committees appointed by Council and by the branches to arrange widely diversified programmes throughout Canada have a great responsibility. The enthusiastic support of our members will be essential for best results. A great number of technical papers will become available for the *Engineering Journal*. In due course it may be necessary to publish transactions to take care of them.

The third problem was pointed up by the unveiling of the memorial in Ottawa to Colonel By. The whole project was so successful, and the nationwide reaction so favourable, that we now must continue to honour engineers who have made outstanding contributions to the development of Canada. The Institute is presently obtaining prices on the cost of publishing (in book form) the biographies of two famous engineers, which I hope will be published under the auspices of the Engineering Institute. Here is a golden opportunity to carry on with the principle initiated at Ottawa so that the people of Canada may become familiar with the leading part engineers have played, and will continue to play, in the building of this Canada of ours.

Education

Many of you will recall that the theme of my talks across the country was—the great need for more and better engineers and technicians, the lack of sufficient facilities for their training and the necessity of doing something about it immediately.

The shortage of engineers is now so evident that further reference to it is quite unnecessary, but it is important to realize that it is becoming increasingly worse, in fact, there are signs that it is beginning to affect our economy.

The desirability of establishing technical institutes in Canada was ably dealt with by Dr. C. R. Young, a past-president of the Institute, in a memorandum submitted to Council in 1944. There is an urgent need for more technical institutes of the type recommended by Dr. Young.

With the great demand for more highly qualified engineers, and with the possibility of those seeking an education doubling in number within the next decade, the challenge is a formidable one for the universities.

If our institutions of higher learning are to carry out their monumental task, they must have substantially increased financial support from governments, business and industry, and individuals.

Anxious to do something constructive about the situation, the Institute, at its own expense, arranged a conference of the deans and heads of departments of all degree-granting engineering universities, to be held in Montreal before the start of our 70th Annual Meeting to discuss engineering education.

The Institute also presented a brief on the problem to the Royal Commission on Canada's Economic Prospects, which was very favourably received.

Demands for copies of the brief have come from various parts of Canada and the United States. The original 350 copies were quickly used up. Of the second printing of 250 copies, only a few remain.

The Institute is fully aware of the urgency of the problem, and is ready and willing to collaborate with other individuals or organizations in any way that will assist in alleviating the present situation.

Canada is being affected as seldom before in history by foreign competition. We must be able to compete successfully in the markets of the world if we are to maintain, and preferably improve, our standard of living. Our abundant resources, incidentally by no means inexhaustible, as some would have you think, should be processed more and more within our country. New products will have to be developed and old ones improved at an unprecedented rate. The impacts of the applications of scientific research throughout the world may affect our country considerably. Never has there been greater need for superbly trained scientists, engineers, and technicians for the continued and future welfare of Canada.

The Future

Now that I face the termination of my presidency, I have mixed feelings. As explained earlier, the post makes great demands upon one, but I wouldn't have missed the experience for anything. I am reminded of a story that is both old and widely distributed. I tell it only to remind you of it because of its appropriateness to the occasion.

The father of 15 children was being interviewed on the merits of large families. When asked how he felt about the whole experience, he replied "I wouldn't take a million dollars for any one of the 15, but I wouldn't give you a dollar for another one."

The presidency is a high office. The opportunity it gives to serve the profession is so great that no one with any sense of responsibility could refuse it. And yet, at the end of my term, as I look back, I wonder how many of the things I had in mind to do have been done. How well have I served the profession?

I don't suppose there has ever been a president who, standing where I stand now, has been satisfied with what he has accomplished. Thus it is that I realize, that here, as in other places, "Man's work is never done."

Perhaps there is more to the presidency than just the day to day details. Perhaps the greatest contribution of all is to pass along to one's successor some of your enthusiasm for the work of the organization, some of your experience to aid him and some of the inspiration that drove you so hard so that he may carry on the things you saw started, and see many of his own brought to fruition.

Don't leave it all to the president. No matter how good he may be, he is helpless without the support of the members. The responsibility of his office, the stirring challenge of the future are yours as well as his.

What will this future hold for the Institute? I see in it opportunities and problems that will tax the best minds in the organization but I see, also, new heights of activity and new achievements that will go on building new standards of service on the foundations laid by those who have gone before.

The Institute is a great organization. It was founded by the leaders of the profession, the giants of their time, and it has been blessed with the continuous support of such persons. Already it has done a work that has made it a distinguished asset to Canada, but what is ahead will be even brighter as it meets square on the challenge of the future.

To every one of you I say if you are interested in your country, if you are interested in the welfare of your profession, stand firmly back of the Institute. It needs you—and you need it.

Annual Meeting Reports

In subsequent issues of *The Engineering Journal*, reports and pictures of the principal meetings and other functions will be published to complete the record of a highly successful program.

Month To Month

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

Bigger and Better

So many times it has been said that a person never really knows the Institute until he has attended an annual meeting. It is true that the great, broad program of the Institute cannot be seen or appreciated in any other way.

The 1956 meeting just completed in Montreal must have impressed many hundreds of people, some in attendance and others who followed it in the daily press. It is encouraging from year to year to see the program improving in quality and quantity, and the members turning out in steadily increasing numbers to participate in it.

This latest meeting as far as the record or man's memory goes has broken all records. There were more people present (1700 to 1800) to hear more papers and panels than ever before. There were more representatives of sister societies, more gentlemen of the press, more ladies, more excitement and more fun than ever before. And of course there were trials and tribulations for committee members and Headquarters staff, but they were not out of proportion to the other factors.

The Institute's Important Work

This meeting proved again and with increased emphasis the importance of the Institute and its work, both nationally and internationally. One needs but to look at the program to see the importance of the subjects discussed and the high calibre of the authors and speakers to realize that the Institute has a great work in hand — work of real significance to the profession and to Canada. The members of the profession through the Institute are indeed accepting their responsibilities towards the development of the profession and of the people associated with it.

Probably nothing ever done previously by the Institute has had as great a significance as the conference on engineering education. To this conference were invited the deans and three members of the staff of every engineering degree-granting university in Canada. In fact, there were additional staff members present as observers. The Institute paid the entire cost of the conference. The deans have reported a most successful two days of meetings. There were about sixty in attendance. There has never been such a meeting before. A report in some detail will appear in a later issue of *The Engineering Journal.*

Sister Societies Participate

The Institute was fortunate and happy to have so many representatives from other societies. The American Society of Mechanical Engineers and the American Rocket Society were joint participants in the technical program. The Institution of Mechanical Engineers and the British Institute of Management also were represented by members participating in the program. As well, there were the presidents of the Institution of Electrical Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the Engineers' Council for Professional Development and a representative of the Société des Ingénieurs Civils de France. It was a great meeting. Not only did it make a worthwhile contribution to the professional life of Canada, but it pointed up the usefulness and adaptability of the Institute itself. Such a showing puts further obligation on the officers of the Institute to forge ahead with Canada but also it gives the encouragement to accept the challenge.

"On the past we build the future" and so on to Banff in June, 1957, for more achievement and for more development of the profession.

Cover Picture

A touch of humour and a tribute to a well-made automobile was added to the 70th annual meeting when Mayor Jean Drapeau and Dr. and Mrs. R. E. Heartz of Montreal arrived at the Mount Royal Chalet in a 1911 Cadillac. The City of Montreal was the host at a buffet supper in the Chalet where over 800 guests were welcomed by the mayor.

C.P.R. Photograph

Annual Meeting

1960

At the April meeting of the Council of the Institute an invitation was received from the Winnipeg branch inviting Council to hold the annual meeting of the Institute in that city in 1959 or 1960.

In view of the fact that the 1957 meeting is to be in Banff, Council felt that another meeting in the West should not take place until 1960. Accordingly the invitation was accepted for that date.

The record shows that the Institute has met twice in Winnipeg—once in 1921 and then again in 1945. Both meetings were outstanding successes and anyone who attended either one of them will be delighted to know that another one will be forthcoming shortly.

Eating our Seed Grain

In the light of today's shortage of engineers and scientists it is disturbing to realize that there are many instances of industry taking away from the universities, people who have had an important part in training engineers and scientists.

Recently an advertisement appeared in "The B.C. Teacher", which illustrates the point excellently. The advertisement is reproduced herewith.

Opportunities for Science Teachers

Young men science teachers will find interesting opportunities in the pharmaceutical field where scientific knowledge, coupled with teaching ability, are prime requisites.

A well known ethical pharmaceutical house, expanding its business, is now offering stimulating work in the presentation of new developments to the Medical Profession.

It is interesting to note that the organization refers to itself as an "ethical" organization. There are some people who might think the adjective was not appropriate under these conditions.

It is inevitable that this competition between industry and education will exist, when it is remembered that the salaries paid at universities are so much lower than those offered by industry. Nevertheless, industry should be wise enough to see that their needs in the future can never be met if they continue to take out the teachers who are solely responsible for producing the crop year after year.

Teachers Going Into Industry

The president and general secretary of the Institute were entertained at lunch by the president of one of the western universities during the visit there last November. During the course of the luncheon the president of the university stated that during the year they had lost eight of their senior instructors. Six out of the eight were going into industry and only two to other educational institutions. It is hardly necessary to explain that this was a serious blow to a university that is trying so hard to do a job of work commensurate with the demands and with the opportunities.

A Dangerous Practice

Perhaps the cure for this suicidal practice is to have the teachers paid better salaries. Certainly it would not be fair to the teachers to persuade industry never to approach them, but perhaps there could be some reasonable compromise between these two extremes. There are some instances where teachers have done better for themselves and for others as well once they got into industry. On the other hand there are a great many teachers now in Canadian universities whose presence there is vital, not only to the numbers of engineers and scientists turned out but to the quality as well. Is it too much to hope that the universities in one way or another will find enough money to pay these important people something like the salary they should be earning, and at the same time that industry will realize that its own success in the future depends upon these people remaining at the universities?

British Plan for Technical Education

From a recent issue of the magazine *Flight,* we see that the British Government is proposing to do something drastic about the shortage of engineers and technicians. The leading editorial in *Flight* contains several interesting passages. Those which relate to facts rather than to opinions are these:

"The immediate objectives of the Government's five-year plan for technical education, disclosed in a White Paper last week, are to increase by 50 per cent the output of students from advanced courses at technical colleges; to double the numbers released by employers for part-time day courses; and to spend some £100m on new buildings and equipment. The main avenue of advance to the highest qualifications will be 'sandwich' courses of alternating theory and practice; and most full-time and sandwich courses are to be concentrated in colleges of advanced technology.

"Much space in the White Paper is devoted to the task of 'selling' technical education — to parents, teachers, employers, trade unions and the general public, all of whom are urged in the national interest to support the Government's plan. A major factor if the plan is to be a success is the attitude of individual employers; the provision of facilities for any young man or woman to continue to advanced training is only one aspect of the complete and imaginative approach to the problem that is required.

"The employer's responsibility to youth is three-fold. Firstly, the practical training offered at a firm's own factory should be an effective apprenticeship, be it full, sandwich, or short-period. It should not be the casual and frustrating semivacuum experienced by so many in the past.

"Secondly, the firm's attitude towards day-release, sandwich and full-time advanced courses at colleges and universities should be an enlightened one. The firm's own short-term interest should not over-ride the line of best development for the individual concerned.

"Thirdly, the student technician's endeavours in achieving a sound education should be matched by honesty and integrity of purpose on the part of the employer after training is completed. Firms may need to be reminded that it is for them to give students good reason to join and stay with their particular organizations."

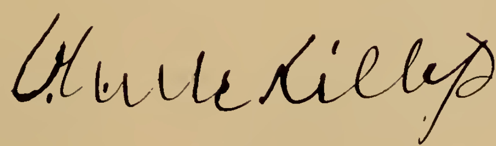
While the editorial in *Flight* is directed principally to the aircraft industry, nevertheless it has much of a general interest. Until a copy of the White Paper itself is received at the Institute, it is thought the information disclosed in this editorial will be of interest to Canadians.

Message from the President

THE privilege of serving the members of The Engineering Institute of Canada in the capacity of president is one for which I am very grateful. The long record of the Institute in the service of this country and, in fact, far beyond our borders is such that I can only consider it a real honour to participate actively in this work. The past presidents and officers have set an example in their devotion to the interests of the Institute that will be an inspiration to those who follow.

Whatever service the engineers of this country have been able to render to their fellow citizens in the past, it would appear that there will be many more opportunities in the future. The responsibility of the engineers for the welfare of the people was recognized during the war, and with peace came a new understanding of the reliance placed upon the work of the engineers by all levels of society. This dependence has become so related to our every day requirements that it is now the very basis of our way of life. Likewise, the experience and advice of engineers is essential for the wise and orderly development of our natural resources. The engineer himself, being one of those resources, should feel a special sense of responsibility to see that his time and talents are used wisely.

When we are able to adopt such an attitude toward our work and responsibility, we will then be thinking as engineers first, and as members of this or that organization secondly. Then Confederation will be an accomplished fact.



V. A. McKillop, M.E.I.C.
PRESIDENT

At the 80-ft deep excavation for the Iroquois lock at Iroquois Point, Ontario, the contractor will soon be placing concrete for the structure. Here ships will pass between the power pool or seaway lake and the upper river to enter the Thousand Islands section of the seaway.

St. Lawrence Seaway and Power Project

The *Engineering Journal* reviews the progress of the St. Lawrence project.

Progress by Ontario Hydro

In general, the wet weather and soft ground conditions during April made construction work difficult. Excavation for all features of the project at end of April totalled approximately 10,700,000 cubic yards.

Concrete placing in the north end of the power-house continued throughout the month of April on an accelerated scale. A total of 67,300 cubic yards had been placed in the "U" abutment sector and the wing wall by the end of the month.

On the diversion canal, now 25 per cent complete, the contractor had reached rock at grade in the closure structure area. This bottom will be ready early in May for concrete placing. The contractor had commenced erection of a new batching and mixing plant. This new concrete plant was expected to go into operation in May.

In preparation for the mile-long diversion canal, the Cornwall transformer station was dismounted, and the contractor had been excavating in the west end of the canal near Robinson's Creek. Meanwhile the new St. Lawrence transformer station was placed in service. It has taken over the 44-kv. and 115-kv. loads formerly handled by the Cornwall transformer station.

With the return of spring weather, dredging operations had been resumed at Chimney Island near Prescott, where dredging was about 12 per cent completed. The Canadian Dredge and Dock Company's unit "Excelsior" had resumed operations on the channel. Meanwhile, at Galop Island, excavation was more than 25 per cent complete. The contractor had reached bedrock in the northwest corner of the excavation and was using the rock produced to build the permanent training dike from the island at the northwest end. Excavation at Iroquois Point was about 32 per cent completed.

Preparations were being made with the return of favourable weather to commence work on the Cornwall dike. The Commission's highway and railway contractors also were preparing for full-scale resumption of work.

Bad weather and soft ground conditions had hindered rehabilitation work in all areas. It had been hampering excavation for sewers and water mains in all four new townsites. At Iroquois, the house moving machines had been operated in a limited way, being supported on temporary timber runways to travel over the soft ground. A total of 123 houses had been moved to the end of April. Work was started in Morrisburg on sewer and water mains. Meanwhile, this work was continuing in new towns Nos. 1 and 2.

Employment had reached a total of 2,800 men on 28 construction contracts.

Progress by NYSPA

April progress and the start of the crucial 1956 construction season were marked by the placement of the first concrete in two additional projects of the power development. April 17 was "Concrete Placement Day" at Barnhart power-house; at Massena intake it was April 24. April was also marked by a new high in employment. Excavation quantities had passed the fourteen and one half cubic yard mark, although excavation for the structures was tapering off as bedrock was exposed.

The structure of Iroquois dam was taking shape as the concrete piers rose from foundation and apron in the east section, with concrete in four piers placed to above tail-water level. Concrete in place at the end of April totalled 34,000 cubic yards. Excavation of upstream dikes had increased the total yardage to two and a half million.

Concrete placement at Long Sault dam was resumed on April 4 with 28,300 cubic yards being placed during the month, bringing the total in place to 60,000 cubic yards. Concrete had been placed to gate sill level over nearly half of the length of the dam. Excavation for Cut "F" was 59 per cent complete and erection of the cofferdam "E" cableway towers was in progress. Employment on this contract had passed the one thousand mark.

With rock excavation at its final depth in sections of the Barnhart power-house, concrete was being placed more than 80 feet below the river surface under two units near the south end. Form construction and installation of embedded items as well as continued drilling, grouting and other activities had required substantial increase in employment.

At the Massena intake, the first concrete was placed in April, some 64 feet below the water level in the canal. The structure is about 22 per cent complete.

Rock and earth excavation in the Galop Island south channel continued to progress, but a resumption of dredging in the Chimney Island area was delayed by a labour dispute.

Access roads were 85 per cent complete; land acquisition 100 per cent complete; reservoir clearing 5 per cent complete; Barnhart Island bridge 97 per cent complete and dikes 20 per cent complete.

Surveys for the Barnhart-Plattsburg transmission line were well underway. Studies were being made of docking facilities near Robinson Bay Lock for Alcoa.

The contract for channel excavation at Point Three Points—Leishman's Point—Ogden Island had been awarded. Bids were received for the electrical work at Barnhart Island power plant.

Preparation of engineering drawings and specifications continued on schedule. Purchase orders had been placed for accessory equipment including load frequency control apparatus and station lightning arresters. Employment had reached a total of 3,290 men on 26 construction contracts.

Progress by SLSA

To the end of April 1956, 32 construction contracts had been let by SLSA for a total of over $80 million. The value of work completed was approximately $15 million or 20 per cent of the work awarded to date.

Construction was actively under way in the Lachine section over the whole 16-mile stretch from deep water in Montreal harbour to within a mile of Lake St. Louis. This work is let in nine general contracts amounting to a total of $45 million, and includes the St. Lambert and Côte Ste. Catherine locks. In addition to the above nine contracts, only three others are required to complete the whole Lachine section.

Here progress is well ahead of schedule. One contract was fully completed eight months before its stipulated completion date, and all others, save one, are proceeding according to schedule. This one has been delayed because of high water, but with normal conditions again prevailing, it will catch up. At the start of the second year of construction the Lachine section was roughly 10 per cent completed by dollar value, with two and a half years to go.

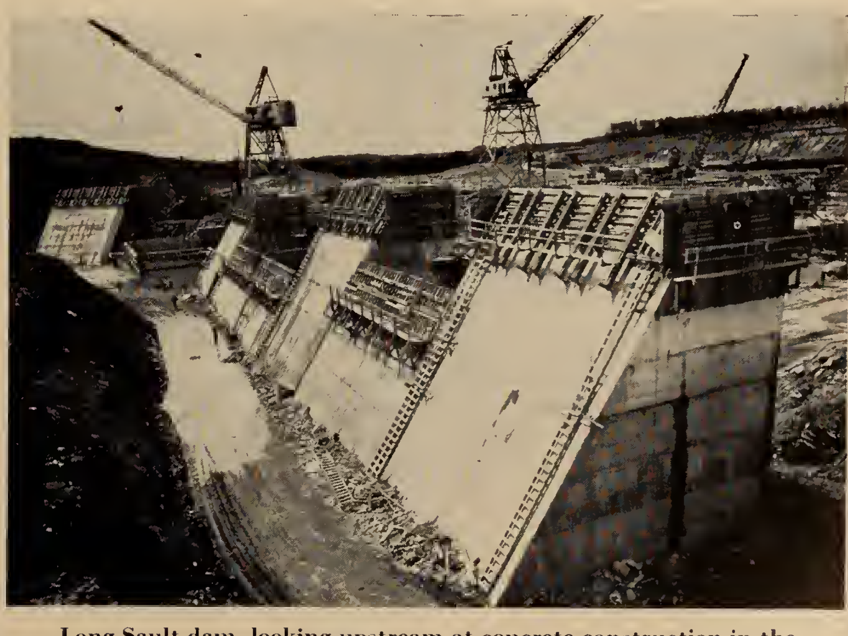
In the Lake St. Francis section which extends for some 15 miles, channels were being deepened by dredging to a depth of 27 feet where necessary. Here 30 per cent of the channel excavation work had been completed and work was ahead of schedule.

The work to be done in the Soulanges section, nearer Montreal, includes the construction of two locks separated by a three-quarter-mile intermediate pool. Also required is the construction of three lift bridges at the existing railway and highway bridges crossing the Beauharnois power canal, which will be used for navigation. No. 3 highway, which follows the shore of Lake St. Louis will be carried under the lower lock in a four-lane divided tunnel.

In this section a contract has been awarded for the first stage construction of the two locks which includes the excavation for the main highway diversion tunnel, the cofferdam, and close to a million yards of rock excavation for the channel. Work is just getting under way.

The award of two additional contracts for the supply of concrete aggregates: one for the supply and delivery of fine aggregate to a railway siding at Côte Ste. Catherine, is announced by SLSA. This fine aggregate is to be used for concrete in the Côte Ste. Catherine lock. The other contract covers the handling of sand from the siding to the contractor's bin.

The contract for the supply of the aggregate—185,000 tons f.o.b.



Long Sault dam, looking upstream at concrete construction in the southeast retaining wall.

railroad cars, is valued at $397,750 and was awarded to Standard Lime Company Limited. The contract to handle the sand at the lock site was awarded to Canamont Construction Ltee., and Canit Construction Ltd. in joint venture, and is valued at $181,300.

Tenders have been called for the excavation of the channel and the construction of a dyke in the Caughnawaga Indian Reservation, Lachine section. This contract will be the last one to be awarded for excavation and dike purposes in this section of the seaway.

The work consists of 1,200,000 cubic yards of common excavation, 1,980,000 cubic yards of rock excavation, and approximately 10,000 feet of dyke construction. In addition, it includes clearing, cofferdams, unwatering, handling and disposal of surface drainage and the disposal of materials. The work must be completed by August 31, 1958.

New Bridge at Cornwall

Cost of a new bridge for the seaway across the St. Lawrence river near Cornwall will probably be shared by Canada and the United States. A bridge now spans the north river channel from the Canadian shore to Cornwall Island. A second bridge spans the south channel from this island to the U.S. mainland. The two bridges are owned by the New York Central Railway which leases them for motor traffic to the Cornwall International Bridge Co. This company also operates a highway across the island.

Seaway shipping will use the south channel instead of the north channel. This calls for demolition of the bridge over the south channel and its relocation across the river at Polley's Gut. On May 3rd a bill to amend the St. Lawrence Seaway Act, to permit Canada's Seaway Authority to build a new international bridge at Cornwall, was introduced in the House of Commons, where it got third reading and was sent to the Senate.

The New York Central will have the right to use the new bridge. However, there are rumors that New York Central may abandon their Cornwall-Ottawa line entirely, now only used for freight service since passenger traffic was abandoned two years ago Negotiations are reported under way with the Ontario government regarding a possible purchase of the right of way for a super-highway between Cornwall and Ottawa.

Progress by SLSDC

A full year after the actual start of earth moving on the American side of the St. Lawrence at Robinson Bay lock, the hole was 95 per cent completed at the end of March, while excavation for Grasse River lock was 88 per cent done, with a further 300,000 yards remaining. Despite spring thaws and a week's strike by machine operators, contractors on locks and two canal excavation jobs had moved three quarters of a million yards for the month.

At the upper end of Long Sault canal "The Gentlemen" big coal-stripping dragline operated by Badgett Mine Stripping Co., had a completion score of 45 per cent. On the mainland portion of the 10 mile overland canal Morrison Knudsen-Kiewit showed a 9 per cent completion. At the Robinson Bay lock site the contractor had started preparing the lock foundations where rock was exposed.

With the award of contracts for building the two locks at Robinson Bay and Grasse River, the peak of the engineering design period has been passed. This effort has demanded the services of many engineers of specialized skill and experience.

Underestimating on major SLSDC contracts has resulted in total spending for the current fiscal year exceeding estimates by some $852,000. In addition, NYSPA has decided that SLSDC should pay some $20 million for dredging in the International Rapids Section. If the Seaway Development Corporation is charged with this added fiscal burden, it cannot operate within the $105 million limitation imposed by Congress two years ago, as the $18 million cushion between estimated spending and the legal limit is being rapidly used up.

A dispute with the Coastguard Service as to who should operate navigation aids has been turned over to Attorney General Brownell for a decision. Both the Comptroller General and Budget Bureau have ruled that the aids are SLSDC responsibilities, but the Coastguard has refused to accept the rulings.

Shipping on the Seaway

New Type Ships Being Created by Seaway

President Lionel Chevrier of SLSA told members of the Society of Naval Architects and Marine Engineers, meeting in Montreal May 3-4, that "The present Great Lakes-St. Lawrence system has already given rise to distinctive types of ships, each adapted to the type of service it is designed for within the limitations imposed by the route or the part of a route to be utilized, of which the laker-type bulk-carriers of ore and grain, and the canaller-type capable of negotiating the present 14-foot canals are the most familiar."

"The length and beam measurements," explained the speaker, "will be governed by the size of the new locks, being built to the same standards as those of the Welland Ship Canal. The seaway will accommodate vessels up to 765 feet long with beam measurements of up to 75 feet. Draught will be limited by the 27-foot depth of the channels and would therefore be some 25 feet."

The timeliness of the seaway in the light of economic development over the last 20 years was also stressed by the speaker. "In what I shall call the 'old days' it was perhaps natural to look upon the seaway project as a tremendous shot in the arm to a sluggish economy greatly in need of some such stimulant. Today, the patient is in robust condition and growing fast. None of our doctors in economics today would feel the need to prescribe the seaway as a stimulant; but they might well prescribe it as a much needed relief from growing pains," he concluded.

Cheap All-Water Rates May Boost Lake Ports

A boost in business for Great Lakes ports following completion of the seaway was predicted by Sydney A. Vincent, consulting architect, Newport News Shipbuilding and Drydock Co. He was addressing a meeting of the Society of Naval Architects and Marine Engineers at Montreal on May 2. The cost of moving a mixed cargo from Detroit to Antwerp by water, stated Mr. Vincent, would be half the cost of moving the same cargo from Detroit to Baltimore and thence to Antwerp by sea.

The speaker's conclusions give

inland ports like Toronto and Hamilton a yardstick by which to estimate the savings of shipping direct to and from lake ports, instead of moving cargo by rail to Montreal and thence by water to Europe. The study is one of few on the comparative costs of shipping from inland ports. It gives a firm indication of the sort of competition the port of Montreal will meet in retaining its present volume of ocean traffic.

Montreal port authorities have maintained the cheaper cost of all water traffic to and from lake ports via the seaway would be offset by factors such as congestion of the Welland canal, amount of overseas traffic destined for unloading at Montreal, and the relatively more economical movement of grain and major export cargo in lakers to Montreal for trans-shipment overseas.

Toronto Area Committee

The committee coordinating technical activities of civil engineer members in Toronto area of the Engineering Institute, the Institution of Civil Engineers and the American Society of Civil Engineers, has concluded one year's work. At an executive meeting of the Joint Area Committee, as it is named, two items were recorded in the minutes which are of interest.

The membership list of the committee is now complete and contains the names of all known members of the three parent bodies residing in the area of Greater Metropolitan Toronto. It was decided to restrict the list to this area, unless specific requests were received from members residing outside of it. Any member who has accidentally been omitted from this list, or who wishes to be included, should contact Mr. B. Hardcastle, c/o McColl Frontenac Oil Co. Ltd., 8 Spadina Road, Toronto, (Telephone Walnut 4-8711).

There will be an Open Night on the program for the 1956-57 session, for which original papers of civil engineering interest are invited from members of the Joint Committee. The tentative date selected for this meeting is April, 1957. Any member wishing to present a paper on this occasion should contact the secretary in writing, outlining his paper briefly.

Aeronautical Meeting

The Canadian Aeronautical Institute held their third annual meeting in Montreal, on May 4 and 5, 1956. For this meeting the C.A.I. had arranged a program treating aviation in its various aspects—propulsion, manufacturing, design, aerodynamics, maintenance and operations. The technical program fulfilled the purpose of reviewing Canadian aviation to date, to the extent that one paper had to be revised to avoid disclosing secrets of Canada's latest supersonic fighter. This was J. Morris' paper on "Some Performance Problems Associated with a Mach 2 Fighter". The technical program was as follows:

The Program

The Development of Rolls Royce Propeller Turbine Engines, by D. P. Huddie.

Choice of Design for an Advanced Turbojet, by F. H. Keast.

Manipulation and Control of Titanium, by L. B Gray.

Transition from Small to Large Aircraft Manufacturing, by H. L. McKeown.

Machining Approach to Aircraft Production, by H F. Young.

Design and Procurement of R.C.A.F. Ground Handling Equipment, by F/L B. D. Darling.

Lift and Thrust Creating Systems—Their Application to Short and Vertical Takeoff Aircraft, by F. C. Phillips, and K. Irbitis.

The Comet 4; Design and Operational Considerations, by R. E. Bishop and J. Cunningham.

An Experimental Investigation of the Effect of Surface Roughness on the Drag of a Cone-Cylinder Model at a Mach Number of 2.48. by Dr. J. H. T. Wade.

Some Performance Problems Associated with a Mach 2 Fighter, by J. Morris.

Boundary-layer-induced Noise in the Interior of Aircraft, by Dr. H. S. Ribner.

The Changing Aspect of Northern Flying, R. N. Redmayne.

Airline Engineering Evaluation of Transport Aircraft, by A. E. Ades.

Field Data Analysis; Some Techniques Currently Being Developed in the R.C.A.F., by S/L. J. E. Neelin and B. Larmour.

McCurdy Award

R. D. Richmond, president of the 1500-member Institute, who is chief development engineer of Canadair Limited, presided at a business meeting, and at the annual dinner.

The annual dinner provided the occasion for the presentation of the McCurdy Award for 1955 to J. H. Parkin of the National Research Council. The Hon. J. A. D. McCurdy for whom the award is named, was there to make the presentation to the Canadian judged to have achieved most for Canadian aviation during the past year. Mr. McCurdy was the first Canadian to fly a powered aircraft.

M. M. Hendrick Is Speaker

Air Vice-Marshal M. M. Hendrick, Air Member for Technical Services, R.C.A.F., speaking at the annual dinner, discussed the R.C.A.F., which in the last three years has become a jet air force using planes which are now all Canadian-built.

He mentioned some of the "tools" of the Air Force: the CF 100; the Sabre VI, used abroad, the Silver Star jet trainer, and the Pine Tree Warning Line, the electronic control network. With these tools, he said, the Air Force has created a fully operational fighting machine.

He touched the subjects of ground control and electronics, and the technical complexity of air defence and offence. The Air Force is predominantly a technical service, he said; one fifth of all its officer personnel are practising engineers. An important technique now is Operational Analysis or Weapons System Analysis, a procedure which will be recognized by engineers in industry.

The great problem facing the military in the future is how automatic to make the air defence system, the air vice-marshal said. But his opinion was that man will still fly in the plane of tomorrow. The new supersonic fighter now under design and development in Canada will carry two men to exercise judgment and to deal with the unexpected. The guided missile still must demonstrate its ability to do all the things promised of it.

Another challenging thought was the possible increasing measure of help from industry, not only to fabricate air defence facilities and overhaul them but to maintain them. However this balance between service and civilian activities for defence may come out, said AVM Hendrick, the fact remains of course that there always will be a partnership between the Air Force and the industries which support it.

Canadian Pipeline Projects

A monthly review of the news and progress of the projects for piping Alberta natural gas westward to Vancouver and the Pacific states, and eastward to serve Canada's central provinces.

Progress by Westcoast Transmission

In sharp contrast to the tangled affairs of the Trans Canada pipeline project and the noise of battle over its destinies in the House of Commons in late April and early May, Westcoast Transmission's 680-mile project to bring Canadian gas to Pacific states was well away to a good start on construction.

Westcoast Transmission construction crews were already shifting into high gear in April, with nearly a third of the expected summer employment of 2,700 men already on the payrolls, clearing right of way, building access roads for delivering the pipe, and laying pipe at river crossings. Delivery of the first 3,000 tons was made at Vancouver in February and March, out of the 90,000-ton $15-million order from Britain for the first 250 miles of pipeline. The balance of the order is scheduled to arrive in monthly lots of 6,000 tons.

Contracts had been awarded for the entire 668 miles of line from Peace River to Huntington at the International Boundary. Dutton Williams is building the northerly 110 miles from Taylor Flats in the Peace River block to the Parsnip River. Canadian Bechtel Limited construction division is undertaking the next 210 miles to just north of Williams Lake; Conyes Construction Corporation is building from there to Merritt, while Mannix Limited is doing the balance from Merritt to Huntington.

Franchises had been executed at Penticton, Kelowna, Vernon and Trail. Inland Natural Gas Company will build a lateral pipeline to serve the Okanagan Valley, tapping the main line at Savona. Other short laterals will serve Prince George, Quesnel, Williams Lake and the surrounding districts.

A contract had been awarded for construction of the $18 million natural gas absorption plant near Fort St. John, B.C. This plant scheduled for completion in 1957, is one of the first industrial operations in Northern B.C. connected with the petroleum industry. The plant is to be located on the north bank of the Peace River near the Alaska Highway bridge, and will process the gas before it enters the pipeline.

It is a three stage operation, in which raw wet gas is scrubbed and cleaned, liquid hydro carbons removed and elemental sulphur produced. The 250 to 300 tons daily of sulphur to be produced initially will be more than sufficient for the needs of the entire British Columbia pulp and paper industry. The plant may be the forerunner of many new chemical industries for British Columbia.

As well as the sulphur, propanes and butanes, the plant will produce large quantities of high grade fuel for cars, trucks and aircraft. As gas volumes carried by the pipeline grow in coming years the capacity of the plant will be increased.

Contracts for building the plant were awarded to the Marwell Construction Company of Vancouver, while the Stearns-Roger Company, which has world wide experience in building gas absorption and gasoline extraction plants, will make the installations. More than 700 men will be employed in building the plant. It will give employment to some 100 permanent workers.

Meanwhile, south of the international border, construction of the Pacific Northwest pipeline to connect up with Westcoast Transmission at Huntington was reported proceeding rapidly. At the end of March more than 750 miles of 26-inch and 22-inch pipe had been laid from the San Juan Basin to Kennewick, Washington, where the line splits into three branches, or about half of the total length of 1,487 miles. The line on the American side is being built by Fish Northwest Constructors, Inc.

A 70-well gas drilling program in the Peace River area at a cost of between $20 and $30 million is being undertaken this summer by Pacific Petroleums Limited. A new gas discovery in April, 160 miles northwest of Fort St. John by Shell Oil and Canadian Gulf Oil, found a 12 million cubic foot per day gasser from the mid Devonian horizon. Located near the centre of British Columbia's gas reserves and close to Westcoast's main source of gas supply, this important discovery is being watched with interest.

The Westcoast Transmission project, given final FPC approval in November, 1955, joins gas reserves of Northern Alberta and Northern British Columbia with the U.S. supply from the San Juan Basin in New Mexico, to supply the States of Washington, Oregon and Idaho, extending the market to San Francisco in California. The size of the pipe was raised to 30 inches in place of the 24 inches originally planned. It will supply 250 million cubic feet daily towards the 350 million cubic feet per day market in the north Pacific states by 1957.

Starting at Fort St. John, centre of the British Columbia gas reserves, it parallels the John Hart highway to Prince George, then follows the Cariboo highway and Pacific Great Eastern Railway south, swinging eastward just above the Fraser Valley to terminate at the U.S. border near Huntington, B.C., 35 miles east of Vancouver. There it will join up with the Pacific Northwest Pipeline Corporation's main from the south. A spur line will serve Vancouver, while other laterals will feed many other British Columbia towns and communities.

The British Columbia Electric Company is carrying out a $10-million program in Vancouver and the lower Fraser Valley to increase its gas distribution system, in readiness for natural gas on November 1. Meantime gas will be supplied from the Pacific Northwest pipeline. Estimated savings to domestic and commercial consumers with natural gas will range from 25 to 52 percent as compared with manufactured gas.

Progress of Trans-Canada Pipelines

Up to the middle of May, the future of the Trans-Canada pipeline project still remained uncertain and confused. The bill to authorize a Crown Company to build the 675 mile Northern Ontario gap had been introduced in the House of Commons, and though lively debates occurred at intervals no final action had been taken. Extension of the time limit allowed for Trans-Canada to give proof of its ability to finance the project had been extended by the Board of Transport Commissioners from April 30 to October 30, 1956.

Trans - Canada announced in March that the company had signed up contracts with producers which strengthened its gas supply picture to a point where only a minor portion of requirements now need to be obtained to supply present market commitments.

The percentage ownership of presently outstanding stock of Trans-Canada is as follows: Canadian Delhi, 24½%; Western Pipelines group, 24½%; Canadian Gulf Oil, 17%; Hudson's Bay Oil and Gas, 17%; and Tennessee Gas Transmission, 17%.

By mid-April, financing for the $153 million project had been completed. The Metropolitan Life Insurance Company is taking $40 million, almost half of the $83 million of the first mortgage bond issue. All told, Canadians will put up $34 million, $10½ million of which comes from Royal Bank of Canada for debentures. The company will raise over $16 million from the sale of common shares, with 55½% of it coming from Canadians.

Heading a strong group of Canadian and United States oil and gas interests, Frank McMahon, Alberta oil and gas promoter and president of Westcoast Transmission, made an alternative offer in April to build the pipeline to the central provinces, without government assistance other than relief on sales tax and duty. Four American mid-west gas utilities would import 400 million cubic feet of gas daily, or twice the amount of import proposed by the Tennessee Gas Transmission. The offer, however, was withdrawn early in May. Legislation providing a $72-million loan to Trans-Canada was introduced in the House of Commons, to enable Trans-Canada to build the western leg this year as far as Winnipeg.

Elections and Transfers

At the meeting of Council held at Montreal, Que., on Tuesday, May 22, 1956, a number of applications were presented for consideration and on the recommendation of the Admissions Committee the following elections and transfers were effected:

Members:

A. R. Dow, *Beaurepaire*
W. N. B. Fitzgerald, *Downsview*
A. B. Hayman, *North Bay*
G. L. Karasek, *Montreal*
A. J. LeBlanc, *Toronto*
G. F. McClay, *Lennoxville*
W. C. McKenzie, *Vancouver*
W. C. McLean, *Valleyfield*
R. T. MacTavish, *Montreal*
H. D. Morgan, *London, England*
A. A. Reid, *Montreal*
E. Rogers, *Montreal*
J. R. Russ, *Montreal*
W. J. Underhill, *St. Thomas*

Juniors:

L. H. Clifton, *Transcona*
I. W. Hollingsworth, *Sault Ste. Marie*
J. A. McNish, *London, England*
A. H. S. Mousley, *Montreal*
J. C. Richardson, *London, Ontario*
S. S. Sapinski, *Vancouver*
R. L. Smyth, *St. John's*

Transferred from the class of Junior to that of Member:

C. T. Aitken, *Montreal*
P. Cormier, *Outremont*
G. B. Edwards, *Ottawa*
V. A. O'Kelly, *Tokyo, Japan*

The following Students were admitted:

Université de Sherbrooke

R. Auclair	N. G. Laflamme
A. R. Audet	A. Lafrance
G. E. Barre	J. Lague
M. P. Bergeron	R. Lambert
C. Blais	A. Lebrun
S. Bolduc	R. Lemay
A. Brochu	A. Leroux
R. Brunelle	J. D. G. Luneau
P. E. Chainey	R. N. Malouin
M. Cote	G. Migneault
G. Delisle	J. P. Morin
N. Fauteux	R. Y. Nadeau
G. G. Fortin	L. Page
G. Gagne	M. Pigeon
A. Geoffrion	J. G. E. Provencal
J. L. B. Grondin	L. Rondeau
C. Hamel	C. Rouillard
G. G. Henault	A. St. George
N. Houde	R. J. J. Trudeau
C. Labrecque	C. Verville

Nova Scotia Technical College

M. C. Campbell	A. T. Lower
W. H. Gates	A. W. Worth

Royal Military College

R. J. W. Blacker	D. S. Oakes

University of Alberta

M. R. Leenders

Carleton College

B. B. MacNabb

Dalhousie University

W. D. Leach

Graduates:

B. G. Ahern, N.S.T.C., B.E. (Elec.), 1956
E. J. Bereta, N.S.T.C., B.E. (Elec.), 1956
H. T. Bodurka, N.S.T.C., B.E. (Elec.), 1956
C. J. Callaghan, N.S.T.C., B.E. (Elec.), 1956
I. C. J. Di Giacinto, N.S.T.C., B.E. (Mech.) 1956
A. D. Lane, N.S.T.C., B.E. (Mech.), 1956
F. Maselli, N.S.T.C., B.E. (Civil), 1956
M. R. McKay, N.S.T.C., B.E.(Elec.),1956
A. M. Osorio, N.S.T.C., B.E.(Civil), 1956
N. W. Prokos, N.S.T.C., B.E.(Elec.), 1956

Applications Through Associations

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections and transfers have become effective:

Alberta

Member:

D. P. Smith

Saskatchewan

Members:

D. A. Black	A. N. Lang
P. F. Brennan	A. P. Newell
E. F. Cybulski	R. W. Phendler
E. H. Hanson	W. J. Wankel

Students:

R. H. Bjerke	J. B. Street
W. E. Threinen	

Junior to Member:

A. E. Dawson — W. A. Schwinghamer

Student to Junior:

D. G. Matheson

New Brunswick

Junior to Member:

R. G. Cowan	L. W. MacDonald
E. C. Garland	G. C. L. McEnery

Nova Scotia

Members:

A. J. MacDonald	E. J. Smith
L. M. Smith	

Junior to Member:

D. J. Bird	J. A. G. Brown
J. B. Morrow	

The Maritime Professional Meeting

St. Andrews by the Sea, N.B.

September 5, 6, 7, 1956

Thirty-five Years Ago

Comment on the *JOURNAL* of June 1921

The most important bit of Institute news in the *Journal* for June, 1921, was buried in the fine print of the Halifax Branch report. J. W. Roland, M.E.I.C., chief engineer of the Nova Scotia Highways Board, had been dismissed without any charges having been preferred against him and without any hearing. Attempts on the part of the Halifax Branch to get at the underlying reasons for this action met with complete failure, the Board refusing to discuss the case at all.

At that time the Board itself was under investigation by a Royal Commission which went on record as saying that Mr. Roland's "honesty and truthfulness have not been questioned. . . . Neither does there appear to be any question as to his capacity as an engineer." The Minister of Highways himself in a speech in the Nova Scotia legislature said he believed Mr. Roland to "be good, conscientious, honest and competent." It seems a little odd, to say the least, that the very people who dismissed Mr. Roland, without reason so far as the record shows, should go out of their way to praise him.

And it seems even odder that no mention of this affair was made in the *Journal* until June, 1921, when the dismissal took place in December, 1920, six months earlier. One would have expected the Institute at large, not just the Halifax Branch, to have exerted every power it possessed to wring some kind of explanation for its action out of the Highway Board, and if it were convinced that Mr. Roland had been wronged, to have done everything it could to secure justice for him. He must have thought the Institute's fine words about the services it was rendering to its members personally, quite voluminous at that time, were only so much hot air.

Of course, we know only what we see in print; much may have been going on behind the scenes. But the only action announced up to June. 1921, was the passage by the Halifax Branch of a strong resolution condemning the Highway Board for the manner in which it had dealt with Mr. Roland and supporting him solidly, small solace to a man who had been so summarily and unreasonably dismissed from what was virtually a public office.

Journal Uses Cartoons

This June *Journal* unbent enough to print a page of cartoons of some sixteen more or less prominent members of the Montreal Branch, contributed by A. J. Racey, the cartoonist of the Montreal "Star". It seems strange that so many of our older and more sedate members ever looked as these cartoons show them and sad to realize that a lot of them are no longer with us.

Each cartoon was accompanied by a poem, if one may be permitted to call it that, for most of the rhymes were pretty bad, even if they did hit off the quirks of their subjects. The author of these masterpieces is unknown; perhaps it is just as well.

Civil Service Debated

The Spinney bill was before the House in Ottawa. This would have taken a good many of the top positions out from under the Civil Service Commission and left them "in the hands of the Government", i.e., made them rewards for political service.

Naturally, the Institute was opposed to any such retrogressive step and said so in a long telegram to the Hon. Mr. Spinney himself. In reply they got assurances from him that "your organization will not be exposed to any hardships by the findings of the . . . (Civil Service) committee."

A correspondent from one of the branches noted that both the University of Toronto and Queen's University had conferred honorary degrees on some of our members and suggested that McGill University ought to do likewise. What he didn't realize was that in the matter of conferring honorary degrees our universities are as independent as the Supreme Court of Canada, and that each has its own cherished methods for selecting its candidates for such honours. It would be quite believeable that McGill did *not* include any engineers in its list *because* the other two did; it was not going to be charged with merely following the procession.

Town Planning

The town planners came up in this *Journal* with three schedules of twelve lectures each, one on "general principles", one on "techniques" and one on "regional and civic surveys", which they hoped the universities might adopt. They admitted that they were probably somewhat ahead of the times. There was only a drop of engineering flavouring in any of these schedules, which gives a pretty good idea of the 1921 concept of town planning.

Technical Papers

The place of honour in this *Journal* went to "Surge Protection on Transmission Lines and Cables", by S. Cunha and G. C. Bond of Montreal Light, Heat and Power, Consolidated. Their paper may have been an excellent one; it is hard to tell. Constant reference was made to its diagrams and most of these were poorly drawn in the first place and so badly reproduced that they were quite unintelligible. In many, if not most, of the Institute's papers illustration plays a major part. They ought to be neat and precise, showing enough, but not cluttered with needless detail. On the whole, the *Journal* does a lot better than it used to, but there is still room for improvement.

J. W. Tyrrel, M.E.I.C., had a paper in this *Journal* on the "Hudson Bay Route". Already the federal government had spent about $6¼ million on trying to develop a harbour at Nelson, before coming to the conclusion that perhaps this was not the best location. They also had about $14¼ million invested in the Hudson Bay Railway by that time.

So a halt was called and a Senate Committee appointed to look into the whole matter. Quotations from its report make interesting reading even now. "Sufficient care was not taken in the selection of Nelson as the terminus . . . A new . . . examination into . . . the merits of Churchill (should be made) . . . The waters . . . teem with fish and valuable marine animals and we believe that the Bay is equally well stocked . . . The mines already discovered . . . are of sufficient number and richness to indicate the existance of great . . . mineral wealth." Well, Churchill was chosen as the railway terminus and the operations of the Hudson Bay Railway over a considerable period are now a matter of record.

F. H. Link, geologist with the Imperial Oil Co. Ltd., wrote an interesting historical paper on the search for oil in the Fort Norman area. Seepages were noted there by Sir Alexander Mackenzie in 1789. The first geological survey, a paleontological one, was made by Meek in 1867 and the first oil reconnaissance was made in 1908-09 by a geologist of the Standard Oil Co. of Ohio. On August 25, 1920, a high grade of oil was struck at Oil Creek.

We hear little of the Norman Wells field today. It has been pretty well eclipsed by more productive fields closer to civilization and to markets, but there are those who insist that Canada's greatest oil potential lies in the far north and in the "tar sands" area. The latter we know to contain enormous reserves of oil. The problem is how to extract it economically, a problem which will be solved when it becomes worthwhile.

Correspondence

City Planning, Montreal

This communication is published at the request of C. E. Campeau, M.E.I.C., director of the City Planning Department, Montreal. Ed.

To the Editor:

The director of the City Planning Department of Montreal wishes to inform builders, promoters, engineers and architects that, in future, all plans submitted to his department for erecting new buildings or for modifying existing buildings, on Sherbrooke and Dorchester Streets and on the Metropolitan Boulevard, will be submitted to the approval of a committee of the Planning Commission especially appointed for exercising an aesthetic and architectural control of construction.

At its last meeting, this Committee on Architectural Control requested the collaboration of all interested citizens so as to give a good aesthetic appearance to the major arteries of the city. In order to facilitate the work of the committee, the director of the City Planning Department requests all promoters and architects to submit preliminary sketches of their projects and to await the approval of the department before proceeding with the preparation of the detailed plans. Everybody will save time by this procedure and will also avoid unnecessary expense.

The Architectural Control Committee and the City Planning Department rely on the help of the architects', engineers' and builders' associations for bringing to fruition an initiative which is one of the first of this type on the American continent.

C. E. Campeau, M.E.I.C.
March, 1956.

Students and Scientists

The following is quoted from the *Hamilton Spectator* of December 8, 1955. Ed.

To the Editor:

What do high school students think about the idea of becoming scientists ?

Dr. Melvin Barnes, assistant superintendent of Oklahoma City schools, said a survey he conducted here indicates the youngsters have little or no desire to make science a life work.

He asked 100 high school juniors this question: Why is it more students do not take science and math ?"

"Einstein! Long hair and a sweat shirt," one youth said.

Some described scientists as "squares" and "little old men with beards working in a musty laboratory."

The majority described science and math courses as dull, that they take too much time and that they aren't taught to really "understand" the subjects.

They declared that an education in science is expensive and, after making the investment, you "wouldn't make much money." And, on top of it all, who wants to be called a "square or a brain ?"

In his interviews, Barnes referred only to advanced high school courses in math or science which students may elect to take.

"A timid, conservative shy little man," one pupil commented when asked about Dr. Jonas Salk (polio vaccine).

"A scientist is an evil genius on TV thinking up ways to torture people," another said.

"Duke Snider (Brooklyn baseball player) is one of the 10 best dressed men. If he was a scientist, would he be ?" a boy asked.

Some suggested the scientist should be "glamorized." Students see the scientist as a man who works "alone" and is not social or friendly.

The foregoing gives a realistic insight into the way a teenager views a scientist. There is no reason to believe, in this day of instant communication, that youths of Canada think any differently than those of Oklahoma City.

How to Influence Youth

While a lot of earnest work is being done to induce youth to select scientific careers, one wonders if the problem has been either fully appreciated or that measures taken have received the emphasis or organization which they deserve. It is not enough to have a local scientist annually visit the school and, somewhat extemporaneously extol the virtues of his profession. Someone has to do a real selling job. A job that is honest and gets down to the teenage way of thinking.

It may well be that one of the key factors in influencing a youth's thinking is an appeal to his sense of adventure. On this theme Her Majesty the Queen has already pointed the way in her Christmas message:

". . . For all of us each new year is an adventure into the unknown. Year by year, new secrets of nature are being revealed to us by science — secrets of immense power for good or evil, according to their use. These discoveries resolve some of our problems, but they make others deeper and more immediate.

"A hundred years ago our knowledge of the world's geography was by no means complete; today most of the blanks have been filled in.

"Our new explorations are into new territories of scientific knowledge and into the unknown regions of human behavior.

". . . In the words of our Poet Laureate:

'Though you have conquered
earth and charted sea
And planned the courses of
all stars that be,
Adventure on, for whom the
littlest clue
Has come whatever worth
man ever knew:
The next to lighten all men
may be you.'

"We must adventure on if we are to make the world a better place. All my peoples of the Commonwealth and Empire have their part to play in this voyage of discovery".

George Matthew Adams in "Voyages Into the Unknown" writes: "Adventurers are among the greatest benefactors. They have delved into the earth for its secrets. They have crossed great areas in search for homesteads and challenged the air, the sea and the untried. You will find these brave and courageous men among our inventors, pioneers and scientists. It's the unknown that men strive to discover".

While all the arts give scope for creative thinking none have more promise than science or engineering.

But convincing youth to consider science as a satisfying career is not enough. It should be backed up with something more substantial of which the following might be considered essential:

1. Assurance of approximately five months summer employment while at University.

2. Arrangements for loans for those who cannot finance their courses along with summer employment.

3. Assurance of a job by which to work his way through University by taking alternate years if he wishes to adopt this means.

4. Make available accurate information concerning rewards and remuneration received by scientists as compared with that received by persons in other professions.

5. Provide funds for enlarged facilities at universities, or establish science and engineering courses at universities where there are none.

6. Provide many more scholarships.

As education is a provincial matter it would seem desirable that all provinces agree to adopt uniform measures which would produce the results so urgently needed on an national scale. They should enlist the services of government, professional associations, educational institutions, industry, clubs and all interested in preserving our progress and way of life.

I feel we are on the threshold of the greatest period of scientific discovery and application the world has ever known.

"Ask, and it shall be given you; seek, and ye shall find; knock, and it shall be opened unto you."

Let's show the kids we aren't squares!

E. T. W. Bailey, M.E.I.C.
Hamilton, Ont.
March 3, 1956.

News of Other Societies

The Canadian Welding Bureau (1391 Yonge Street, Toronto) as a recently elected member of the International Institute of Welding, has provided Canadian welding engineers with information about the annual meeting which will take place in Spain, July 1-8, 1956.

●

The Nova Scotia Technical College announces the offer of a fellowship of $2000.00 by Bruner Mond Canada Sales Limited, Toronto, Ont. The fellowship is for the academic years 1956-57 and 1957-58, tenable at the department of civil engineering of N.S.T.C., for the purpose of studying the possibility of extending the highway construction season in Canada, to prevent freezing and promote compaction during freezing weather.

Further information may be obtained from the Registrar, Nova Scotia Technical College, Halifax.

●

The American Institute of Mining and Metallurgical Engineers held the 1956 Pacific northwest regional conference in Seattle, Washington, May 3, 4, 5, 1956.

Canadians taking leading parts in the conference were Dr. J. Gordon Parr, of the University of Alberta, and Dr. Desmond F. Kidd, of Attwood Copper Mines Ltd., Vancouver. In addition, six technical papers were presented by Canadians.

●

The International Society for Photogrammetry and the Swedish Society for Photogrammetry invite participation in the eighth international congress of photogrammetry being staged at Medborgarhuset, Medborgarplatsen, Stockholm, July 17-23, 1956.

●

The Netherlands Universities Foundation for International Cooperation offers a summer session at the University of Delft from July 20 to August 9, on the subject of "Communications in Our Shrinking Modern World".

Information about sessions and fees can be obtained from Mrs. A. F. P. Volten, secretary summer session, NUFFIC, at 20 Molenstraat, The Hague, Netherlands.

●

The Embassy of the Republic of Germany in Ottawa, has supplied information about industrial fellowships which are available from private donors in Germany for Canadian graduates in engineering.

The fellowships are for 4000.-DM each (approximately $950.) and can be used either for studies at a German university or for practical work with the donating firm.

Applications, giving some details and references as to academic abilities and character and facility in the German language should be addressed to: Presse-und Kulturreferat, Embassy of the Federal Republic of Germany, 580 Chapel Street, Ottawa.

Columbia University, New York, offers a summer session, July 29 to August 10, 1956, on the subject "What Managers Do and How They Do It". This is the fifth annual utility management workshop, with participation open to nominees from private gas, electric, telephone and pipeline companies, airlines, railroads and other transportation companies:

●

Massachusetts Institute of Technology (Cambridge 39, Massachusetts) lists subjects on the summer program as follows: Recent Developments in Fluid Power Control, July 9 to July 20; Control Systems Engineering, July 30 to August 10; Disposal of Industrial Wastes, from August 20 to 31.

●

L'Association des ingenieurs electroniciens will hold a congress and exhibition on automation in Paris from June 18 to 24, 1956. This is organized in conjunction with the main national engineering associations and its international character is pointed out by the fact that the vice-presidents are Dr. J. F. Coales of Cambridge University, and Dr. D. P. Campbell of Massachusetts Institute of Technology.

Correspondence should be addressed to: Secretariat du Colloque sur "l'Automatique", Chaire de Mécanique, Conservatoire National des Arts et Metiers, 292 Rue Saint-Martin, Paris (111).

●

Natural Resources Research Institute (University of Wyoming, Laramie). The fourth biennial briquetting conference, September 1, 2, 3, 1955, brought together speakers from Mexico, France, the United States and Canada. Canadians contributing to the sessions were E. S. Babinszki, Calgary, Dr. N. Berkowitz, Edmonton, R. P. Charbonnier, M.E.I.C., Calgary, W. A. Lang, Edmonton, C. F. J. Rozenhart, Calgary, and E. Swartzman, Ottawa. Dr. Berkowitz and Mr. Swartzman, and Mr. P. Prokopy, Calgary, serve on the executive of the Institute.

●

The Town Planning Institute of Canada (King Edward Hotel, Toronto 1). . . . A. P. C. Adamson of University of Toronto, is the president for 1956; P. Alan Deacon, Toronto, and Burroughs Pelletier, Quebec, vice-presidents; Hugh T. Lemon, Toronto, secretary-treasurer. Other officers are: A. H. Armstrong, Ottawa; C. E. Campeau, M.E.I.C., Montreal; R. Norman Dryden, Kitchener, Dr E. G. Faludi, M.E.I.C., Toronto, E. Fiset, Quebec, L. Gertler, Edmonton, Stanley H. Pickett, St. John's, D. J. Reddington, Cooksville, Ont., D. F. Taylor, M.E.I.C., Toronto, J. A. Walker, M.E.I.C., Vancouver, Murray Zides, Regina.

●

American Society for Engineering Education (Secretary, W. Leighton Collins, University of Illinois, Urbana, Ill.) will hold the 1956 annual meeting at Iowa State College, Ames, Iowa, June 25 to 29.

NEWS OF THE ASSOCIATIONS & CORPORATION

Information received through co-operation with the provincial organizations

British Columbia

Engineers in the News

H. P. J. Moorehead, chief engineer of the Powell River Company has been named vice-president of engineering.

F. G. Pearce has been appointed to the position of chief engineer of Vancouver Iron Works Ltd. Mr. Pearce has served both Vancouver Engineering Works Ltd. and more recently Vancouver Machinery Depot Ltd., as sales manager. As chief engineer, he will be in charge of hydro-electric turbines and associated equipment.

R. W. Racine has been appointed heating sales engineer for the B.C. Electric, responsible for promotion and sales of natural gas and electric space heating.

J. C. McAdam, who preceded Reg Racine as heating sales engineer has been appointed B.C.E. sales research engineer directing a staff on statistical, analytical and administrative operations.

C. G. Hewlett has been named the first winner of the Peacock Memorial Prize in mineralogy. The prize, amounting to $100.00 was recently announced by the Walker Mineralogical Club, of the University of Toronto, and is given for the best Canadian scientific paper on pure or applied mineralogy. Dr. Hewlett's paper, entitled "Optical Properties of Potassic Feldspars" was an outcome of studies made for his doctorate degree at the University of Wisconsin in 1954. He is a local graduate of 1949 and is presently with the geological staff of the B.C. Department of Mines in Victoria.

M. L. Zirul, of the Provincial Water Rights Branch has been promoted from district engineer to senior hydraulic engineer and has left Kamloops and taken up his new position in Victoria.

H. D. M. Jager, formerly chief engineer of Bralorne Mines Ltd., has been appointed chief engineer, Pioneer Gold Mines of B.C. Ltd.

B. L. McCallum has accepted a position with John Laing & Son (Canada) Ltd. He was with the Department of Transport, Air Services Construction.

J. H. Thomson has been hired by the Aluminum Company of Canada Ltd., as a field engineer on the Kitimat townsite development. He has been with Central Mortgage & Housing Corp.

R. H. B. Hebbert is now employed by Phillips Electrical Company Ltd., and has been sent to England for a one year training scheme with British Insulated Callander's Cables Ltd.

D. F. Samis has accepted a position with Sydney Roofing & Paper Company Ltd., in Victoria. He was formerly at Ocean Falls with Crown Zellerbach.

D. A. Foster has been transferred from Winnipeg to a new position as mechanical engineer for the Atlantic Region of the Canadian National Railways with headquarters in Moncton, N.B.

G. B. Ralston is now Vancouver manager of International Radiography & Inspection Services Ltd.

G. R. Wyer, executive vice-president of Canadian Fairbanks-Morse Company Ltd., Montreal, was elected a director of Canadian Locomotive Company Ltd., Kingston.

W. J. Trembath, until recently with the Trans-Mountain Oil Pipeline Co. in Vancouver has left for Maracaibo, Venezuela where he joins the Gulf Oil Corp.

F. R. Mehling has accepted a position with Crown Zellerbach Canada Ltd. at Port Alice, B.C. He was with Stanley Smith Engineering Ltd.

E. J. McKenzie and **J. E. Snowball** have entered into the partnership of Richmond Consultants Ltd., a new firm of consulting engineers with offices on Mitchell Island, Vancouver 15. Both men were previously employed by McCarter, Nairne and Partners.

D. D. Kristmanson, a '53 chemical engineering graduate of the University of British Columbia has been awarded an Athlone fellowship for two years study in England. Mr. Kristmanson was given the award as an ex-graduate with two years' practical experience in his field. He has been working as a chemical engineer at central research with the Consolidated Mining and Smelting Company of Canada Ltd., Trail. He will spend a year studying in England and another working in British industry.

D. H. Brown, with the Canadian Pacific Railways, formerly at Nanaimo, is now working in the chief engineer's office in Montreal.

Robert M. Martin, recently retired from the Indian Affairs Branch, Dept. of Resources and Development, has taken a position with the New West Construction Company of Edmonton, and will be engaged on a Pacific Great Eastern contract near Dawson Creek.

W. N. Plumb has accepted a position with Henry L. Hill and Associates, consulting mining, metallurgical and geological engineers. Mr. Plumb was formerly with Giant Mascot Mines at Spillimacheen.

E. S. Jones, scheduled to retire on May 31, will continue in his post as deputy minister of highways for another year. Provincial cabinet has approved deferment because his experience is required while the department is engaged in a complete reorganization program which will decentralize control.

Frederick Thomson, formerly with Crown Zellerbach Canada Ltd. at Port Alice, has taken a new position with Sydney Roofing & Paper Co. in Victoria.

W. R. Tracey is now employed by Trans-Mountain Oil Pipeline Co. in Vancouver. He had been with Northern Electric Co. in Montreal since his graduation last year.

M. F. Painter has taken a position with C. D. Schultz & Co. and will be project engineer in the Buttle Lake area. He had been District Engineer of B.C. Forest Service at Okanagan Mission, B.C.

J. E. Snowball has been elected District Lieutenant Governor of the Toastmasters' Club in B.C.

C. O. Brawner, of the Beaver Toastmasters' Club in Victoria recently won the B.C. district speech contest at Courtenay and competes against speakers from Oregon and Washington in Vancouver on May 26th.

Dr. C. Riley on Public Relations

The Public Relations Committee of 1956 has been divided into several subcommittees, one of which is an engineers' education committee. It would have been better to say continuing education committee because no one ever finishes either his technical or cultural learning. It was considered worth while to publish a few short articles, repeating some well-known facts regarding education of engineers.

Propaganda is repetitious but is specially effective if the same thing can be said in a different manner each time, so it was decided to retell some old tales that all of us know.

Public relations may be divided into two general classes — conscious — or deliberate, and the unconscious or spontaneous. Of the two the latter is the more effective. An example of the deliberate, of course, is paid advertising. The most obvious example of the second is the satisfied patient or the happy client. Reputations grow fastest and last longest with satisfied customers.

In the case of engineers the best public relations are those established by the individual engineer as a citizen rather than by conscious effort. As in the other professions or businesses, this is accomplished in two ways. The first is the practice of our profession and here every one of us strives for perfection. A task well done, particularly in engineering may speak out for his creator for many years, as for instance, a well-built structure. Not all can build great bridges, but minor tasks are bricks which may build reputations.

Social Contacts

The second way is our social contacts, and in the part we play as citizens. The engineer should not only participate in public affairs and in society but he should take a leading position in at least some phases of it. After all, he generally has had the advantages of university education, but the intensive courses required for engineering are of a sort only to equip the student as an engineer rather than as a citizen. That is true in a large measure for all university courses, but it is especially true in engineering.

Complete Citizen

A complete citizen should have some knowledge of the legacy left us by the great thinkers of the ages. He should have some knowledge of history, literature, philosophy, and the arts. Probably the legal profession gets more of this in university than the engineer. Certainly a greater percentage of its members appear in public affairs and in the society of man than members of the engineering profession. Therefore, the engineer should make a conscious effort to improve his cultural background and perform his duty as a leading citizen of his community. This means first increasing his general knowledge; second, fitting himself to express himself clearly and intelligently and to fit himself to move in public affairs with assurance and grace. Assuming the above discussion is valid, it is proposed to discuss later some of the ways in which the engineer can fit himself better as the leading citizen he should be.

Abstract from *The B.C. Professional Engineer,* April, 1956.

Ontario

News of the Members

Robert B. McIntyre has been appointed a director and assistant general manager of Dowty Equipment of Canada Ltd. of Ajax, Ont.

Mr. McIntyre obtained his engineering degree from the University of Toronto in 1936 and subsequently on a Massey Fellowship obtained an engineering degree from Cambridge University, England. He returned to Toronto in 1938 and lectured at the University of Toronto and for the first four years of World War II was in charge of engineering in the aircraft division of the Massey-Harris Company.

He later joined the De Havilland Aircraft of Canada Ltd., where he held a number of engineering and production positions before becoming manager of the engine division, which position he held at the time of his appointment by Dowty Equipment of Canada Ltd.

E. Czerkawski has accepted a position as electrical engineer with R. M. Way & Company Ltd., consulting engineers, 321 Bloor St. East, Toronto. Mr. Czerkawski was formerly with the Canadian Comstock Co. Ltd., Toronto.

Terence J. G. Simms is presently located in Cutler, Ont., where he is working for Noranda Mines Ltd. as a resident engineer on the construction of a new plant in that area.

G. Rozentals has ceased his employment with Armet Industries Limited, of Guelph, Ont., and has accepted a position as chemical engineer with Naugatuck Chemicals of Elmira, Ont.

John Brooke has moved from Ottawa to Chalk River, Ont., where he is employed by the Atomic Energy of Canada Ltd. Prior to this move Mr. Brooke was with the mechanical engineering division of the National Research Council in Ottawa.

Grant A. Bacchus has resigned his position with the Ontario Department of Highways to join the Metropolitan Toronto Planning Board as assistant traffic engineer in the Transportation and Services Division.

Mr. Bacchus graduated in civil engineering from the University of Toronto in 1951 and has been with Ontario Department of Highways until the recent move, latterly as traffic studies engineer.

Arthur H. Holmes is employed in the engineering department of the Hydro Electric Commission of Ontario. Previous to the acceptance of this position he was with Foundation of Canada Engineering Corporation Ltd., in Toronto.

J. W. A. Donald, of Ford Motor Company of Canada Ltd., has been transferred from Windsor, Ont., to Edmonton, Alberta, where he is resident engineer on the construction of the new parts depot in that city.

Geoffrey P. Webb, of the English firm of consulting engineers, Kennedy and Donkin, has moved from London, England, to Caracas, Venezuela, in connection with his firm's undertakings at that place. Mr. Webb left Canada for England during 1955.

J. D. Mitchell, of Dominion Engineering Company Ltd., Montreal, Que., has been appointed manager of the Power Crane and Shovel Division of the company.

Mr. Mitchell graduated in engineering from Queen's University in 1941 and following service in the R.C.N. during World War II, joined Dominion Engineering in 1945 in the capacity of sales engineer. In 1953 he was made assistant manager of the Power Crane and Shovel Division.

I. C. Percy, of Niagara Falls, Ont., has moved to Montreal, Que., where he has accepted a position in the power section of Aluminum Laboratories Ltd., of Montreal. Mr. Percy, who obtained his degree in electrical engineering at the University of Toronto in 1951, has been with the Hydro Electric Power Commission of Ontario at Niagara Falls, Ont.

G. B. Batanoff has left the Canadian General Electric Co. Ltd. and is now employed by Marshall Refrigeration Co. Ltd., at 892 Millwood Road, Toronto 17.

Prior to the change Mr. Batanoff was a sales engineer with the Canadian General Electric Company, with which he has been associated since his graduation in engineering from the University of Saskatchewan.

R. C. P. Preston has accepted the position of county engineer, County of Peterborough, and is now located in the city of Peterborough, Ont.

Mr. Preston graduated in civil engineering from the University of Toronto in 1950 and vacated a similar appointment with the County of Prince Edward in order to assume his new position.

Hugh F. Jenkins has left the Ontario Hydro with which he was employed at the Stewartville Generating Station, Glasgow Station, Ont., and is with Atomic Energy of Canada Ltd., at Deep River, Ont.

D. F. Knudsen formerly editor of "Electrical News and Engineering", Toronto, has accepted the position of manager of public relations for Computing Devices of Canada Ltd., of Ottawa.

Mr. Knudsen is a graduate in electrical engineering of the University of Toronto and prior to assuming editorial duties with the Hugh C. MacLean Publishing Company some five years ago, was associated with the Bell Telephone Company of Canada.

Victor L. Savage has joined Libby Engineering Ltd., Montreal and Toronto, heating, ventilating and air conditioning engineers and contractors. Manager of the industrial division, he is now located at the company's head offices, 7000 Park Avenue, Montreal 15, P.Q.

Mr. Savage was previously with the Quebec North Shore Paper Company and the Ontario Paper Company for eight years, latterly as steam and ventilation engineer. He is a McGill graduate in mechanical engineering, Class of 1941.

Alwyn T. Wason has been appointed executive engineer, Public Works Department, Barbados, British West Indies, and is presently concerned with the construction of a new 300-bed hospital.

Mr. Wason graduated in engineering from the University of British Columbia in 1951 and has been following his profession in the British West Indies since graduation. Latterly he has held the appointment of assistant engineer of the Public Works Department, Barbados.

V. M. Wallingford, who was formerly resident engineer for the New Brunswick Electric Power Commission on its Beechwood power project, is now resident engineer on the construction of the aluminium plant at Baie Comeau for the Canadian British Aluminium Company Limited and is located at Baie Comeau, Que.

P. R. Boon has terminated his employment with the Canadian General Electric Co. Ltd. in Peterborough, Ont., and has moved to Toronto to join Monsanto Canada Limited, 183 Front St. East, as a technical sales representative in plastics.

Ying L. K. Hope announces that the offices of Ying L. K. Hope and Associates, consulting professional engineers, have moved to 40 Irwin Ave., Toronto 5. The previous location of the organization was at 77-79 Huntley St., Toronto.

George R. Wyer, the executive vice-president of The Canadian Fairbanks-Morse Company Ltd. of Montreal, Que., has been elected a director of the Canadian Locomotive Company Limited, of Kingston, Ont.

Annual Meeting Reports

COMMITTEE ON GERONTOLOGY

J. R. Gilley, Chairman

In recognition of the desire of a number of members of the Association who have retired from full-time practice due to age, to obtain some form of employment for economic reasons or to keep active professionally, Council of the Association authorized a Committee on Gerontology at its meeting in July, 1955.

Council did not limit the Committee by any specific terms of reference and to the chairman was entrusted the task of selecting members of the Committee.

The work of the Committee to date has been almost entirely along the lines of organization and at this stage the various broad functions have been assigned to sub-committees covering:

(a) Employment
(b) Library
(c) Publicity
(d) Other services such as counselling, social life and recreation.

In addition to these four it is planned to appoint another sub-committee (e) called Preparation for Retirement —primarily for the 50 years and over group. Much data and information have already been collected in regard to this plan.

Here, I interject a timely quotation —"Useful activity is the wonder drug for the older citizen."

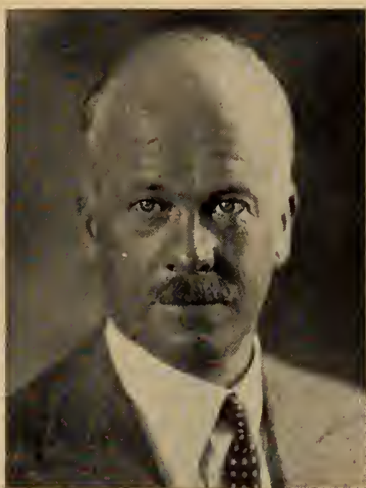
In recent years medical science has increased longevity in all the Countries of the western world—Canada is no exception. The percentage of the population in Canada over 60 years of age grows larger each year. Governments at the three levels—Dominion, Provincial and Municipal, have a real concern for the problems created by this trend in the age grouping of the population. Dr. Edward Stieglitz an eminent Gerontologist from the United States, in discussing problems of longevity, has commented that life should have breadth and depth as well as length.

The Committee on Gerontology will make every effort to provide personal service to the older age group of this Association. As far as we know your Association is the first professional organization or society in Canada to appoint such a Committee. It is obvious, therefore, that the achievements of this Committee will be studied and measured by the vast number of professional organizations in this country. Your Association now has a unique opportunity to provide leadership in the field of Gerontology throughout the Engineering Profession as well as in the other professions across Canada. May we bespeak your interest and personal support in this important new venture.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

The Earl of Bessborough, former Governor General of Canada, 1931-35, and HON. M.E.I.C., died on March 10, 1956, at Stansted Park, Hampshire, England.



The Earl of Bessborough, Hon.M.E.I.C.

A man of wide international business interests, he was chairman of the board of the Unilever Margarine Corporation, De Beers Consolidated Mines and the Sao Paulo Railway in Brazil. He had also been associated with such undertakings as explosives and insurance.

Born on October 27, 1880, Vere Brabazon Ponsonby was educated at Harrow and Trinity College, Cambridge, and was called to the bar in 1903 after graduating with a bachelor of Arts. During the first World War he served in Gallipoli and France, and was attached to the headquarter staff of the British Expeditionary Force in France. He was a Conservative Member of Parliament before succeeding to the earldom on his father's death in 1920.

He arrived in Canada in 1931, his term of office following the Imperial Conference of 1926. He made the opening address at the Imperial Conference in 1932, which was called to determine the economic relations between Commonwealth nations.

One of the last official acts performed by Lord Bessborough in Canada was to dissolve the seventeenth Parliament, Aug. 14, 1935, and swear in the new ministers of the cabinet of the late Rt. Hon. R. B. Bennett.

McGill University and the University of Toronto awarded him honorary doctorates of law while he was in Canada. He accepted honorary membership in the Institute in 1931.

Donald A. Ross, M.E.I.C., senior partner of the firm of Pratt and Ross, architects and engineers, Winnipeg, died on April 1, 1956.

Mr. Ross was born in Winnipeg on October 5, 1878, attended Upper Canada College and later studied mining engineering at the University of Toronto. He started his career as terminal engineer for the Canadian Northern Railway in Winnipeg, and later became locating engineer for the Canadian National Railways. He was engineer in charge of the construction of the Pinawa hydro-electric plant, the first hydro-electric plant on the Winnipeg River. He designed and supervised the construction of the Winnipeg Electric Company steam plant in 1912. His firm was also responsible for many of the large buildings in Winnipeg and several churches, including the First Presbyterian Church, a Synagogue, and a new Catholic Church recently opened.

During the First World War, Mr. Ross was Deputy Assistant Quarter Master General, Military District No. 10.

Active for many years in the affairs of the Engineering Institute, Mr. Ross was chairman of the annual meeting of the E.I.C. (then Canadian Society of Civil Engineers) in 1910, which was the first annual meeting of the Institute outside Montreal. He continued his interest in Institute matters up to a short time before his death, taking a special part in the guidance of younger engineers.

Mr. Ross joined the Institute as an Associate Member in 1904, transferred to Member in 1910.

Maxwell V. Sauer, M.E.I.C., noted hydraulic engineer with the St. Lawrence Seaway project and alternate member of the Canadian section of the joint board of engineers, died on April 28, 1956, in Lachine, Que.

Born in Plattsville, Ont., Mr. Sauer graduated from the University of Toronto in 1901 with a degree in applied science, spent a year in post-graduate study, and was the following year a fellowship winner.

The early years of his career were marked by appointments with the Ontario Power Company at Niagara Falls, with the Niagara Falls Power Company, Niagara Falls, N.Y., in 1905, and the Iroquois Construction Company in Buffalo, N.Y.

Renewing affiliations begun on graduation, he went back to work, in 1907, with the Ontario Power Commission, and became, in 1912, mechanical engineer in charge of design, field and inspection departments. Later, working with the Hydro Electric Power Commission of Ontario, he was prominent in the design and construction of the Queenston - Chippawa power development.

Joining Canadian Vickers in 1923, Mr. Sauer was named hydraulic engineer, with headquarters in Montreal. In 1926 he accepted the appointment of vice-president of William Hamilton Limited, at Peterborough, Ont. Two years later he was designing engineer for the Winnipeg Electric Company in Winnipeg, but in 1929 chose to return to the east to join the Beauharnois Construction Company at Beauharnois, Que. Later, in 1934, he was appointed assistant chief engineer for the Beauharnois Light, Heat and Power Company.

He was hydraulic engineer and general superintendent of generating stations, with the Montreal Light, Heat and Power, and later with the Quebec Hydro-Electric Commission, receiving the appointment as consulting engineer in 1951. He retired in 1953 from Hydro-Quebec.

Mr. Sauer was closely associated with the St. Lawrence seaway project since that time. He was appointed by the federal government, pursuant to the order of the international joint commission of October, 1952, dealing with the power development in the international rapids section of the St. Lawrence River.

Recipient of the Keefer Medal of the Engineering Institute, in 1945, for his paper, "St. Lawrence River Control and Remedial Dams—Soulanges Section", he was also honoured by the University of Toronto engineering Alumni Association's award of merit in 1945.

Mr. Sauer joined the Institute as a Student Member in 1904, transferred to Member in 1913. He attained Life Membership in 1948.

Maxwell V. Sauer, M.E.I.C.

He was also a member of the Corporation of Professional Engineers of the Province of Quebec.

Leonard Galbraith McNeice, M.E.I.C., of the consulting engineering firm of McNeice Associates, Orillia, Ontario, died on March 26, 1956, in Toronto.

Mr. McNeice was born at Reay, in the Muskoka district of Ontario, on May 31, 1890. He received his secondary education at Gravenhurst, Ont., and then went on to engineering studies at Queen's University in 1913, gaining a B.Sc. degree in civil engineering. He served a short apprenticeship on Dominion Land surveying at that time and then joined the consulting engineering firm of Chipman and Power, in London, Ont. In 1917 he became town engineer at Wallaceburg, Ont., and remained there until 1931 when he embarked on a career that was to last for twenty-two years, as general manager of the Orillia Water, Light and Power Commission, as well as filling the position of town engineer for the community. He had a wide influence on the growth and development of the city. About two years ago Mr. McNeice and his son Leonard M. McNeice formed the present consulting engineering company being operated in Orillia. They had been in charge of a number of large water and sewer projects in Ontario towns.

A former executive of the Canadian Section American Waterworks Association, Mr. McNeice was also past president of the Canadian Institute on Sewage and Sanitation, past president of the Electrical Employers' Association of Ontario; member of the American Institute of Electrical Engineers and other electrical associations, and member of the American Public Works Association.

He joined the Institute as a Student in 1913, became an Associate Member in 1919, and in 1936 was transferred to Member. He attained Life Membership in 1955.

Captain William Hamilton Abbott, M.E.I.C., a member of the staff of H. G. Acres and Company Limited, Niagara Falls, Ont., died in Toronto, on April 6, 1956.

A native of Montreal, Captain Abbott was born on April 2, 1887, and studied civil engineering at McGill University. With the Canadian Field Artillery for 5 years in World War I, and discharged with the rank of captain, he was a winner of the Military Cross and was mentioned in despatches on several occasions.

He was, within the first few years of his engineering career, resident engineer with Hull Electric Company in Hull, Que., and was also associated with the Manitoba Power Company Limited, in Winnipeg, with charge of transmission of power from Great Falls to the western part of the province. From 1922 to 1923 he was on the engineering staff of the Gregory Commission on the Ontario hydro electric enquiry. He joined Beaubien, Busfield and Company of Montreal, working as principal assistant engineer from 1923 to 1927. In 1928 he joined the Foundation Company of Canada and was assistant superintendent for the company on the construction of the Ghost power development for the Calgary Power Company. In 1930 he went to St. John's, Newfoundland with the Newfoundland Light and Power Company, in connection with the Pierresbrook development.

Later, in 1945, he was associated with the Montreal firm of T. Pringle and Sons Limited, in Montreal and the Associated Textiles of Canada. Two years later he was manager of the Air Vent Sheet Metal Inc., of Montreal.

He joined the H. G. Acres Company in Niagara Falls, in 1949, which firm he continued to serve until the time of his death. In 1953 Capt. Abbott was named project manager with the company.

He joined the Institute in 1920 as an Associate Member and became a Member in 1940.

William Gray Goodeve, M.E.I.C., executive engineer with General Motors Diesel Limited, at London, Ont., died in an aircraft accident there on April 16, 1956.

A member of the R.C.A.F.'s City of London 420 (Reserve) Squadron, he had flown with the Royal Navy's Fleet Air Arm during World War II.

Born in Chatham, Ont., in 1921, he received his preliminary education there and at St. Andrew's College, then studied at Queen's University, receiving a B.Sc. degree in mechanical engineering in 1948. He was taken on the staff of Richards Wilcox, where he worked on crane design. In 1950 he chose to join General Motors Diesel Limited as a sales and service engineer.

Mr. Goodeve joined the Engineering Institute as a Member in 1952.

Personals

News of the Personal Activities of Members of the Institute

R. W. Diamond, M.E.I.C., has retired from the position of executive vice-president, western region, of the Consolidated Mining and Smelting Company of Canada Limited, at Trail, B.C. He will continue to serve in an advisory capacity.

From Campbellford, Ont., he was educated at the University of Toronto and was awarded a B.A. Sc. degree in mining and metallurgy in 1913. After several years with the Anaconda Company at Anaconda, Montana, he joined the staff of the Consolidated Mining and Smelting Company of Canada Limited at Trail, B.C., in 1917, thus beginning what was to be a career filled with achievements and honours in his field. Originally engaged to carry out research into the separation of the mineral components of the Sullivan ore, this job was accomplished in the next three years. As a direct result of this work and as superintendent of concentration he saw the Sullivan grow to become the most important lead-zinc mine in the world. He directed the development and growth of the company's chemical and fertilizer program which commenced a short time afterward.

R. W. Diamond, M.E.I.C.

Following a series of appointments to various important operational posts he was appointed assistant general manager in 1939, vice-president and general manager in 1945, and executive vice-president, western region, in 1952. He was elected to the Board of Directors of Cominco in 1945 and in 1947 was appointed president of the West Kootenay Power and Light Company Limited.

His achievements as an engineer and a business leader have been marked by recognized and have been widely the many honours from universities and professional societies which include the McCharles Medal and Award, the Leonard Medal, the Selwyn G. Blaylock Medal, the Julian C. Smith Medal of the Engineering Institute, honorary degrees, the presidency of the Canadian Institute of Mining and Metallurgy, and the Institute of Metals' Platinum Medal.

The Selwyn G. Blaylock Medal was presented to him "for distinguished service to Canada through exceptional achievement in the field of metallurgy, and for his contributions to the eminent position of the Consolidated Mining and Smelting Company of Canada Limited."

W. R. Schriever, M.E.I.C., a native of Zurich, Switzerland, has been presented with the Baker Gold Medal of the Institution of civil engineers (London), making him the first Canadian to win the prize.

In this country since 1948, when he joined National Research Council's division of building research, he is today head of the division's building design section. He was associated with the Toronto subway during the entire stages of its construction, in the capacity of resident research engineer, and his prize-winning paper, "Strain measurements on the temporary road deck for the Toronto Subway", describes some of the results of the research work carried out by the Division in co-operation with the Toronto Transportation Commission.

The Baker Medal, triennially awarded, was established in 1934 and has been presented only six times previously. It commemorates the life and work of Sir Benjamin Baker, famous designer of the Forth Bridge.

Mr. Schriever is a graduate of the Swiss Federal Institute of Technology, class of 1944, and of Harvard University, where in 1948 he concluded further studies and received the M.Sc. degree.

P. A. Dupuis, M.E.I.C., has been named president of the Association des Diplômés de Polytechnique.

Joint chief engineer with the Department of Public Works, bridge branch, for the Province of Quebec, he has held this position since 1949. He has been associated with the department since 1921.

He is also a professor at Laval University, conducting courses relative to the building of bridges.

His many professional affiliations include membership in the Corporation of Professional Engineers of Quebec, the International Road Federation, the Canadian Good Roads Association; the American Concrete Association, the International Association for Bridge and Structural Engineering, and the Federation Internationale de la Precontrainte.

Named president of the Quebec section of the Polytechnique Graduates

P. A. Dupuis, M.E.I.C.

Association in 1944, students of the Ecole Polytechnique in 1952 invested him with "L'Ordre du Mérite."

He has worked with the Quebec Branch of the Engineering Institute, serving as its chairman in 1947. He was elected honorary secretary-treasurer of the Corporation of Professional Engineers of Quebec in 1952.

J. H. Wallis, M.E.I.C. Retirement of J. H. Wallis, vice-president and manager of the power crane and shovel division of the Dominion Engineering Works Limited, after twenty-eight years of service, has been announced recently. A director of the Dominion Welding Engineering Company Limited, he remains active as president of Lakeshore Power Shovels Limited, Beaconsfield, Que.

• Personals

Returning from extensive service in the first war with the rank of major, he gained his early experience with the Canadian Creosoting Company and then spent several years associated with the pulp and paper industry. He worked as supplies engineer with the Riordon Pulp Corporation, Temiskaming, Que., as purchasing agent with the Ste. Anne Paper Company at Quebec City, and with Murray Bay Paper Company Limited at Beaupre, Que.

Named manager of the Dominion Welding Engineering Company Limited, Lachine, Que., in 1928, he became general manager of the Dominion Hoist and Shovel Company Limited, Montreal, in 1931, and manager of the Dominion Engineering Company Limited, in 1935.

In 1953 the Dominion Hoist and Shovel Company Limited, a subsidiary, was integrated into the Dominion Engineering Works as the Power Crane and Shovel Division. Mr. Wallis became vice-president of the parent organization and manager of that division.

A member of the Royal Canadian Engineers, Reserve Force, he commanded the third Canadian Division Engineers, Reserve Force, during part of the Second World War, subsequent to which he was appointed honorary lieutenant colonel of the regiment. He relinquished the command in 1955.

C. O. Maddock, M.E.I.C., is vice-president, office manager and part owner of the Nickel Belt Cement Products Limited in Sudbury, Ont.

Mr. Maddock was construction and estimating engineer with International Nickel Company Limited at Copper Cliff, Ont., for a number of years before his recent retirement. He joined the company in 1926, originally as a draughtsman.

He is a University of Toronto graduate, and a past chairman of the Sudbury Branch of the Engineering Institute, serving in this capacity in 1951.

T. A. Harvie, M.E.I.C., was the choice of the Montreal members of the Canadian Aeronautical Institute as chairman of the Montreal Branch during the year 1956-57. The election took place recently.

A McGill University graduate, class of 1941, with a B. Eng. degree in mechanical engineering, Mr. Harvie's engineering career to date has been with Canadair Limited in Montreal. First with the company in 1947, following extensive overseas service, he was supervisor of tests and developments, design engineer, and in 1953 was named to the position of development project engineer with the firm.

S. H. Hawkins, M.E.I.C. Retired to Ganges, B.C., is S. H. Hawkins, who was last year project engineer for the P.F.R.A. Red River project, while on leave of absence from his position as resident engineer for Defence Construction Limited, Penhold, Alberta.

In this country a great many years since leaving the old town of Shrewsbury, England, Mr. Hawkins worked first with the National Transcontinental Railway in a variety of positions from draughtsman and topographer on survey parties, to resident engineer in charge of plans, estimates, layouts and field work, in connection with railway construction.

Overseas with the Canadian Infantry and the Canadian Engineers from 1914 to 1919, he was the last two years captain and adjutant of the tenth battalion, Canadian Engineers.

After the war he moved to Alberta and was for many years associated with the irrigation department of the Alberta Department of the Interior. He was district engineer for P.F.R.A. at Eastend and Swift Current, Sask., and project engineer on irrigation work in Calgary before joining Defence Construction.

Mr. Hawkins joined the Institute as a Student in 1909, became an Associate Member in 1920, and transferred to Member in 1940.

George O. Saunders, M.E.I.C., vice-president of Canadian Locomotive Company Limited at Kingston, Ont., has now been named a director of the firm.

He joined the company fourteen years ago as an assistant in the plant engineering department, transferred to diesel engineering and subsequently became manager of locomotive sales, assistant to the works manager in charge of steam locomotive production, and then works manager.

He is a graduate of Queen's University in mechanical engineering.

G. W. Moule, M.E.I.C., with the City of Winnipeg Hydro-Electric System since 1945, has transferred his services to the engineering branch of the B.C. Power Commission in Victoria, B.C.

He joined the Winnipeg company as a designing engineer, and three years later, in 1948, was named contract engineer. Prior to that time he had been associated with Canadian Industries Limited and Defence Industries Limited, in Montreal and Winnipeg.

Mr. Moule will be remembered by Winnipeg Branch members of the Institute as secretary-treasurer in 1948.

D. R. Webb, M.E.I.C., has been elected president of the Association of Professional Engineers of New Brunswick.

A native of Saint John, N.B., he received his education at Saint John High School and the University of New Brunswick, from which he graduated in 1935.

Manager and consulting electrical engineer for Webb Electric Company in Saint John for many years, he has, since 1953 been associated with Kearns and Bromley, consulting engineers, also of that city.

F. A. Ritchie, M.E.I.C., has been appointed director of manufacturing engineering-manufacturing staff, of Ford of Canada Limited in Windsor, Ont.

Mr. Ritchie's career with Ford began in 1931 when he joined Ford in Windsor as a summer student employee. In 1942 he was placed on the staff as a designer in the former plant engineering department, and a year later he headed experimental test work on universal carriers, being done at that time.

Since 1948 Mr. Ritchie has held numerous supervisory positions, including those of assistant superintendent and, later, superintendent of production engineering, and assistant general superintendent, industrial engineering. Last February he was named general superintendent of industrial engineering.

He is a B.Sc. graduate in mechanical engineering from Queen's University.

L. E. Neil Carr, M.E.I.C., of Calgary, will henceforth carry out his services as consulting engineer under the name of Carr and Company Limited, at new offices in Calgary.

A 1946 graduate of McGill University, with a B. Eng. degree in mechanical engineering, he was for a time employed with Larwill Construction Company in Calgary before going into private practice several years ago.

Dr. J. D. Mollard, M.E.I.C., soils specialist, has been retained by The Photographic Survey Corporation Limited, of Toronto in a consultant capacity. He recently retired as chief of the Air Photo Analysis and Engineering Geology Division of the Prairie Farm Rehabilitation Administration to set up in Regina the firm of J. D. Mollard and Associates Limited, consulting engineers.

Dr. Mollard has been technical consultant for the Canadian Government's Columbo Plan surveys in Pakistan and Ceylon. These surveys are being conducted by PSC which has personnel now in both countries.

A civil engineering graduate from the University of Saskatchewan in 1945, he also obtained an M.Sc. degree from the Purdue University in Indiana two years later, specializing in the field of highway engineering. Subsequently for some time he was with the Indiana State Department of Highways, doing research work on airphoto mapping and engineering evaluation of soil and bedrock materials.

Dr. J. D. Mollard, M.E.I.C.

A little later he returned to Canada where he has mainly been associated with the Dominion Department of Agriculture's P.F.R.A. He took time out to obtain his Ph.D. at Cornell, where he stayed several years as research engineer and lecturer and to direct air photo studies in Newfoundland and British Columbia for various governmental bodies.

W. A. Cairns, M.E.I.C., has been named superintendent of the Consolidated Mining and Smelting Company fertilizer department at Kimberley, B.C.

A University of Alberta graduate, Mr. Cairns was previously assistant general superintendent of the Alberta nitrogen department of the Company which he

• *Personals*

joined in 1936. He worked as a research chemist at Trail, B.C., and was transferred to the chemical fertilizer operations in Calgary in 1945, as assistant superintendent of the nitrate group. He became superintendent of development there in 1946, and assistant superintendent in 1949.

J. Douglas Anderson, M.E.I.C. Transferred from Winnipeg to Montreal, with Canadian Pacific Railway Company, is J. Douglas Anderson, assistant engineer of track.

A 1945 graduate in civil engineering from the University of British Columbia, with a B.A.Sc., he shortly afterwards gained an M.S. degree from the University of Washington.

Mr. Anderson has held the position of special engineer while in Winnipeg.

R. W. Borrowman, M.E.I.C., is with the City of Ottawa Department of planning and works, as engineer in charge of planning.

He has been associated with the Metropolitan Planning Commission since 1945 and has held the position of assistant planner since 1949. Earlier he was a building and maintenance engineer of Defence Industries Limited, Winnipeg works.

He is a graduate of the University of Manitoba, class of 1940, with a B.Sc. degree in civil engineering.

R. E. Davey, M.E.I.C., for five years head of the works department for the town of Brockville, Ont., has taken up a similar position with the township of North York, Toronto.

Mr. Davey has also served as town engineer of Trenton, Ont. He is a graduate of the University of Toronto.

G. T. C. Scott, M.E.I.C., a University of London, England, graduate, class of 1947, is an associate with The Canadian-British Engineering consultants in Toronto. He came to the firm in 1953 as a representative of Sanford Fawcett and Partners.

E. L. Johnson, M.E.I.C., has been appointed manager of the factory division of The Robert Mitchell Company Limited.

Since 1949 he has been with the Mitchell Company, most recently as assistant general manager of the Mitchell subsidiary, Prowse Limited.

At one time works manager with the Dominion Ammunition Division of Canadian Industries Limited, in Brownsburg, and Defence Industries Limited, Montreal Works, he was later factory manager for the Continental Can Company of Canada Limited, in Montreal.

H. J. Gordon, M.E.I.C., assistant engineer for track with the Canadian Pacific Railway in Montreal, has been transferred to Calgary where he will take up the duties of special engineer, concerned with alterations being made to the Canadian Pacific Railway station.

With the railway for his entire professional career, since 1934, Mr. Gordon gained his early experience in the position of draughtsman and transitman. Serving with the Royal Canadian Engineers, throughout the second world war, both in Canada and overseas, it was not until 1946, discharged with the rank of captain, that he returned to the railway. Then he was assigned to the Vancouver division which appointment was closely followed by that of assistant engineer in Montreal. For a time locating engineer at La Cave, Ont., he has since 1950 been located in Montreal and from 1953 worked as assistant engineer of track.

Mr. Gordon is a graduate of McGill University.

G. J. Dunne, M.E.I.C. After ten years association with Frank W. Horner Limited, in Montreal, Mr. G. H. Dunne has been elected to the company's board of directors.

At first employed as supervisor of the fine chemical department, following graduation in 1944 from McGill University, he became production manager in 1952 and has served in that capacity until the present time.

Frank H. Hedley, M.E.I.C., has moved to Vancouver where he has accepted a position as sales manager with Okanagan Equipment Company Limited in the firm's sawmill division.

Mr. Hedley was formerly a manager of Canadian Westinghouse Company Limited in Edmonton.

S. M. Finlayson, M.E.I.C., has been elected a director of the John Inglis Company Limited, and its associated

S. M. Finlayson, M.E.I.C.

company, the English Electric Company of Canada Limited. Mr. Finlayson is President of the Canadian Marconi Company, Montreal, and also president of the Montreal Board of Trade.

W. T. Butler, M.E.I.C., has been appointed vice-president and general manager of Bauer Bros. Company (Canada) Ltd., Brantford, Ont., a newly incorporated branch of an established American pulp and paper equipment firm, now constructing a plant in Brantford.

Mr. Butler started his engineering career with Howard Smith Paper Mills Limited in 1940, as assistant mill chemist, Beauharnois division, upon graduation from McGill University; then, at the close of the war, after lengthy military service, he resumed work as chief mill chemist.

In 1947 he chose to join the Abitibi Power and Paper Company Limited as technical control superintendent, and in time became administrative assistant to the director of research.

He is a member of the technical section of the Pulp and Paper Association and the Technical Association of the Pulp and Paper Industry. In 1954 Mr. Butler was chairman for the Sault Ste. Marie Branch of the Institute.

A. H. Harris, M.E.I.C., is managing director of Regulators and Equipment Limited, a Winnipeg company recently organized to manufacture and sell Reynolds Gas Pressure regulators and associated equipment to the gas industry in western Canada.

Most recently he has been connected with the Winnipeg and Central Gas Company, as vice-president and general manager, but retired last year from active participation in the affairs of the firm, to continue membership in the capacity of consultant only. He was, for a number of years, manager of gas utility with the Winnipeg Electric Company.

Oliver Cundall, M.E.I.C., an English engineering graduate of the University of Manchester, class of 1946, has joined the staff of the C. D. Howe Company in Montreal as a design engineer.

In England, Mr. Cundall was associated with consulting engineering in London. Since taking up residence in this country he has had employment with the Foundation Company of Canada, with Preload Engineers Inc., and, most recently, with O. V. McCulloch and Company, consulting engineers in Montreal.

He is an associate member of the Institution of Civil Engineers and a member of the Association of Professional Engineers of Ontario.

F. S. Heeley, M.E.I.C., has moved from Winnipeg to Toronto where he has accepted a position with W.H. Smith and Company (Electrical Contractors) Canada Ltd.

He has been system planning engineer with the City of Winnipeg hydro electric system since returning from Brazil in 1953 after nearly two years with the Brazilian Traction Light and Power Company Limited in Sao Paulo. Prior to that time he was also with the Hydro Electric System in Winnipeg. He is a graduate of the Royal Technical College of Salford, England, class of 1947.

R. Bing-Wo, M.E.I.C., has once again been elected secretary-treasurer of the Saskatchewan Branch of the Institute. First chosen to serve in this capacity in 1952, he has repeatedly held the office since that time.

Long active in the affairs of the Institute, he has, since 1949 been continually in demand as an officer. He was at that time elected to serve a two year term as a member of the executive of the Saskatchewan Branch. Concurrently with this he was a councillor with the Association of Professional Engineers of Saskatchewan for two years. In 1952, at the time he took office with the Institute he was also appointed registrar and secretary-treasurer of the Association of Professional Engineers.

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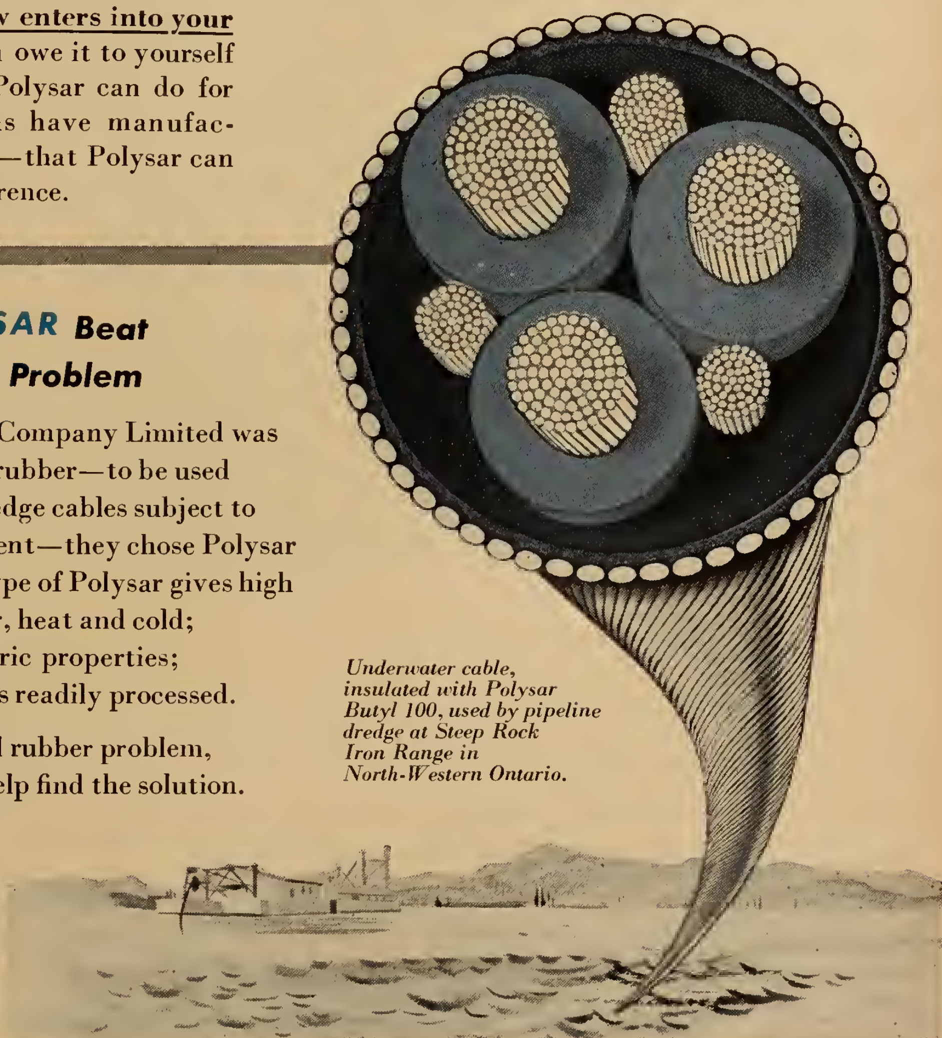

Underwater cable, insulated with Polysar Butyl 100, used by pipeline dredge at Steep Rock Iron Range in North-Western Ontario.

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Last year Mr. Bing-Wo represented the Association of Professional Engineers at the annual meeting of the Dominion Council of Professional Engineers, held in St. John's, Newfoundland.

He is an engineer in the design department of the Dominion Department of Agriculture, P.F.R.A., with headquarters in Regina, and has been associated with the Department since graduation from the University of Saskatchewan in 1943.

Austen B. Barnes, M.E.I.C., has joined the engine division of de Havilland Aircraft of Canada Limited in Toronto.

From Birmingham, England, he has, since coming to this country, included among his professional appointments a period with Phillips Electrical Works in Brockville, Ont., in 1952, with Automatic Electric (Canada) Limited the following year and the Canadian General Electric Company Limited where at Lansing, Ont., he held the position of maintenance engineer.

Zygmunt K. Radecki, M.E.I.C., has accepted a position as instrument engineer with the Aluminum Company of Canada at Arvida, Que.

A chemical engineer from the Technical University of Lwow, Poland, where he graduated before the war, Mr. Radecki's previous appointments include that of section engineer in the department of solvent recovery with Canadian Celanese Limited, at Drummondville, Que., from 1948.

V. M. Wallingford, M.E.I.C., formerly resident engineer for the New Brunswick Electric Power Commission on their Beechwood power project, is now resident engineer on the construction of the aluminum plant at Baie Comeau, for the Canadian British Aluminum Company Limited.

F. L. Fournier, M.E.I.C., formerly of Calgary, has moved to London, Ont., where he holds the position of general manager of Bluewater Oil and Gas Limited.

Mr. Fournier is a former senior geologist with Imperial Oil Limited in Calgary. He became associated later, in the same capacity with Calvan Consolidated Oil and Gas Company Limited in 1951, in that city. In 1953 the firm appointed Mr. Fournier vice-president and general manager.

He is a University of British Columgia graduate in geological engineering.

K. L. Hall, M.E.I.C., mechanical engineer with Trans Mountain Pipeline Company in Vancouver since 1953, has been transferred to Kamloops, B.C.

Mr. Hall has also been associated with McColl-Frontenac Oil Company (B.C.) Ltd., in Vancouver, as lubrication engineer. He is a graduate of the University of Saskatchewan.

D. A. G. Smith, M.E.I.C., is in Uranium City, Saskatchewan with Lake Cinch Uranium Mines.

Active in the fields of mining and metallurgy for a number of years, he has been associated with the International Uranium Mining Company Limited at Yellowknife, N.W.T., and in Edmonton. He has been mining engineer with the Winnipeg Supply and Fuel Company, which he joined in 1948, and more recently, in 1954, he was the chief inspector of mines with the Department of Mineral Resources, Regina.

Mr. Smith is a graduate of Queen's University.

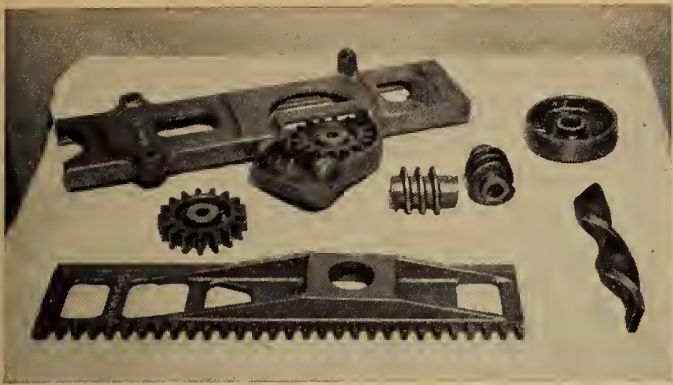
J. S. Motherwell, M.E.I.C., is with Sandwell and Company, consulting engineers, in Montreal, where he fills the position of resident engineer. He has been with the company in Vancouver and after service with the R.C.A.F. during the war was associated with the Powell River Company in British Columbia. Earlier in his career he was with the Dominion Engineering Company Limited at Montreal.

He is a graduate of the University of British Columbia in mechanical engineering.

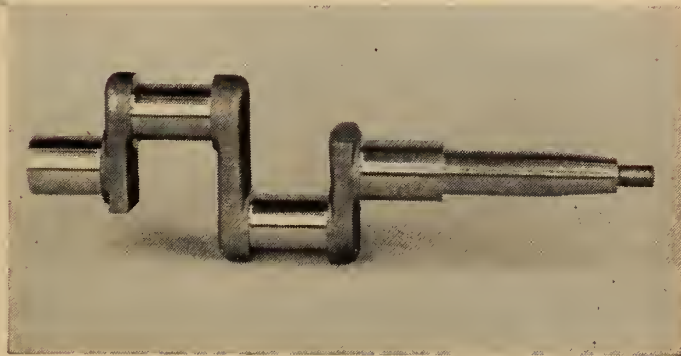
H. E. Palmer, M.E.I.C., who is a 1951 graduate in mechanical engineering from the University of British Columbia is with Westcoast Transmission Company Limited in Calgary. His position is that of natural gas engineer.

In 1953 he was assistant production engineer with the Canadian Natural Gas Company Limited in that city.

Eric Blair, M.E.I.C., is now associated with the firm of Crippen Wright Engineering Limited in Vancouver.



A good example of the intricate castings possible with ductile iron. These 60-45-10 type were cast by Bell Foundry Co. Ltd., St. James, Manitoba, to be used on a grain swather. Notice flat bar test piece, at right, twisted in ductility test.



A sample of an exacting casting that must be able to absorb shock, possess torsional rigidity, have excellent wear resistance and yet be readily machinable. This ductile iron crankshaft of 80-60-03 type was cast by Canada Iron Foundries, Limited, Special Products Plant, Hamilton, Ont.

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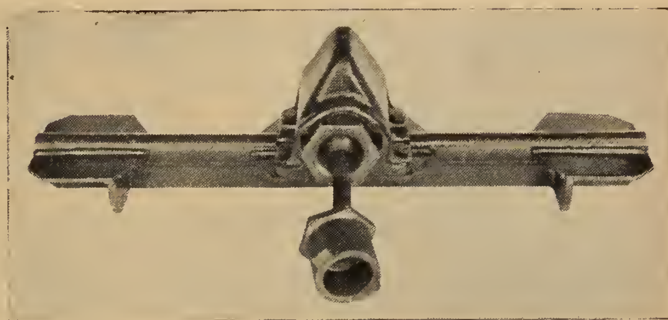

Ductile iron Jungle Trac, a type of equipment which adapts tandem axle trucks to half track for off-the-road service. Parts include adjustable links or "dumbells", and bushings which were cast by Otaco Limited, Orillia, Ontario, in their 60-45-10 Ductalloy.

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• Personals

He was formerly engaged in civil engineering, design, and construction service with the Indian Affairs Branch of the Department of Citizenship and Immigration, at Ottawa.

H. Wittnich, M.E.I.C.

H. Wittnich, M.E.I.C., has accepted a position with the Steel Company of Canada.

In 1954 he was appointed assistant to the industrial engineer of Alnee Wood Products Inc., in Montreal, with charge of production control. He has also worked for R.C.A. Victor Company in Montreal and with Canadian Allis-Chalmers Limited in Lachine, Que.

A. Gall, M.E.I.C., formerly chief draftsman with the British Columbia International Engineering Company Limited at Kemano, B.C., has accepted a position with Monarch Forge and Machine Works in Portland, Oregon.

After completing studies in engineering in England he began his career with Messrs. Head Wrightson and Company Limited in 1945, and two years later was transferred to South Africa by the firm and spent six years gaining experience in various types of engineering, with the original firm and others. In 1953 he supervised the layout, design and detailing of gold mine and uranium plants to be constructed in that country. Shortly afterwards he came to Canada to take up his position in British Columbia.

G. Arczynski, M.E.I.C., has left his position as design engineer with John Inglis Company Limited in Toronto to join the firm of Crippen Wright Engineering Limited, consulting engineers, in Vancouver.

A graduate of the Polish University College of London, Eng., he received a diploma in mechanical engineering in 1948.

J. D. Kean, M.E.I.C., has resigned from the position of county engineer, Peterborough, Ontario, after seven years' service. He will take up new work with the Curtis Bros., general contractors, in that city.

He was engineer for East Whitby township before going to Peterborough and was also junior engineer in the East York township of Ontario for a time.

He is a University of Toronto graduate.

H. Brekke, M.E.I.C., has joined the consulting engineering firm of H. A. Simons Ltd., at Kenora, Ontario, where he is responsible as inspector for all concrete work in connection with the extension of a paper mill in that district.

Mr. Brekke was for several years associated with the City of Winnipeg, first as hydraulic engineer in 1941 with the hydro-electric system, and later, in 1946, as construction superintendent.

Mr. Brekke came to this country from Europe. He is a civil engineering graduate from the German University of Prague which he attended before the war.

Yum-Hong Omen Lee, M.E.I.C., who in 1950 gained an M.Sc. degree from the University of Toronto, following a de-


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gree in Lingnan, Canton, China in civil engineering the year before, is with the Ontario Hydro Commission at Toronto.

Mr. Lee was formerly structural designer with H. G. Acres and Company in Niagara Falls.

R. M. Ferguson, M.E.I.C., is now employed by Consolidated Mining and Smelting Company in Trail, B.C., as a designing draftsman.

Mr. Ferguson, who is a graduate of the University of Alberta in civil engineering, was previously associated with Dominion Bridge Company in Calgary.

Hans Streibel, M.E.I.C., has accepted a position with H. G. Acres and Company Ltd., in Niagara Falls, Ont. He was formerly a design engineer with C. J. Jeffreys in Montreal.

Mr. Streibel graduated from the Institute of Technology in the Free City of Danzig in 1936. He was awarded a diploma in civil engineering.

T. N. Davidson, M.E.I.C., is assistant superintendent, distributing house planning, with Northern Electric Company in Montreal.

A Queen's University graduate of 1941, in electrical engineering, he was during the next two years a sales engineer with the Canadian National Carbon Company. Then, at the close of the war, after three years service with the R.C.N., he joined his present firm as telephone equipment engineer.

Sean Martyn, M.E.I.C., of University College, Galway, Ireland, class of 1947, who in this country has been working for Bell Telephone Company of Canada, special contracts division, in Montreal, has moved to Val D'Or, Que., where he has accepted a position with the Fraser-Brace Engineering Company Limited.

H. Frymann, M.E.I.C., a graduate of the Swiss Federal Institute, class of 1950, has assumed the position of chief electrical engineer with the St. Lawrence Cement Company in Quebec City, following several years service as an electrical engineer with the company.

R. H. Tooley, M.E.I.C., of Sault Ste. Marie, Ontario, has accepted a position with Abitibi Power and Paper Company in that city, as assistant staff engineer, in the firm's research and development division.

He has formerly been associated with the Algoma Steel Corporation in Sault Ste. Marie, Ont., working in the capacity of assistant to the superintendent of maintenance.

In 1950, receiving a B.Eng. degree in mechanical engineering, he graduated from the University of Saskatchewan.

Mr. Tooley is secretary-treasurer of the Sault Ste. Marie Branch of the Institute.

James E. Twiss, M.E.I.C., has resigned as assistant to the electrical superintendent with the International Nickel Company of Canada Limited, in Copper Cliff, Ontario, to accept a position with R. M. Way and Company Limited, consulting engineers in Toronto. He will be assistant chief electrical engineer.

Mr. Twiss joined the International Nickel Company on graduation from Queen's University in 1947 and worked as a junior electrical engineer until 1949. In the years that followed, until his promotion to assistant to the electrical superintendent in 1954, he served as assistant chief electrician at the Copper Cliff smelter and Garson mine.

E. J. Wilson, M.E.I.C., is employed by Messrs. Racey, McCallum and Associates, Limited as a site engineer on the Mid-Canada Early Warning Defence Line.

He has previously, for several years been employed by Canadair Limited, in Montreal.

V. S. B. Corbet, M.E.I.C., has been appointed mill manager of Canadian Cottons Limited, in Hamilton, Ont.

He graduated from McGill University with a B.Eng. degree in 1944 and after a period of service with the R.C.E.M.E., joined the staff of J. D. Woods and Gordon, management consultants, where he held the position of supervisor. In

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1953 he became manager of industrial engineering for Canadian Cottons, with headquarters in Cornwall, Ont.

Mr. Corbet has been an active member of the Cornwall Branch of the Institute and served on the executive for the past two years.

Dr. K. L. Pinder, Jr.E.I.C., who returned to Canada in 1955 following two years study in England on an Athlone Fellowship, has been appointed to the staff of the Pulp and Paper Research Institute of Canada. Dr. Pinder will join a special group of scientists engaged in developing a new technique, invented at the Institute, for the recovery of chemicals from industrial waste liquors.

He received a B.Eng. degree in chemical engineering from McGill University in 1951, his master's degree a year later and while at the University of Birmingham in 1954 received a Ph.D. degree in chemical engineering.

Dr. Pinder spent some time with Shell Oil Company in Calgary on his return to Canada.

J. E. Sinnot, Jr.E.I.C., has terminated his association with the Ford Motor Company of Canada Limited at Windsor, Ontario, where he held the position of electrical design engineer and has joined the staff of Pagon and Goodman in that city.

He is a University of Toronto graduate, class of 1950.

Horace Owen Moses, Jr.E.I.C., has accepted employment with Sandwell and Company Limited, consulting engineers in Vancouver.

He is a University of British Columbia graduate in mechanical engineering.

In 1953 he was associated with Canadian Industries Limited at Shawinigan Falls, Que., as a foreman.

Jean R. E. Moreau, Jr.E.I.C., has been named assistant manager of the Eagle Pencil Company at Drummondville, Quebec.

A graduate of the Ecole Polytechnique, class of 1951, in civil engineering, he has had experience with the Canadian Arsenals Limited at St. Paul L'Ermite, Que., and with Dominion Engineering Works Limited, Lachine, Que.

G. Roy Pond, Jr.E.I.C., has recently accepted the position of assistant mechanical engineer in the motive power and car equipment department of the Canadian National Railways. He is now located at St. John's, Newfoundland.

Mr. Pond was previously employed as assistant to the process development superintendent of Mersey Paper Company Limited in Liverpool, N.S., after having graduated in mechanical engineering from Nova Scotia Technical College in 1954.

J. Haworth, Jr.E.I.C., has accepted the position of plant design engineer with Courtaulds (Canada) Limited, Cornwall, Ontario.

Mr. Haworth graduated from Queen's University in 1947 and shortly afterwards went to Cornwall in connection with equipment installation in a rayon plant for Robert A. Rankin Company Limited.

He has since spent time with the firm in Dartmouth, N.S., and Montreal in 1951 and 1952.

For a time he was associated in 1949 with Stadler, Hurter and Company in Montreal.

Frank A. Kay, Jr.E.I.C., has for some months held the position of chief engineer with Quebec Iron and Titanium Corporation at Sorel, Quebec. He was field engineer with the firm in 1953.

Mr. Kay is a 1950 graduate from McGill University, in mechanical engineering.

R. A. W. Clayton, Jr.E.I.C., is working as a project engineer with Sandwell International in Montreal.

He has worked previously with Sandwell and Company Limited, consulting engineers, in Vancouver.

He is a 1951 graduate of the University of British Columbia in civil engineering.

Henry E. Parker, Jr.E.I.C., a 1952 graduate of McGill University and winner of an Athlone Fellowship that year, has returned to the university as a

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lecturer in the department of mechanical engineering.

Under the provisions of the Athlone Fellowship, Mr. Parker went to England in 1953, where he attended the College of Aeronautics at Betchley, Buckinghamshire.

L. H. J. Mooney, JR.E.I.C. From Quebec City to Paris, France, is the transfer recently accorded Mr. Mooney, district manager with Otis Elevator Company Limited for the past several years, and, at an earlier date sales engineer with the firm.

He is a 1950 graduate in electrical engineering from McGill University.

George N. M. Currie, JR.E.I.C., lately of Charles E. Napier Company Limited in Toronto has taken an appointment with Urwick Currie Limited, management consultants, in that city.

He is a mechanical engineering graduate from McGill University, class of 1951, and holds an M.A.Sc. degree, gained in 1953, from the University of Toronto. Mr. Currie is especially qualified in public health engineering.

Wallace E. Stewart, JR.E.I.C., is associated with Defence Construction (1951) Limited, in London, Ont.

With the City of Hamilton, Ont., in 1953, shortly after his graduation from the University of Manitoba, he has since then also been employed with H. G. Acres, in Niagara Falls.

Elias Blouin, JR.E.I.C., a 1954 graduate from Laval University in electrical engineering has been for some time employed as electrical engineer with the Canadian Resins and Chemicals Limited at Shawinigan Falls, Quebec.

J. Alberto Dada, JR.E.I.C., an electrical engineering graduate from McGill University, class of 1954, who was shortly afterwards working in San Salvador, El Salvador, with Dada, Dada and Company, is now employed by the Compania Alumbrado Electric de San Salvador. He holds the position of distribution engineer.

J. G. Doyle, JR.E.I.C., has accepted a position with Sperry Gyroscope Company of Canada Limited, in Montreal, as product engineer.

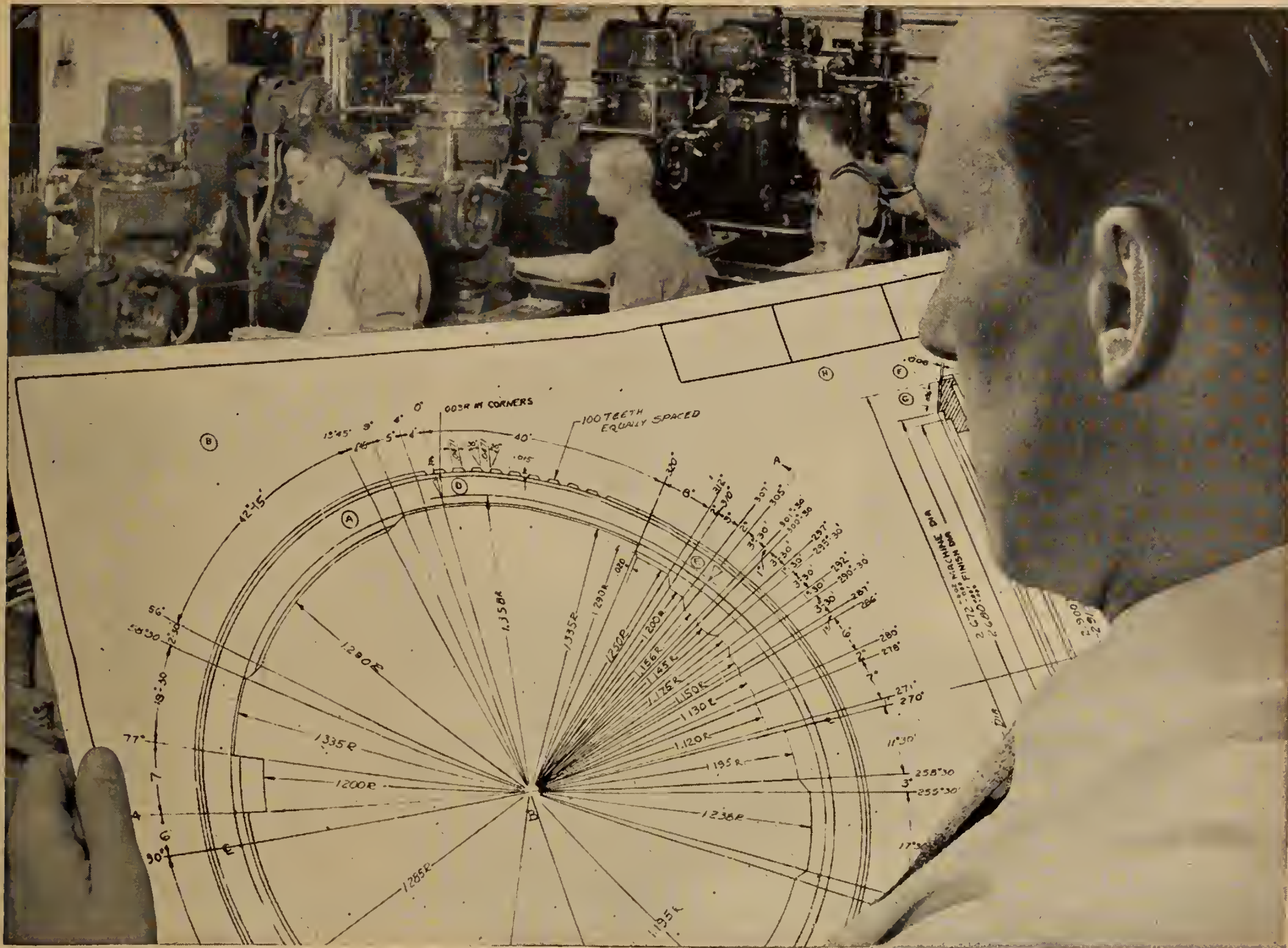
A graduate of the Nova Scotia Technical School, class of 1950, he joined the Canadian General Electric Company in Montreal the following year and has been with them in the intervening period.

J. H. Whalen, JR.E.I.C., back to Canada September last, after extensive experience overseas, is with the Canadian International Paper Company, Montreal, in the Economic Planning Department.

J. H. Whalen, Jr.E.I.C.

In Sweden in 1954, he spent some time with the Holmens Bruk Paper Company at Hallstavik, and later, at Aylesford, England, was with the Albert E. Reed Paper Company.

Mr. Whalen obtained a B.Sc. degree in civil engineering from the University of New Brunswick in 1952, then went on to the Massachusetts Institute of Technology, Cambridge to gain a master of science degree in the spring of 1954.



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Wm. G. Allen, Jr.E.I.C., has left the Canadian Army Signals Engineering Establishment, Ottawa, and has taken a position with the Atomic Energy of Canada Limited, Deep River, Ontario.

Shortly after his graduation from McGill University in 1949 with a B.Eng. degree in electrical engineering he became a lieutenant with the Canadian Signals Research and Development Establishment, Department of National Defence (Army), at Ottawa. In 1953, as chief mechanical engineer with the unit, he held the rank of captain.

Lorne A. Keyes, Jr.E.I.C., has accepted a position with R.C.A. Victor Company Limited in Montreal. He is an electrical engineering graduate of Queen's University, class of 1954.

M. S. Dubas, Jr.E.I.C., who in 1955, attained a master of science degree at the University of Alberta, has joined the staff of the Materials Testing Laboratories, in the southern Alberta city of Lethbridge.

Raymond F. Sherk, Jr.E.I.C., has been named representative in Toronto and Southwestern Ontario for Spartan Air Services Limited and Canadian Aero Service Limited.

R. F. Sherk, Jr.E.I.C.

A graduate of the University of Toronto, class of '52, and a former R.C.A.F. pilot, his more recent background includes both marketing and engineering.

Mr. Sherk is a member of the Ontario Association of Professional Engineers.

R. H. Dunn, Jr.E.I.C., is production manager with Precast Haydite Limited in Toronto.

He is a 1951 graduate of McGill University, with a B.Eng. degree in civil engineering. In 1953 he was plant engineer with Canadian Copper Refineries Limited, in Montreal.

H. E. Ryan, Jr.E.I.C., has accepted a position with the Ebasco International Corporation in Elizabeth, New Jersey, U.S.A.

Previously a staff engineer with the Nova Scotia Power Commission in Halifax, he is a 1949 graduate from the Nova Scotia Technical College.

F. D. Malloch, Jr.E.I.C., has accepted a position with the Department of Northern Affairs and Natural Resources, Ottawa.

F. D. Malloch, Jr.E.I.C.

A graduate of the RCN College, Royal Roads, B.C., and Queen's University, Mr. Malloch graduated from

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• Personals

the latter in 1951 with a B.Sc. degree in mechanical engineering. He has since then been employed in the Wire and Cable and plant maintenance departments of Northern Electric Company Ltd., in Montreal.

Gordon E. Smith, JR.E.I.C., who last year worked with Mathews Construction Company Limited in London, Ontario, has joined Proctor, Redfern and Laughlin, civil and consulting engineers in Toronto.

A Queen's University graduate, class of 1950, he joined the Ontario Department of Highways soon after graduation, working in Toronto and Bancroft, Ontario.

R. G. Cowan, JR.E.I.C., until recently employed by C. D. Howe Company Limited, consulting engineers, in Montreal, has transferred his services to Moore, Mainville and Cowan consulting engineers in Moncton, N.B.

Before joining the C. D. Howe Company in 1952, he was with Building Products Limited in Montreal as a foreman and was mechanical engineer with Hagan and Company Halifax Limited.

He is a 1950 graduate of the Nova Scotia Technical College.

James G. Morrison, JR.E.I.C., who has been associated with Bell Telephone Company of Canada since 1951, has been transferred from Kingston to Ottawa. For the last two years he has held the position of traffic assistant in the St. Lawrence District, with headquarters in Kingston. He now becomes traffic superintendent of the Ottawa Valley District, with headquarters in Ottawa.

A graduate of 1951 he studied engineering at the Nova Scotia Technical College.

Warren A. Trotter, JR.E.I.C., has relinquished his position as assistant commissioner of works in the Township of East York, Ontario, and has become associated with the Toronto firm of consulting engineers, Gore and Storrie.

Mr. Trotter is a Queen's University graduate, class of 1948. He has also lived in Kingston as a graduate civil engineer where he held the post of deputy city engineer.

Lieut. C. A. Millar, JR.E.I.C., has been assigned the duties of Platoon Commander, Apprentice Training Company, R.C.E.M.E. School, Kingston, Ontario.

Combining an army career with engineering since graduation from the University of British Columbia in 1953, Lieut. Miller that year became control officer with the Department of National Defence, No. 7 Coy., R.C.E.M.E., Coldbrook, N.B.

J. D. Ross, JR.E.I.C., is employed by Sherritt Gordon Mines Limited, in the chemical and metallurgical division of the company's nickel refinery at Fort Saskatchewan, Alta.

A graduate in engineering physics from the University of Saskatchewan in 1953, he has gained experience with the Schlumberger Well Surveying Corporation at Stettler, Alta., and Fort Saskatchewan.

Donald W. Blair, S.E.I.C., a Queen's University graduate of 1955, is with Geocon Limited, in Montreal.

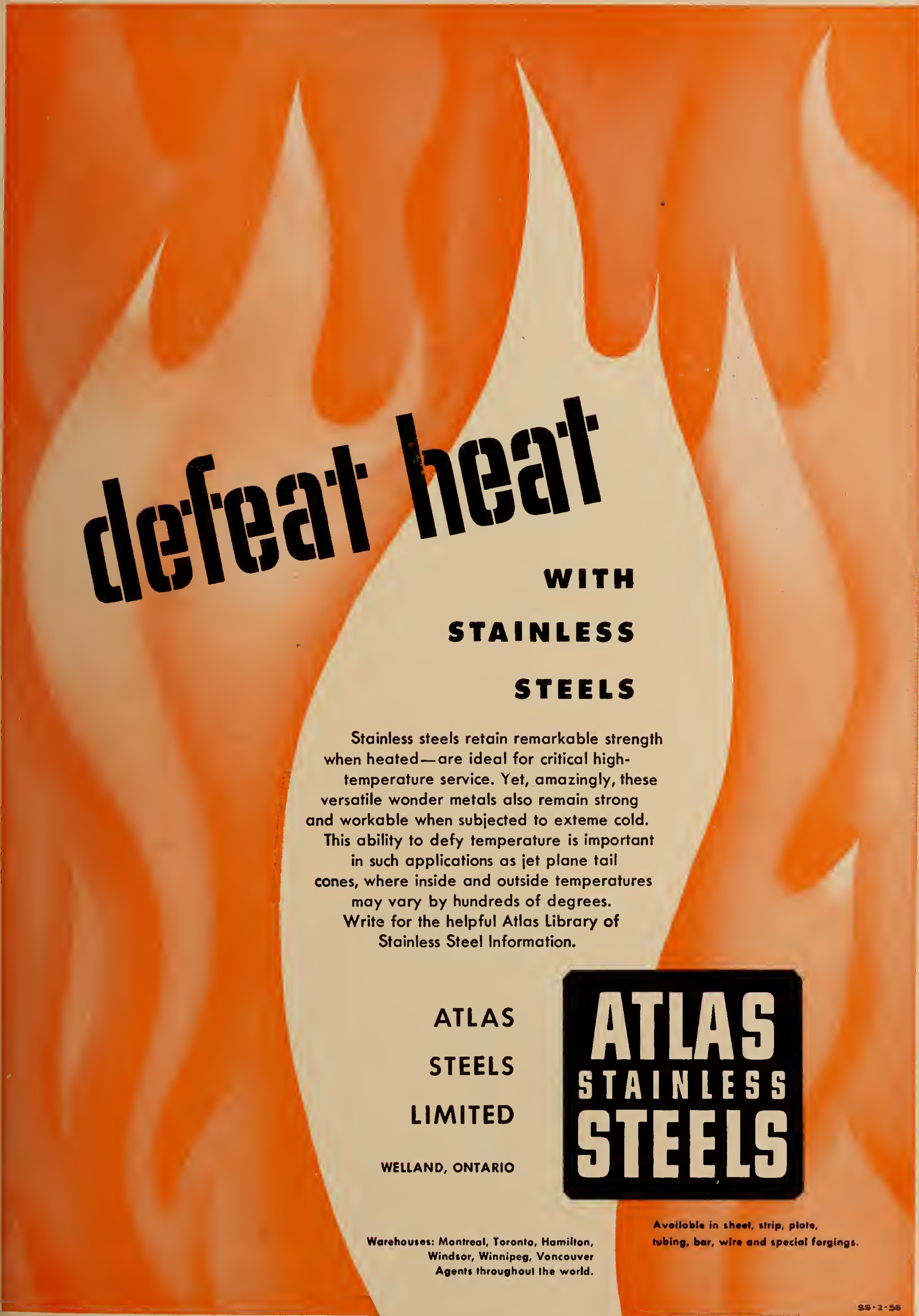
G. J. Palmer, S.E.I.C., a graduate in mechanical engineering last year, from the University of Manitoba, has taken up work with Canadian Industries Limited at Shawinigan Falls, Que.

E. J. Bliss, S.E.I.C., a 1955 graduate from the University of New Brunswick, with a B.Sc. degree in civil engineering, is employed with the Maritime Cement Company Limited, in Moncton, N.B.

C. M. Goodrich, S.E.I.C., a University of Saskatchewan graduate, class of 1955, is working with the Department of Public Works, Government of Alberta, Edmonton, where he will serve as a mechanical engineer in the architectural branch of the Department.

Since graduating last year he has been briefly associated with the Canadian Gulf Pipe Line Company and the Peace River Oil and Pipeline Company, in Edmonton and Valleyview, Alberta.

C. J. Partridge, S.E.I.C., a 1955 graduate of Queen's University who since then has worked as field engineer with the Bell Telephone Company of Canada at Knob Lake and Sept Isles, Quebec, is now employed by B. Perini and Sons at Blind River, Ontario.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Sudbury

H. M. Whittles, jr.e.i.c.,
Secretary-Treasurer

H. F. Coffin, jr.e.i.c.,
Branch News Editor

Annual Meeting Held

The annual meeting of the Branch was held at the Sudbury Granite Club on May 3, 1956. Special guests for the evening were the wives of the members.

Following the dinner at 7 p.m. there was a short business meeting during which the election of officers for 1956-57 took place with results as follows: chairman, L. T. Lane; vice-chairman, J. W. Smith; non-resident committeeman, J. F. McCallum; resident committeemen, W. B. Ibbotson and R. P. Crawford.

After the meeting an evening of dancing was enjoyed.

Toronto

Louis Bresolin, jr.e.i.c.,
Secretary-Treasurer

A. C. Davidson, m.e.i.c.,
Branch News Editor

Joint Meeting—April 19, 1956

This was a joint meeting with the American Society of Mechanical Engineers and was the final meeting of the current winter season for the Engineering Institute.

Dr. G. Ross Lord—on Flood Control

Dr. G. Ross Lord, m.e.i.c., Professor of mechanical engineering, University of Toronto, spoke on "Humber Valley Flood Control". This engineering problem is of great local interest because of the disastrous flood which occurred in the watershed caused by Hurricane "Hazel", in 1954. Although the problem is of local interest, as previously remarked, there are important conclusions which can be applied to the prevention of similar floods in drainage areas like that of the Humber.

Humber Valley Watershed

The Humber Valley watershed is approximately 336 square miles in extent.

E. V. Gage, treasurer of the Engineering Institute in 1955, spoke to the guests following the banquet.

Engineering Societies Dance

At a recent dance held by the Engineering Societies, in Shawinigan Falls. From left to right are: Mrs. A. P. Earle, R. A. Phillips, vice-president of the Corporation of Professional Engineers of Quebec, Mrs. E. E. Copping, G. H. Hoganson, speaker, and office engineer with the Canadian National Railways; E. E. Copping, dance chairman, Mrs. G. H. Hoganson, E. V. Gage, Mrs. R. A. Phillips and A. P. Earle, chairman of the St. Maurice Valley Branch of the American Institute of Electrical Engineers.

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First cost of the neoprene coatings is higher, says Earl D. Radcliffe, superintendent of operations, but "it looks like we'll only have to do the job every other year instead of six times a year. The net result should be that we keep our trucks painted for 1/6 the materials cost and 1/12 the labor cost." Mr. Radcliffe also reports that in addition to material and labor costs he loses $100 in revenue every time a truck is brought in for repainting. This amounts to $600 a year per truck with acid-resistant paint, only $50 a year per truck with neoprene coatings. And the company expects 4 years extra service from trucks coated with neoprene, thus reducing the cost of tank depreciation by $800 per year per tank.

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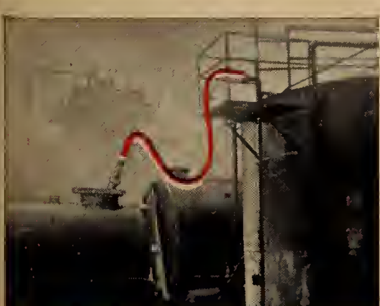

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• Branch News

The headwaters of the river are near Orangeville, and the river itself falls about 1200 feet in 58 miles. There is a tree cover of about 10 per cent. Approximately one-sixth of the river channel lies in the Toronto metropolitan area. Because of the population involved, there is considerable interest in its discharge of flood water. The works of man may be damaged and lives lost when the river goes on a rampage.

The kind of flood which may create conditions similar to those in October, 1954, is that generated by a decadent hurricane. Spring floods are not likely to cause such damage because present day weather forecasting gives ample warning. The flash flood generated by a summer thunder shower presents a considerable threat, but the area of the Humber watershed is above the critical value (200 sq. mi.) for such a flood to do great damage. The Great Lakes themselves ameliorate severe thunder showers. Most of these, with a duration of twenty-four hours pass to the south of the Lakes.

Hurricanes Not on Increase

Hurricanes themselves are not increasing in number, they are simply getting more publicity. Most hurricanes occur in the summer or in the fall, and there have been some twenty-five in Ontario since 1900. Altogether there have been seventy-two floods in the Humber Valley watershed since 1791, with half occurring in the period 1921-34. A few statistics will point up the fearful power of the flood caused by Hurricane "Hazel".

Year	Flow, c.f.s.
1878	9,535
1897	10,381
1946	4,800
1947	4,690
1954	45,600 (Weston gauge)
	49,000 (Estimated at mouth)

The flow over Niagara Falls at night presently is 50,000 c.f.s.

The horse-power dissipated from "Hazel" was between two million and three million over the whole watershed; the amount is almost equal to that which will be generated by the St. Lawrence seaway power development.

The engineer should consider the cost of flood control in the light of the losses incurred, both of life and property; loss of communications, road, rail and wire; health hazards, waste of water and loss of water.

Man is encroaching on the Humber River Valley without much thought to the consequences. The watershed is being denuded, other cover is being removed, the river is being confined to its regular flow channel, housing is being built on the floodplain, agricultural drains and storm drains are all increasing the flood danger.

Not a Maximum

Is hurricane "Hazel" a maximum flow? Is it infrequent? Might another occur in fifty years? These are pertinent questions. The recorded rainfall during Hazel was 7.25 inches, corrected to 9 inches in forty-eight hours, with a

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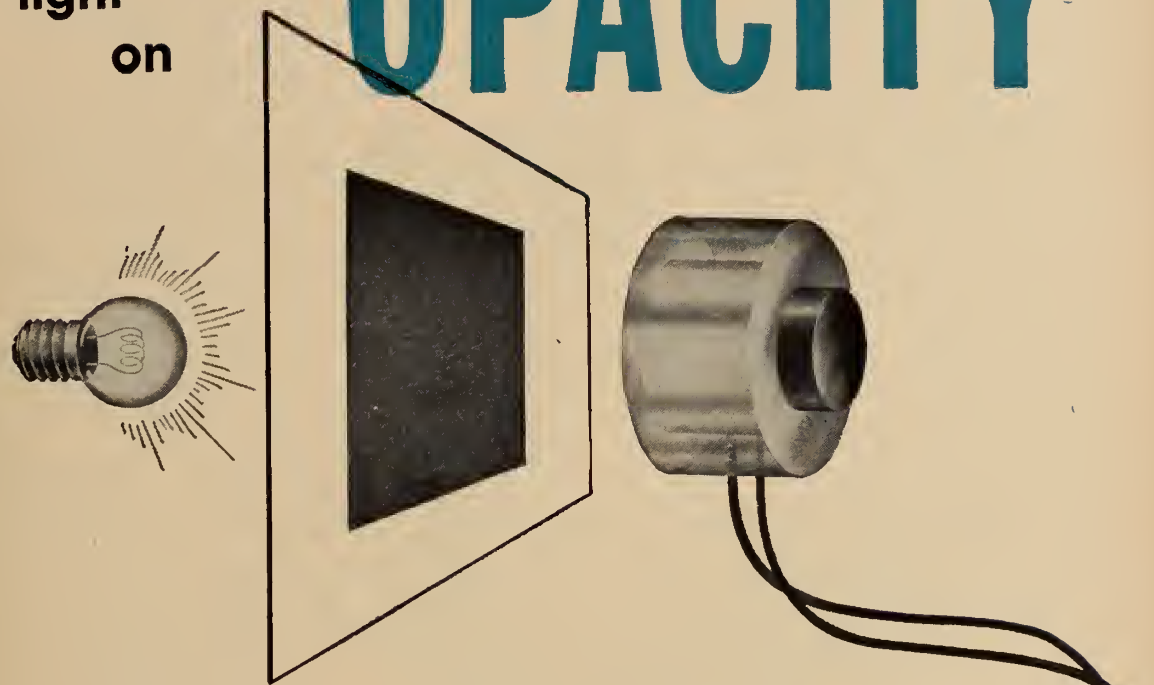

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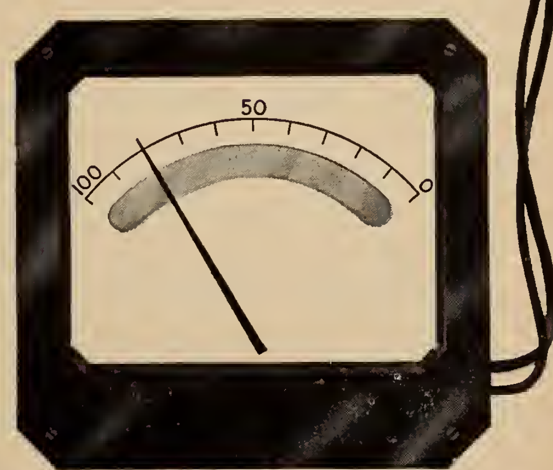

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90 per cent run-off. Investigation shows that this is *not* a maximum. Much greater might occur, possibly 15 inches of rainfall.

Obviously if worse is to come something should be done. The proposed control is balanced between building impounding resevoirs, channel improvements, and conservation, although most residents of low areas and river flood plains everywhere in the world object to dams being built. Five are proposed on the upper reaches whose capacity will reduce a flood like that following "Hazel", to half. The Great Lakes themselves form just such a series of natural reservoirs, preventing any major disasters. So do the Kawartha Lakes at Peterborough. The recreational advantages alone from the construction of such a system of dams are obvious.

To Be Built Gradually

The whole control system will be built gradually. Flood plains will be abandoned. Channel improvements are under way at Woodbridge. This improvement will pay for itself in the first major flood, like the one on the Etobicoke creek at Brampton, which cost $1,000,000 but saved Brampton, during "Hazel".

This channel control will be tied into conservation. Trees will be planted on slopes and hills which never should have been denuded of cover; strip farming, contour plowing and ponding will be encouraged. The channel will be cleaned and kept clean.

At present the Humber River is nothing but a natural sanitary sewer carrying raging floods in spring and fall, subsiding to a useless ditch in summer.

There were about ninety interested listeners who entered into a lively discussion after the talk. Two very interesting points were brought out:

1. There were $3,000,000 lost in the flood following "Hazel", versus $14,000,000 proposed cost to control the Humber.
2. A river meanders because the grade is below that for eroding the channel. If meanders are straightened by using a cutoff channel, a weir must be employed at the bottom of the cutoff, else the artificial channel may be itself destroyed by a flood.

Toronto

Joint Committee, E.I.C., I.C.E., A.S.C.E.,

H. Fealdman, m.e.i.c.,
Chairman,

B. Hardcastle, m.e.i.c.,
Secretary

Meeting of April 12, 1956

This meeting was the last in a series especially arranged for those interested in the field of civil engineering. The three previous meetings as well as this one were very successful if attendance and interest evidenced by questions asked are any criticism. Those who conceived the idea of the meetings and who carried out the necessary and

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• Branch News

arduous work which made them a success, are to be heartily congratulated for filling a great gap in the professional life of the civil engineer so ably here in the Toronto area.

Joint Paper Presented

L. J. Marcon and W. R. Schriever, of the building research division, National Research Council, Ottawa, gave jointly a paper on loading test on a prestressed concrete beam at Cobourg, Ontario.

Although this was only one test, from which an engineer is hardly justified in making general conclusions, both authors felt that the basic theory presently employed in prestressed concrete design is sound.

No attempt will be made here to paraphrase or even summarize the test results since it is expected that the paper will be published eventually in the technical press. However, a few salient features of the test will be described which are considered to be ingenious and novel.

Features of Test

Loading was applied by hydraulic jacks and measured with calibrated gauges. Reactions were measured with load cells. Deflections were taken with dial gauges and a wire and pulley system with a further check using a surveyor's level and rod. Both electrical resistance strain gauges were used to find strain in the steel and concrete. There was good agreement between design and empirical strain, which the authors demonstrated well.

The beam was subjected to the old National Building Code (1941) requirements for test loading. The results were very satisfactory.

Various other loads were applied, and finally the beam was loaded toward failure. Unfortunately, a jack tilted out of position at 294 tons load and the ultimate collapse load was not reached. The beam withstood D.L. + 5½ L.L. according to the calculations of the authors, and might have reached D.L. + 6 L.L.

Deflections varied with humidity, the authors found, and also the deflections varied, due to readjustments of strain in the material.

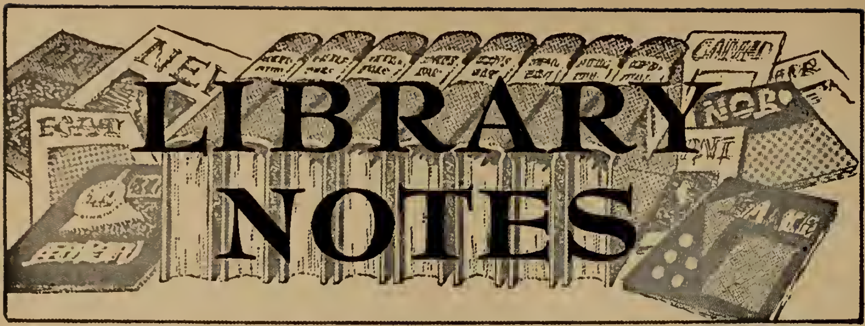
The authors are to be complimented on the painstaking care with which the tests were conducted, the data compiled and conclusions drawn.

Designer Answers Queries

Philip Benn, the designer of the beams used at Cobourg was present at the meeting and he very kindly answered many queries. This was a very interesting phase of the meeting as it is rare for a designer to have his design so thoroughly discussed and verified.

W. R. Schriever Honoured

The chairman of the meeting, Harold Fealdman, stated that Mr. Schriever had received the Sir Benjamin Baker Medal of the Institution of Civil Engineers for a paper which he had given before the Institution on tests which he had conducted on the temporary deck structure of the Toronto subway. This is a signal and well deserved honour for Mr. Schriever.



Additions to the Institute Library

Reviews — Book Notes — Abstracts

BOOK REVIEW

Design and construction of steel merchant ships. David Arnott, ed. New York, Society of naval architects and marine engineers, 1955. 494 pp., illus., $14.00 (U.S.).

For years the need for a modern, comprehensive textbook on ship design and construction has been keenly felt by students, naval architects and engineers, technical and public library users, and others interested in this field. The present work, resulting from the efforts of many outstanding members of the United States shipbuilding industry, fills this need.

Needless to say, there are limits to the subject matter which it was possible to include. Only ordinary, modern, steel merchant ships are discussed to the exclusion of warships and other highly specialized types. The practical, rather than theoretical, approach is taken, and the emphasis is more on structural design than on ship construction. Examples of the ordinary ship calculations are not included.

The book is divided into fourteen chapters, beginning with such basic design factors as hull form and power estimates. Consideration is then given to general arrangements and interior design, and to the historical background of ships' structures. The next two sections on structural design and methods of joining structural parts contain much-needed textbook information on new material specifications, and on riveting and welding in ship construction.

There is a detailed discussion of the function and design of such structural members as deck beams, machinery casings, rudders, foundations, etc., followed by a chapter on fittings. The last part of the book is devoted to specialized arrangements and equipment: cargo-handling, anchor, mooring, and towing arrangements, steering, hull piping systems, heating and ventilation, lifesaving equipment and aids to navigation, and hull preservation and maintenance.

A valuable feature of the work is the bibliographies found at the ends of many of the chapters. The Glossary of shipbuilding terms in the appendix should also be of particular interest to those new in the field.

M. R.

BOOK NOTES*

Prepared by the Library
The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

***Aeroelasticity.** R. L. Bisplinghoff and others. Cambridge, Addison-Wesley, 1955. 860 pp., diagrs., $14.50. (U.S.).

In the first part of this book which is divided roughly into two halves, the authors present analytical methods for dealing with problems of aircraft structures under load, and problems of two- and three-dimensional incompressible flow, compressible flow, and three-dimensional unsteady flow. In the second part, these methods are applied to practical problems of static aeroelasticity, flutter, and dynamic response phenomena. The theory, design, and construction of models, and experimental techniques are also dealt with briefly. The book is intended for advanced students and practicing engineers.

Air conditioning - refrigerating data book: design volume, 9th ed. New York, American Society of Refrigerating Engineers, 1956. 231 pp., diagrs., $10.00. (U.S.).

This is the companion work to the Society's Applications volume, and in it is found the fundamental data and basic engineering information relating to the theory and principles of the design of refrigeration and air conditioning equipment and systems.

The main portion of the book is divided into sections dealing with theory, physical data, application design, basic equipment, auxiliaries and self-contained units, and operation. The chapters on air distribution and controls have been largely rewritten and other revisions bring the subject up-to-date.

There is also a Classified section listing manufacturers of components and assembled units of air conditioning and refrigerating equipment.

***Les barrages en voute mince.** Jean Lombardi. Lausanne, F. Rouge & Cie, 1955. 163 pp., paper. Sw. fr. 28.70.

The author develops in a systematic manner a method of analysis for the thin arch dam in accordance with standard shell theory, with particular attention to torsion effects. Realistic examples are dealt with, and a step-by-step calculation is carried out. The general method developed is compared with the classic method of arch dam analysis.

Brazing. E. B. G. Trehearne. London. British welding research association, 1956. 27 pp., illus., 5/-.

This booklet is one of a series on welding and associated processes, methods and designs. It is a guide to available brazing methods, and to the metals and types of joints most suitable for brazing. There are sections on the treatment of metal before and after brazing, on aids to production, and on new materials.

***Chemical engineering processes and equipment.** E. Molloy and E. Carr, eds. Toronto, British Book Service, 1955. 236 pp., $3.60.

Concise descriptions of a wide range of processes and equipment are presented, supplemented, in some cases, with lists of references to more detailed information. The equipment dealt with includes ball and pebble mills, mixers, porous stainless steel filters, heat exchangers, film dryers, electrical precipitators, and automatic dust collectors. Among the processes covered are vibro-agitation, tabling, magnetic separation, elutriation, evaporating, crystallization, and heavy media separation.

Design of reinforced concrete. B. W. Boguslavsky. New York, Macmillan, 1956. 428 pp., diagrs., $7.50.

The author's purpose in writing this book was to present the student with the fundamentals of structural theory as applied to the design of reinforced concrete members, and to provide a guide for the practicing engineer in actual design work. To facilitate these two objectives, the text contains a number of formulae and methods which are new or generally unfamiliar, and also includes many illustrative problems.

Among the unusual features of the book are formulae for designing slabs and beams which automatically include their own weight, formulae for estimating the size and weight of the footings, and for estimating the cross sectional dimensions of prestressed concrete beams. The chapter headings describe the contents of the book: beams, tension, columns, slabs, footings, retaining walls, bridge arches, maximum moments in building frames, and design of a building.


MAINTENANCE
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• Library Notes

Die designing and estimating, 4th ed. W. N. Nordquist, ed. Cleveland, Huebner, 1955. Various pagings, illus., $7.50 (U.S.).

Since the publication of the third edition of this book in 1942, several new chapters have been added, including those on press die design, the basic principles of cutting with press dies, and the selection of die materials. The remaining sections contain new and up-to-date information. In addition to the above mentioned subjects, the book covers the applictaion and design of piercing, blanking, cutting, compound, combination, drawing, deep-draw, progressive, side or cam-action, temporary and short-run dies, and lamination dies.

A special section gives procedures for predetermining die costs, and a list of practical points in die design and construction is appended.

*__Distribution of lateral forces in small buildings,__ 2nd ed. L. A. Briggs and O. M. Bloch. Glendale, Briggs Publishing Company, 1955. 89 pp., $3.00 (U.S.).

A presentation of a method of distributing lateral forces, whether earthquake or wind, into the resisting piers or walls. The subjects treated include determining forces, how elements of a structure resist forces, the proportion of the force resisted by each pier, wall rigidities, rotational analysis, and walls normal to force. Three chapters are devoted to analyses of small wood frame structure, a similar structure of concrete, and a three-storey structure.

Electric dipole moments. J. W. Smith. Toronto, Butterworth, 1955. 369 pp., $8.40.

In this book are described the techniques of the determination of the electric dipole moments of molecules. It was written for those interested in physical measurements and also for those who use the results of such measurements.

The first section presents the theoretical principles underlying the various methods of determining dipole moments, and describes the experimental procedures involved. The second part interprets the values obtained, while the third section examines some of the problems which have been solved with the use of dipole moment determinations.

In the appendix the principles of wave mechanics are outlined as much of its terminology is used throughout the book.

Electronics. A. W. Keen. New York, Philosophical library, 1956. 255 pp., illus., $7.50 (U.S.).

This is an elementary and descriptive treatment of the science of electronics, written for the non-technical reader with some knowledge of electricity and magnetism.

Among the subjects discussed are electronic conductors, control devices, beam tubes, circuits elements and processes, electronic sound, radio communication, television, computing, electronics in industry, electronic instruments and excitation.

An encyclopedia of the chemical process industries. J. R. Stewart and F. E. Spicer. New York, Chemical publishing co., 1956. 820 pp., $12.00.

Based on the 1953 edition of Stewart's Scientific Dictionary, this is a reference work covering the raw materials, processes, equipment, and finished products of the chemical process industries. It also lists definitions of technical and scientific terms used in this field.

The encyclopedia will also serve as a buyer's guide to chemists and consumers, as it lists the manufacturers and uses of a great number of trade-name and trade-marked products in the United States, although, in most cases, it does not give the address of firms.

Frequency response. Rufus Oldenburger, ed. Toronto, Macmillan, 1956. 372 pp., diagrs., $7.50.

These are the papers presented at the 1953 A.S.M.E. Frequency-Response Symposium plus ten additional articles. Beginning with a section on the fundamentals of the subject, they cover fre-

• Library Notes

quency-response aids; servo, airplane and power system applications; process control; transient response; optimum controls; nonlinear techniques; sampling controls; and statistical methods.

The editor's introduction acquaints the reader with historical developments, fundamental theory, and significant advances. Among the articles are two by Russian engineers which were hitherto unavailable to the general reader.

The golden book of management. L. Urwick, ed. London, Newman Neame, 1956. 298 pp., illus., 35/-.

In recording the work of some seventy pioneers in management this book will serve as a reference tool for students of business management. Eleven countries are represented, with the United States predominant. The special contributions, publications, careers and personal characteristics of each man are described in an average of four pages. The book is published under the auspices of the International committee of scientific management, and the editor is well known in the field.

Hi-fi loudspeakers and enclosures. A. B. Cohen. New York, Rider, 1956. 360 pp., diagrs., $4.60 (U.S.).

This book will appeal particularly to those wishing to build or assemble their own high-fidelity set. It is divided into sections on the Loudspeaker, the Enclosure, and the Room, and detailed design information is given. The appendix consists of 18 complete plans for the construction of typical loudspeaker enclosures of all types and for various speaker sizes.

High-temperature technology. I. E. Campbell, ed. New York, Wiley, 1956. 526 pp., illus., $15.00.

In this important work sponsored by the Electrochemical Society, thirty-five specialists in the field described new materials of construction for service at very high temperatures, methods used in production, and techniques for measuring properties.

Among the materials discussed are oxides, carbides, borides, silicides, nitrides, sulfides and cermets. In the section on methods of producing these materials, there are chapters on sintering, resistance and induction-heated furnaces, and arc furnaces. The last part of the book contains papers on the mechanical and physical properties of these specialized materials, and on special techniques for their measurements, e.g. high-temperature microscopy and X-ray diffraction.

In general, consideration is given to service at temperatures above 1500° C, although some of the discussion relates to processing at moderate temperatures.

Introduction to color TV, 2nd ed. Milton Kaufman and H. E. Thomas. New York, Rider, 1956. 156 pp., diagrs., $2.70 (U.S.).

The few changes in this new edition include descriptions of larger screen picture tubes and more simplified receiver circuitry. There are chapters on the NTSC color television system, tri-color picture tubes, and adjustment of receivers.

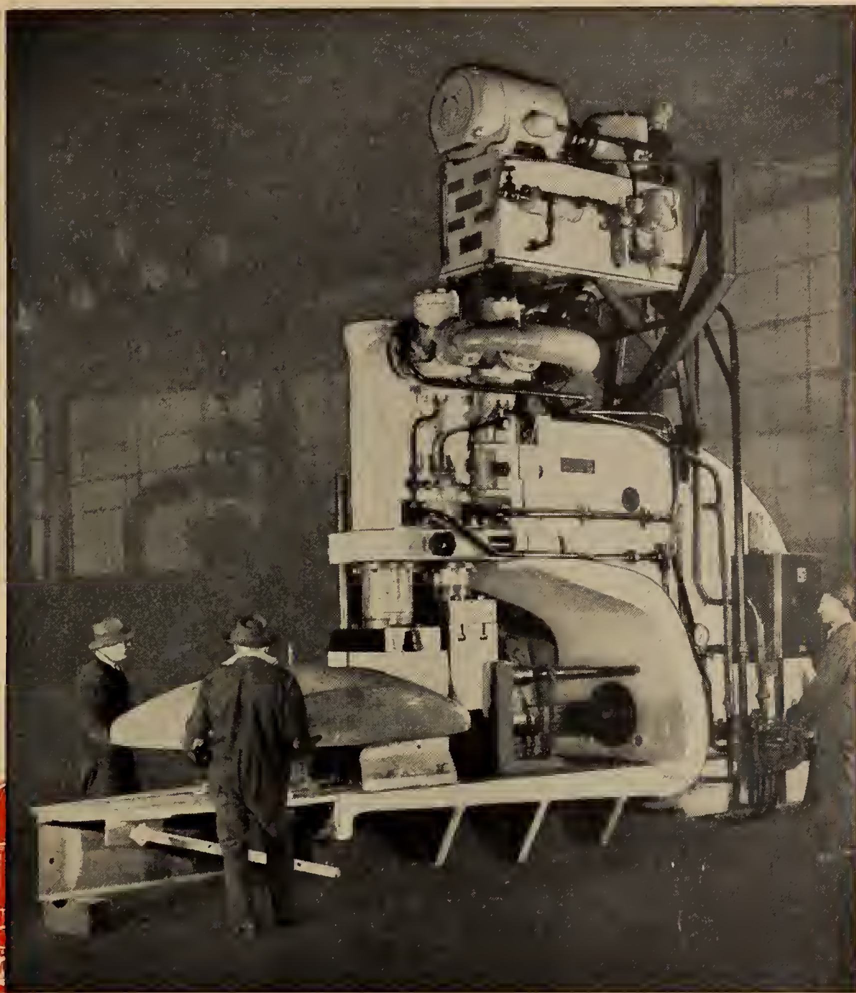
Introduction of plasticity. Aris Phillips. New York, Ronald, 1956. 230 pp., diagrs., $7.00 (U.S.).

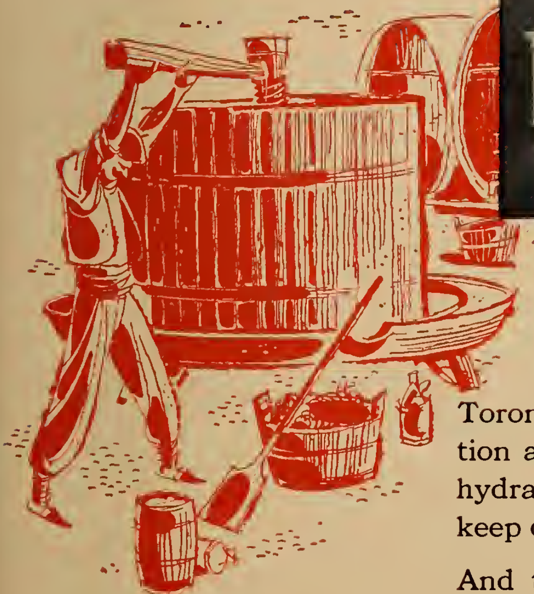
This text on metal plasticity is suitable for advance engineering students as well as for the practicing engineer. It introduces the latest methods of calculating stresses and strains in plastic materials, but uses only the minimum mathematical tools. The concept of a tensor is excluded.

The first six chapters deal with one-dimensional problems, beginning with axial loading, and going on to deflections and curved bars. The last three chapters consider problems of combined stress: stress-strain relations; collapse under combined stresses; and strain hardening under combined stresses.

Inventions and their management, 3rd ed., rev. A. K. Berle and L. S. De Camp. Toronto, Van Nostrand, 1954. 742 pp., $10.75.

This is a recognized handbook for inventors, investors, company executives and businessmen, and attorneys. Its objective is to show the aspiring inventor how to approach and manage an invention successfully, from the original idea through development, protection, and commercialization. Many test cases are





• Library Notes

presented to illustrate different procedures.

Among the vast amount of information contained in the book, there are chapters on patent laws and limitations, patent searches and study of the market, patent applications and sales, trade marks, copyrights, and accounting and taxes in relation to patents.

The appendix includes a glossary of terms connected with inventions and their management.

Legal problems in engineering. Melvin Nord. New York, Wiley, 1956. 391 pp., $7.50.

While there are a number of books available on the legal aspects of engineering, this work will be a valuable addition to such a collection because of its thorough treatment of the subject. The author has been able to include a wide field of topics by eliminating unnecessary long case histories and detailed documentary examples.

Among the legal principles discussed are contracts, sales, insurance, workmen's compensation, public utilities and labor law. This section is followed by one on the ethical responsibilities and professional registration (specifically in the United States) of engineers.

The last part of the book is concerned with construction contracts, governmental regulation, patents, and air and stream pollution.

The mathematics of physics and chemistry, 2nd ed. Henry Margenau and G. M. Murphy. Toronto, Van Nostrand, 1956. 604 pp., $8.75.

One of the main additions in this new edition is the chapter on the theory of Laplace and Fourier transforms. A number of other small changes and corrections are also found but the main plan of the book is the same.

The first section discusses the mathematics of thermodynamics, which is followed by ordinary differential equations, special functions, vector analysis, coordinate systems, and calculus of variations. There are also discussions of the mechanics of molecules, matrices, quantum mechanics, numerical calculations, linear integral equations and group theory.

Multivibrators. Alexander Schure, ed. New York, Rider, 1956. 48 pp., 90c (U.S.).

The basic principles of the multivibrator are outlined in this booklet, with particular attention given to these major types: the bi-stable multivibrator, mono-stable multivibrator, and a-stable multivibrator.

Naval boilers, 2nd rev. ed. R. F. Latham. Annapolis, Md., U.S. Naval Institute, 1956. Various pagings, illus.

Written as a textbook for midshipmen in the United States Naval Academy, this work provides an introduction to the fundamental features of a steam generating plant. It traces the history and development of steam generating units from early times to the nuclear power plant, with emphasis on marine boilers used in the U.S. Navy. The function of the boiler unit within the framework of the propulsion plant is described, including principles of heat transfer, circulation, and properties of steam.

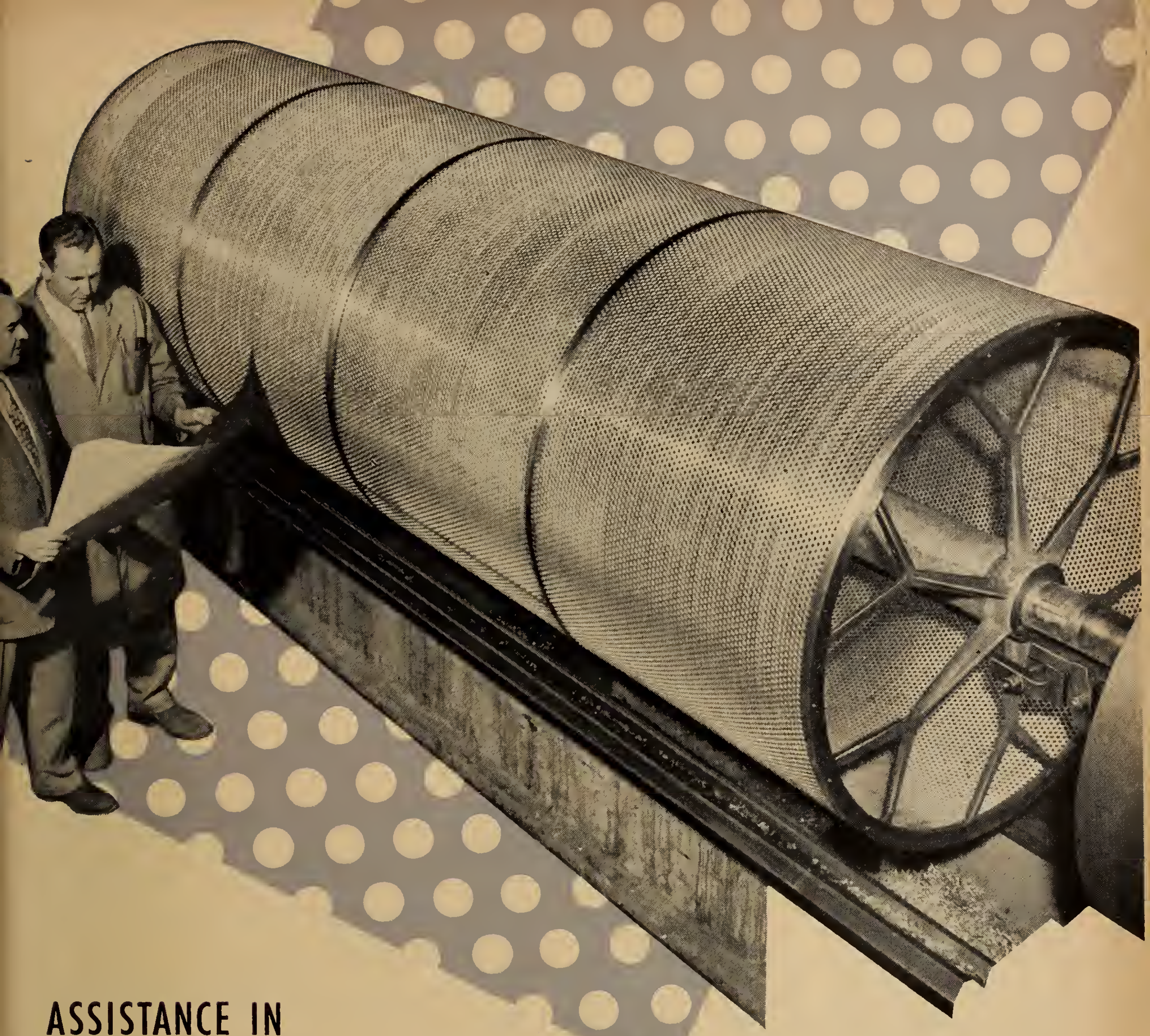
The last four chapters deal with such basic operating equipment and techniques as boiler water treatment, including types and effects of contamination. There are also sections on fuel oil, combustion, atomizers and burners used in naval boilers. The final chapter deals with basic naval power plant arrangements, and economical boiler operation and maintenance.

***Overhead line practice,** 2nd ed. John McCombe. London, Macdonald, 1955. 287 pp., illus., 25/-.

A clear presentation for engineers, foremen, linesmen, and others, of the details of the layout, design, and erection of overhead power lines. All the aspects of the work, from surveying to inspection and testing of lines are covered. In this edition there are new sections on sag-tension calculations, aluminum alloy conductors, and maintenance; the chapter on legal notices and right-of-way has been omitted.

Practical problems in soil mechanics, 2nd ed. rev. H. R. Reynolds and P. Protopapadakis. London, Crosby Lockwood, 1956. 205 pp., illus., 18/-.

The practical approach is emphasized in this book which illustrates the application of soil-mechanics methods and analyses to everyday problems.



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Among the subjects discussed are soil properties, stability of earth slopes, embankments, retaining walls, foundations, artificial cementation and ground water lowering, soil stabilization for roads and airfields, and site exploration and soil investigations.

Many problems are fully worked out, a feature which will help civil engineers in their design work.

Proceedings of the first conference on coastal engineering instruments. R. L. Wiegel, ed. Richmond, Calif., Council on wave research, 1956. 302 pp., illus., $5.00 (U.S.).

The purpose of this conference was to present papers on many of the instruments used to obtain data necessary to the design of coastal structures, ships and seaplanes. They are too numerous to list but they include the capacitive wave profile recorder, parallel wire resistance wave meter, the thermopile wave meter, the N.I.O. wave analyzer, the storm wave force meter, shock pressure meters, Carruthers current meter and wire angle gage, and C.B.I. Salinity-temperature meters.

Proceedings of the RETMA symposium on automation. New York, Engineering publishers, 1956. 114 pp., illus., $5.00 (U.S.).

This book includes both the papers presented at the symposium sponsored by the Engineering Department of the Radio-Electronics - Television Manufacturers Association and the discussions which followed. Included are both practical and theoretical considerations of techniques and systems, economic problems, design principles, and application details.

The subject covered are: mechanization for high volume assembly; data sensing, processing and utilization; the future of automation; automation for low volume production; and redesign for automation of components and products.

Within these broad subjects there are discussions on such specific topics as automatic production of components, automatic warehousing and automatic ticket reservation systems, automation of non-circular gear cutting, etc.

Proceedings of the symposium on printed circuits. New York, Engineering publishers, 1955. 122 pp., illus., $5.00 (U.S.).

This symposium, sponsored in 1955 by the Radio-Electronics-Television Manufacturers Association and the Institute of Radio Engineers, covered all the methods of printed circuitry in present-day commercial use.

The papers deal with both theoretical and practical aspects, materials and components, design and production, testing and evaluation, and reliability and management problems. Effective methods of using new techniques are discussed, as well as the economic factors involved.

Productivity measurement, v. 2—Plant level measurements: methods and results. Toronto, Ryerson. 1956. 194 pp. $1.50.

A brief account is given of the practice in various European countries regarding productivity measurement in plants. A discussion of such practical problems as collection of basic data, interpretation and use of results, is followed by solutions actually used. The second part of the book deals with a comparison of results in different countries, with an account of difficulties encountered in making these international comparisons.

This is the second volume on the subject published by the Organisation for European economic co-operation.

***The radio amateur's handbook, 33rd ed., 1956.** West Hartford, American radio relay league, 1956. Various pagings, $3.00 (U.S.).

A new edition of a standard handbook covering the entire field from basic theory to practical construction details. Changes have been made throughout to take note of recent changes in practice, a new chapter has been added on semi-conductors, and a considerable amount of new apparatus is described in the chapter on measurement. This edition also includes design data and construction information on v.h.f. beam antennas.

• Library Notes

Rubber in automobile engineering. R. Dean-Averns. London, Natural rubber development board, 1956. 206 pp., illus., 5/-.

The aim of this book is to explain the properties and characteristics of rubber from the point of view of the automobile engineer. The greater part is devoted to engine vibration problems and suspension systems in relation to the use of rubber. There is a chapter on pneumatic tires, followed by sections dealing with the use of rubber in the clutch, drive, steering and brakes; in units attached to the body or frame; in electrical fittings, hoses and seals; in door mounting, flooring and seating.

Theodolite design and construction. E. W. Taylor. York, Cooke, Troughton & Simms, 1955. 136 pp., illus., 20/6.

This manual deals with the construction and design of an accurate and reliable theodolite. It discusses graduated circles, reading the circles, effects of eccentricity and misplaced indices, the telescope, the spirit level, the adjustments of a theodolite, the mining theodolite, and accessories for the instrument.

The theory and technique of ship design. G. C. Manning. New York, Wiley, 1956. 278 pp., $10.00.

In his preface, the author expresses the opinion that ship building is an art as well as a science and he has based the contents of his book on this philosophy. It is a study of the fundamental principles and processes used in the design of ships of all classes, with the emphasis on commercial vessels.

Beginning with a chapter on the philosophy of ship design, the book [illegible] to consider such problems as th[illegible] liminary estimate of displacement, elements of form, and of stability. There is a chapter on preliminary lines and calculations, on the design of general arrangements, on strength and weight calculations, and on contract and final design.

The appendices include the computation of righting arms from principal dimensions and coefficients, and Taylor's mathematical lines.

***Transistor electronics.** A. W. Lo, and others. New York, Prentice-Hall, 1956. 521 pp., diagrs., $12.00 (U.S.).

In this book, written for graduate students and electronics engineers, the emphasis is on a basic understanding of the circuit aspects of the transistor and on the physical principles governing transistor operation as a basis for practical circuit design.

The book begins with a discussion of transistor physics and general properties of the transistor as a circuit element, then goes on to describe stabilization of the d-c operating point, low-frequency amplifiers, power amplifiers, high frequency operation, high-frequency amplifiers, oscillators, modulation and pulse circuits. A large number of illustrated practical circuits facilitates circuit design, and the effect of various physical phenomena of transistor action on equivalent circuits is also covered.

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

Belts and belt drives

Modern multiple V-Belt drives. (Allis-Chalmers manufacturing company).

Bridges

Standard specifications and code of practice for road bridges. Section 1—General features of design. (Indian roads congress, 1956).

Canada. Royal commission on Canada's economic prospects.

Housing and urban growth in Canada. (Central mortgage and housing corporation.)

The role of the automobile in Canada's next quarter-century. (Ford Motor Company of Canada.)

Concrete, Reinforced. Beams.

Plastic flow (creep) of reinforced concrete continuous beams. G. W. Washa and P. G. Fluck.

• Library Notes

Gasoline.

Gasoline survey for summer, 1955. P. B. Seely and others. (Canada. Dept. of mines and technical surveys. Fuels division.)

Highway accidents.

Statistical analysis of highway accidents. (U.S. Highway research board. Bulletin 117.)

Industrial relations.

Disability retirement in industrial pension plans. (Princeton. Univ. Industrial relations section, $2.00 (U.S.).)

Union strike votes. (Princeton. Univ. Industrial relations section. $3.00(U.S.).)

Mines and mining.

Measurement of thorium in ores by the thorium emanation method. J. B. Zimmerman and J. A. F. Bouvier. (Canada. Dept. of mines and technical surveys. Radioactivity division. Technical paper No. 14).

Miscellaneous.

Charles F. Kettering, 16th Hoover medalist.

Deadly motoring or planted safety? (American association of nurserymen.)

New York's air travelers. (Eno foundation for highway traffic control.)

Regional industrial index of British Columbia, 1954 ed. (B.C. Bureau of economics and statistics.)

Roads and streets.

Effects of chlorination and microorganisms and constituents of asphalts. (U.S. Highway research board. Bulletin 118).,

Experimental concrete pavements. (U.S. Highway research board. Bulletin 116).

Design and testing of flexible pavement. (U.S. Highway research board. Bulletin 114).

Land acquisition 1955. (U.S. Highway research board. Bulletin 113).

Soil mechanics.

Transactions of the fifth annual soil mechanics and foundation engineering conference. (Kansas. Univ. Bulletin of engineering and architecture No. 36).

Vertical sand drains for stabilization of embankments. (U.S. Highway research board. Bulletin 115).

The following annual reports have also been received by the library:

Canada. Dept. of labour. Director of Canadian vocational training. Report for the fiscal year ending March 31, 1955.

New York (City). Dept. of public works. Annual report, 1955.

Nova Scotia. Board of commissioners of public utilities. Report for the year ended December 31, 1955.

Nova Scotia research foundation. 8th annual report, 1955.

Winnipeg. Greater Winnipeg water district. Annual report for year ended December 31, 1955.

• Library Notes

STANDARDS REVIEWED

A.S.T.M. standards. American society for testing materials, 1916 Race Street, Philadelphia 3, Pa.

A.S.T.M. specifications and tests for electrodeposited metallic coatings. $1.85 (U.S.).

The 17 specifications here reprinted have either been developed jointly with the American Electroplaters Society, or have subsequently been endorsed by them. There are specifications for zinc, cadmium, nickel-chromium, and lead on steel; nickel-chromium on copper; nickel-chromium on zinc; and chromate finishes on zinc coatings. In addition there are recommended practices for preparation of low-carbon steel, high-carbon steel, zinc-base die castings, and copper-base alloys for electroplating; chromium plating on steels; and preparation of and electroplating on stainless steel and aluminum alloys.

A.S.T.M. specifications for steel piping materials. $4.00 (U.S.).

This 1955 edition of the compilation contains 58 approved specifications for ferrous pipe, tubes, castings, and fitting and bolting materials in their latest forms. New specifications include those for metal arc welded steel pipe for high pressure transmission service, cold drawn wrought iron heat exchanger and condenser tubes, and alloy steel castings, normalized and drawn for high pressure and elevated temperature service.

A.S.T.M. standards on cement, 1955. $2.75 (U.S.).

This compilation includes 37 specifications and methods of test of which 18 have been revised since the 1954 edition and 5 are new. The publication also contains information on analytical balances and weights, a manual of cement testing, a list of selected references on portland cement, and other data.

A.S.T.M. standards on plastics, 1955. $5.75 (U.S.).

This volume includes 143 specifications and tests on properties, analytical methods, molds and molding processes, conditioning, plates, sheets, tubes, rods and molded materials, and electrical tests. Much of the material has been substantially revised since the last compilation appeared in 1954.

British standards, British standards institution, 2 Park Street, London, W. I. British standards are available from the Canadian standards association, National Research Building, Ottawa.

B.S. 1116-1956 — Flexible trailing cables for quarries and metalliferous mines. 6/–.

In this revision of the 1943 edition the three parts have been combined. The main new features are the inclusion of 6.6. kV cables, and the incorporation of composition and test requirements for rubber insulation and for natural rubber and polychloroprene sheaths by reference to B.S. 7. The standard does not include collectively or individually screened cables, for which reference should be made to B.S. 708 — Trailing cables for mining purposes.

B.S. 1306: Pt. 1:1955 — Non-ferrous pipes and piping installations for and in connection with land boilers. 3/–.

This standard applies to the design and construction of non-ferrous pipework for connecting a land steam boiler to engine, turbine or industrial plant, and to all associated auxiliary pipework. It specifies maximum design pressures and temperatures for copper pipes and gunmetal castings used in these installations.

B.S. 1470-77:1955 — Standards for wrought aluminium and aluminium alloys. B.S. 1470 — 6/–; B.S. 1471-77 — 7/- each.

These eight revised standards deal with various wrought forms as follows:—

B.S. 1470 — Sheet and strip.
B.S. 1471 — Drawn tube.
B.S. 1472 — Forgings and forging stock.
B.S. 1473 — Rivet, bolt and screw stock for forging.
B.S. 1474 — Extruded round tube and hollow sections.
B.S. 1475 — Wire.
B.S. 1476 — Bars, rods and sections.
B.S. 1477 — Plate.

The system of nomenclature adopted throughout all standards in the earlier series has been retained; but two new prefix symbols have been introduced, 'V' for extruded round tube and hollow sections and 'B' for bolt and screw stock.

Three new materials have been introduced in the series, namely super-purity aluminium designated 1, and two aluminium-magnesium-silicon type alloys designated H20 and H30, which have been included immediately following H10 because of their similarity to that material. Alloy H20 contains an addition of copper, and also manganese, and/or chromium, while H30 is a copper-free alloy with an obligatory manganese content.

The tolerance tables in several of the series have been extended, and minor amendments made to the values specified.

B.S. 2004:1955 — Polyvinyl chloride insulated cables and flexible cords for electric power and lighting (for working voltages up to 250 volts). 6/–.

This revision incorporates an amendment providing for tinned copper conductors, with plain copper conductors as an alternative, to be supplied when specified by the purchaser. Apart from changes resulting from the introduction of tinned conductors, and a few corrections and minor editorial amendments, the text is the same as that of the 1953 edition.

B.S. 2633: 1956 — Class I Metal arc welding of steel pipelines and pipe assemblies for carrying fluids. 10/–.

Lack of uniformity in welds used in pipelines and pipe assemblies, and for securing flanges and attachments e.g. anchor plates, has resulted in a variety of practices. This standard is one of the process standards in the comprehensive series for the welding of steel pipelines and pipe assemblies for carrying fluids. It covers the shop and site metal-arc welding of steel pipelines and pipe assemblies for carrying fluids suitable for Class I conditions and in sizes up to 24 inches diameter. It covers all types of butt joints, branches and sleeve welds, in addition to qualifying tests for welders.

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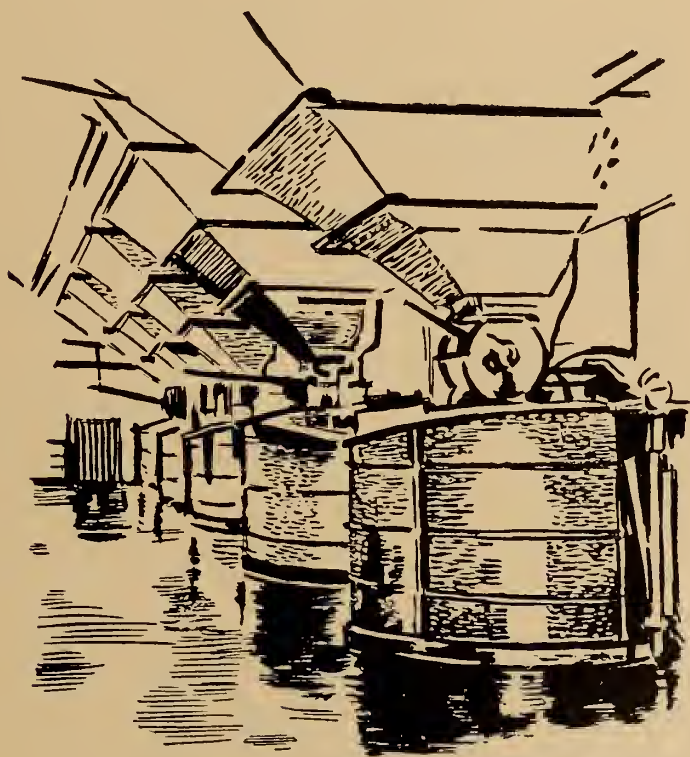

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B.S. 2641: 1955 — Glossary of terms relating to automatic digital computers. 3/-.

The development of high-speed digital computers has produced a need for the standardization of the terms used in this technique. In the early stages, however, it was thought that methods were changing so rapidly that attempts to draft a glossary would be inadvisable and profitless, and delay was counselled. Techniques now having reached a more stable state, this glossary has been produced. It contains about one hundred entries, covering the following subjects: Fundamental terms; Coding systems; Storage techniques (mainly electronic); Programming and routines. For completeness, a few definitions relating to number representation and number scales are included.

B.S. 2642: 1955 — General requirements for the metal-arc welding of medium tensile weldable structural steels to B.S. 968 Type a. 6/-.

B.S. 2642 specifies the general requirements for the metal-arc welding of medium tensile weldable structural steel to B.S. 968, Type a, under normal conditions of manufacture and service. Details are given of the materials to be used and the design of butt and fillet welds. Graphs are included for the determination of intermediate values of plate thickness and varying degrees of preheat for rutile and low hydrogen electrodes for use with both butt and fillet welds.

B.S. 2645: Part 1: 1955 — Tests for use in the approval of welders. Part 1. Manual metal arc and oxy-acetylene welding of mild steel and low alloy steel sheets, plates and sections. 12/-6.

B.S. 2645 has been prepared to make available a series of standard tests, one or more of which can be selected for assessing or testing the capabilities of a welder. It is complementary to B.S. 1295, 'Tests for use in the training of welders'. The tests in Section 1, for which the specified material is mild steel, are for use in the preliminary assessment of a welder's skill.

The tests in Section 2 are for use in the approval of welders for specific applications.

B.S. 2688: 1955 — Dimensions of impulse magnetos (unscreened and screened) 5/6.

This new British Standard applies to the dimensions of base mounted and spigot impulse magnetos for internal combustion engines. It deals only with the dimensions of unscreened and screened impulse magnetos necessary to ensure interchangeability, and also applies to impulse starters separate from, and constituting an attachment to, standard magnetos to B.S. 1620 and B.S. 5027.

B.S. 2693: 1956 — Screwed studs. Part 1: General purpose studs. 3/6.

It is hoped that publication of this British Standard will meet a long felt need, since it is the first British Standard to give full information, including limits and tolerances for the threads, for screwed studs intended for general use. The principle adopted is that of mating an oversize stud with a standard tapped hole and the amount of oversize and the thread tolerances specified are those considered suitable for most purposes. Details are given for studs with UNF, UNC, B.S.F. and B.S.W. threads in diameters up to 1½ in. and for studs with No. 2 and No. 4 B.A. screw threads.

B.S. 2697: 1956 — Rack type gear cutters. 2/6.

This standard includes tables of dimensions and permissible errors, it indicates the method of mounting, and shows the tooth form and explains the terms used, by the pictorial method. Two appendices give details of the marking to be employed and instructions for ordering the cutters.

B.S. 2708: 1956 — Unified black square and hexagon bolts, screws, nuts (UNC and UNF threads) and plain washers — normal series. 5/-.

This is the latest addition to the range of standards for unified fasteners and it is intended to satisfy the demand for bolts and nuts with smaller hexagons for applications where precision tolerances are not required.

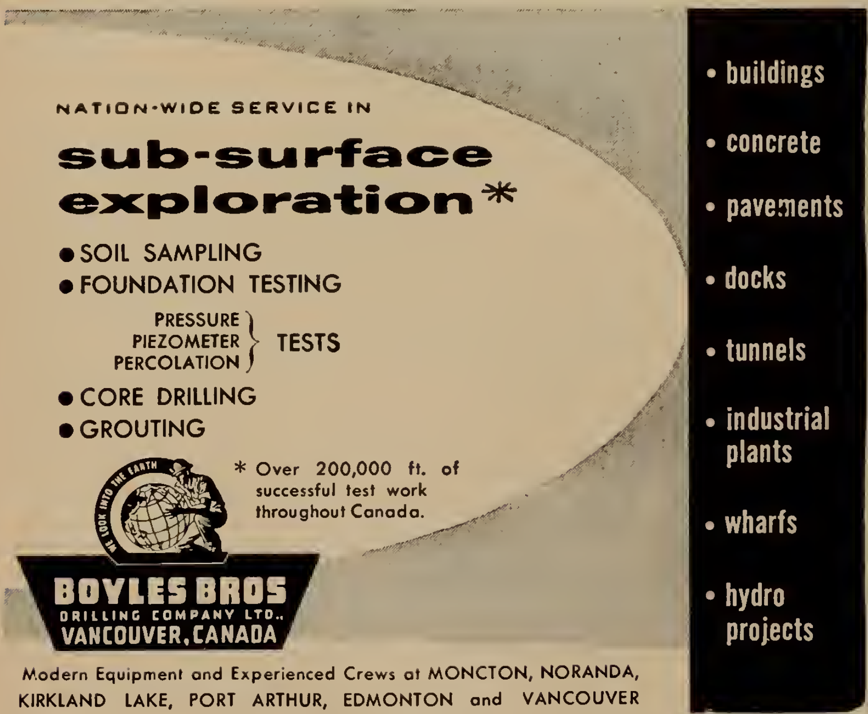
A table of heavy hexagon nuts in sizes from ¼ to 2 in. has been included, since users of the standard may wish to follow what is common practice in the U.S.A., where square headed bolts are often used, not only with square nuts, but with heavy hexagon nuts. The standard also includes appendices giving formulae for the calculation of sizes outside the range of the specification, details of identification marking, and tables of approximate weights of bolts and nuts.

The Maritime Professional Meeting

of

The Engineering Institute of Canada and the Associations of Professional Engineers of Nova Scotia, New Brunswick, Prince Edward Island and Newfoundland.

St. Andrews by the Sea, N.B. **September 5, 6, 7, 1956**



The Pulp and Paper Industry

Canada's largest single industry is well known by the title "pulp and paper". Since pulp, the basic material of the industry, is derived from wood (with the exception of less than one per cent from other sources) it might be more appropriate to borrow the term "forest products" to describe the great range of derivatives covered by this industry. Not only paper, in its many forms, but packaging and building materials and valuable chemical products play a large part in its flourishing operations.

The pulp and paper industry is the largest single employer of labour in Canada; it also has need of professional men from all occupations, and the engineer finds his place among them in many different fields. Chemical, civil, mechanical, electrical, and forest engineers all have their opportunities in the various branches of the industry.

Forest Operations

Canada has one of the largest coniferous forests in the world that is suitable for development for the large-scale production of pulpwood. These forests must now keep the mills supplied with some 40,000 cords of pulpwood a day for an output of about 32,000 tons of pulp and paper—and the industry is developing all the time to meet an ever-growing demand for all its products.

These forests are managed scientifically and economically, so that the harvest of pulpwood may be gathered and moved to its destination by the best means, and so that the future supply is assured through proper methods of conservation.

The engineer may be needed for general administrative duties, but is more likely to work on logging operations within the forests. Cutting operations in British Columbia, where trees are large and work proceeds throughout the year, is almost entirely mechanized and uses many units of heavy equipment. There is also a definite trend towards mechanization in the eastern woods operations.

Apart from cutting and handling methods, the engineer helps to plan, far in advance of actual operations, the means of transporting the pulpwood to the mills. This involves surveys of natural waterways and routes for rail and road, and the subsequent developing and building of these channels for the ready flow of material. New areas have constantly to be opened up, and the magnitude of the operation may be judged from the fact that over twelve million cords of pulpwood are cut and moved each year.

The Mills

There are some one hundred and thirty pulp and paper mills across the continent of Canada and Newfoundland. Numerically, over 40 per cent are in Quebec, rather more than a third in Ontario, nearly a tenth each in British Columbia and the Maritimes, and the remainder (some 5 per cent) in Newfoundland, Manitoba, and Alberta.

The mills may produce pulp alone, or paper or both.

The newsprint mills form the largest group within the industry, with about 60 per cent of total production; of this total another 23 per cent is pulp for sale (largely to other mills and the chemical industry), and 10 per cent is paperboard. The remaining 7 per cent of output is made up of other types of paper.

Basically, the mills are equipped with a variety of heavy and complex machinery and require large

Newsprint spins out of the dry end of a huge paper machine. Engineering talents of all kinds are required to keep the mills and equipment in operating condition, to develop and improve products, and to do research.

amounts of power for their operation. As an example, the major mills of one leading Canadian organization consume power at the rate of 365,000 h.p. each day. Civil, electrical, and mechanical engineers are needed for the operation and maintenance of the mills and their associated equipment; chemical engineers are in demand for the work of technical control departments, where the quality of materials and products is constantly controlled, and also in the chemical pulp mills.

The two methods of making pulp are mechanical and chemical. Mechanical pulping, largely used for newsprint material, requires heavy machinery and makes great demands for electric power. Chemical pulping is a more complex process of considerable concern to the chemical engineer. Whatever the source of pulp, its conversion to paper again involves the engineer in the planning and layout of plant and the design of paper-making machinery. A single machine may be several hundred feet long and produce over 200 tons of paper a day in widths of the order of twenty feet. (Engineering departments are constantly developing such machinery, and other equipment, and working on changes and improvements in plant processes.)

In addition to the engineer's part in operating, maintaining, and improving these mill processes a considerable amount of fundamental and applied research and development work is continuously carried out by the mills.

The bottom of one of the eight digesters in a New Brunswick pulp mill. Each digester is 16 ft. dia. and 60 ft. high, made of steel with a special brick lining.

Other Manufacturing Operations

Perhaps the most rapid growth to be expected within the industry will be in the field of packaging materials. Apart from paper for bags and wrapping, there is a continuing trend to the use of boxboard and container board cartons. Both for small items and for heavier equipment the paperboard container is ever more widely adopted so that more paper and paperboard is now used for packing than all other packaging materials combined.

The design and manufacture of these packaging products and the containers into which they are made represents an increasingly important section of the industry, with its own problems and requirements for the engineer.

Similarly, hardboard and other paper products are in increasing demand as materials for building and construction, while the chemical engineer may be increasingly engaged in developing the use of pulp by the chemical industry.

Opportunities for the Engineer

The man with a basic engineering degree has many opportunities for a career in the pulp and paper industry. Usually he will start as a junior engineer in a particular branch and proceed to gain practical experience as he works on the job.

In many cases the graduate will be assigned to a task which he follows through while he receives additional training and guidance from senior engineers. As his training proceeds and he gains necessary experience the young engineer fits himself for more advanced positions.

Promotion is generally by merit, based on the combination of ability and experience possessed by the candidate.

From junior engineer on the general staff, progress will depend on the particular bent of the individual, but there are positions to be filled in the plant engineering departments of the mills up to chief engineer or to senior superintendents of process control departments. Similarly the other manufacturing divisions, for example those making containers, have their own plant and process engineers, while such positions as plant manager are frequently filled by the professional man.

The demand for engineers in the forests has already been indicated, and many are employed at administrative and managerial levels.

In several cases the president of a company or group of companies within the industry is an engineer, as also are other senior executives and their immediate staffs.

The way is thus open to the engineer with the right combination of skills and experience to proceed to the top positions in an industry that is itself a leader with a foreseeable future of rapid and extensive expansion. The industry particularly has a need for men of imagination and broad outlook.

Training Schemes

Most companies take engineering students for summer work and provide a basic training in various aspects of the industry.

As already mentioned, the young graduate joining a company is often given on-the-job training and guidance during the first year or two of his assignment. Some companies provide formal training courses for engineers entering specific divisions; for example, in all phases of plant operation in manufacturing departments such as container plants.

Salary Scales

Wages throughout the industry are generally good, and the scale of salaries for engineers are in keeping with those obtaining in other leading Canadian industries.

Junior engineers may start at a salary of $350 a month or more, rising to, say, $1000-$1250 monthly for a senior plant engineer, with correspondingly higher figures for the upper managerial positions.

Other Benefits

Paid vacations, sick leave, pension schemes, and various forms of health insurance are generally available throughout the industry.

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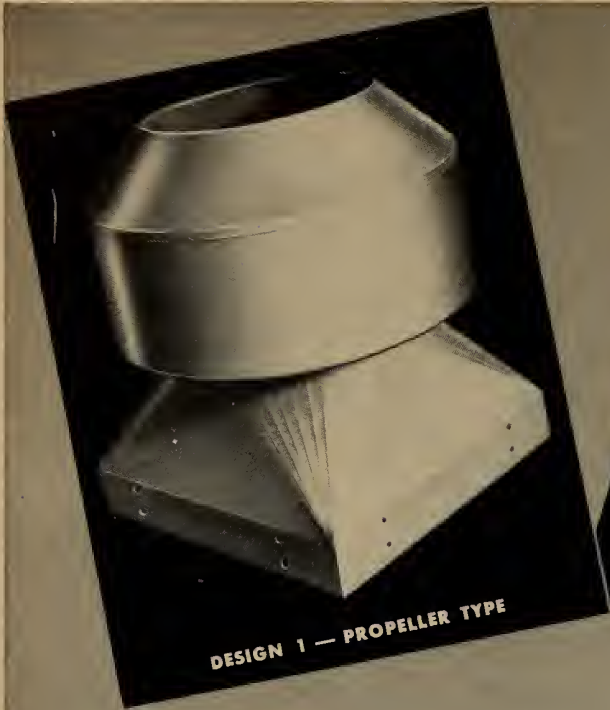

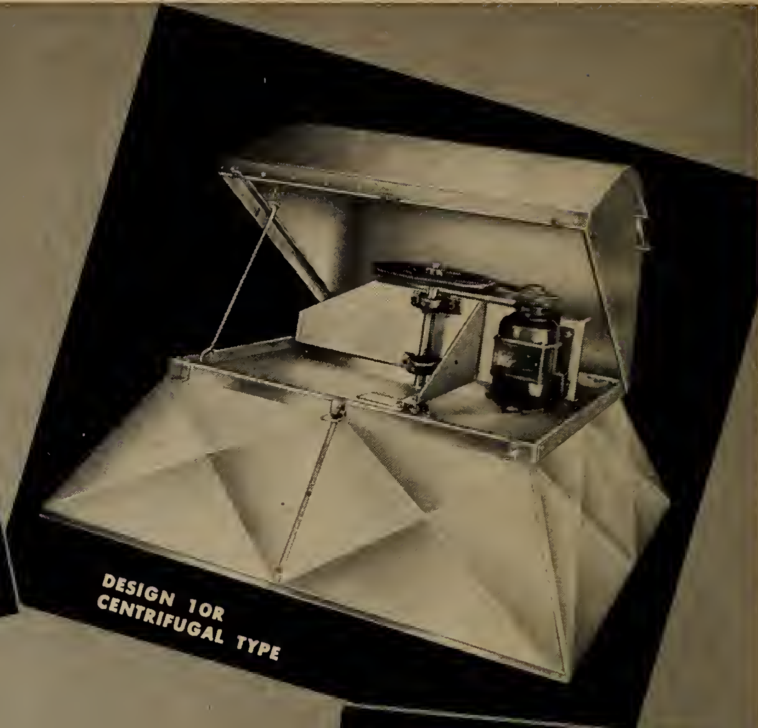

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Cross Suspension System

Kemano-Kitimat Transmission Line

H. B. White, M.E.I.C.

Power Transmission Engineer, Aluminum Company of Canada, Limited

On January 26th, 1955, an avalanche destroyed three towers in the Kildala Pass section of the 49-mile long Kemano-Kitimat transmission line and thus interrupted the delivery of power to the Aluminum Company of Canada aluminum smelter at Kitimat, British Columbia. After temporary repairs had been made, and the circuits re-established, study was given to several schemes of permanent repair and relocation that would keep this section of line free from avalanche danger in the future.

Considerations of safety, time and cost led to the use of a new type of cross suspension system for supporting high voltage transmission lines. The lines, which run up a narrow valley at this point, were to be suspended from two steel wire ropes strung across the valley. The system was erected, and power was being fed over it on September 26th, 1955, eight months after the outage, and only six months and four days from the date of the decision to proceed.

Power Outage

Approximately 40 miles of the Kemano-Kitimat transmission line is of a heavy but conventional double circuit type of construction with "Falcon" ACSR as the conductor, and a nominal line voltage of 287 Kv. For the nine mile section between the valleys of the Kemano and Kildala Rivers, where the lines rise steeply up and over the mile-high Kildala Pass, an exceptionally heavy construction is used, with two single circuits strung with "Emu" ACSR conductor.[1]

"Emu" ACSR

Diam.	2.2947 in.
Stranding Al	108 x 0.1765
Stranding steel	37 x 0.1261
Alum. area	3,364,000 circular mils.
Wt. per ft.	4.760 lb.
Design ultimate strength	135,400 lb.

The two single circuits are identified as right (R) and left (L) as seen when looking from Kemano towards Kitimat. The right line is carried on steel towers of a lattice type construction and the left line on a new type of tubular aluminum tower.[2]

A new type of cross suspension system was adopted for the permanent re-location of part of the Kemano-Kitimat transmission line which was destroyed by an avalanche in 1955. The work involved is described in this comprehensive paper. The author was responsible for the project design.

On the afternoon of January 26th, a dry snow avalanche slid off the southwest slope into Glacier Creek Bowl which is just below the last rise up into Kildala Pass, and destroyed aluminum tower 113L and steel towers 111R and 112R. There was also damage to the crossarm of tower 113R, which stands above the slide area, as a result of the conductors being dragged sideways by the snow.

The conductors remained intact throughout, although severely damaged. However, they were short circuited in many places by contact with each other and with the fallen towers so that power supply to Kitimat was interrupted.

Temporary Repairs

The temporary repairs were carried out under conditions of continuous bad weather as 47 inches of snow fell during the nine days required to re-establish the left circuit and a further 75 inches fell between February 4th and February 15th, by which date the right line had also been returned to service.

Maximum advantage was taken of the few breaks in the weather to move men and material to the site by helicopters and with the assistance of the tractors that had been stored in the area, and two more that were driven up the old construction road, repairs were made that remained in service until September when the new suspension system was ready to carry power.

The aluminum towers of the left line consist of a box girder crossarm resting on five, or in some cases six, tubular leg members arranged to form A frames or tripods. The avalanche swept the legs from under the crossarm at Tower 113L, and left the crossarm, undamaged and still attached to the conductors, almost resting on the snow. The damage to the left line was limited to this and a temporary repair was made to this line first. The crossarm and insulators of tower 113L were removed, the conductor spliced and restrung through the double span from tower 112L to 114L. This was a strong repair measure, although both the design ice carrying capacity and ground clearance had to be reduced.

The repairs to the right line were more difficult as two towers had been demolished, and the conductors between towers 110R and 113R damaged beyond repair. The damaged crossarm on 113R was repaired and the gap between 110R and 113R

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was spanned with "Partridge" ACSR, which has an aluminum area of 266,-800 circular mils and a diameter of 0.642 inches. The sag in this span of 4,200 feet was only 159 feet, which resulted in a stringing tension of about 49 per cent of the ultimate strength of the conductor. This high tension was adopted to keep the conductor well above possible future avalanches to which the left line remained exposed.

It was anticipated that such a high stringing tension would result in considerable vibration and dampers were applied. In spite of them there was a pronounced vibration of the conductors, especially at the upper end of the span where strong steady winds are prevalent. Close examination of the three conductors, when they were removed after eight months' service, showed only one strand broken by fatigue.

There was little reserve strength in this small conductor to carry the heavy ice that could be expected in the area during the remainder of the winter season, but with the entire electrical load of the Kitimat smelter kept on this right line, the heating of the conductor was sufficient to prevent ice or rime formation.

Permanent Relocation

Even before temporary repairs had been completed, studies were begun to find a way of assuring that such an outage could not be repeated.

Attention was first given to the strengthening of the towers, the deflection of snow slides from the towers and the controlling of the snow movements by structures installed in the snow basins which would prevent avalanches from starting. These plans were abandoned because of the problem of controlling such a vast quantity of snow and doubt that the measures would be effective.

Several alternative routes for the tower lines were then investigated. One consisted of re-routing the lines up the ridge to the southwest of Glacier Creek Bowl and around the back of the snow basins to the Pass. A second route went only part way up the ridge to a pair of tall heavy angle towers from which long spans reaching over the slide area took the circuits to the Pass. A further scheme utilized two very tall towers just below the slide area, to permit long spans to clear the danger area to towers located near the Pass.

All the above-mentioned schemes would require between two and three years to design, fabricate and erect at a cost of between 1.5 and 3 million dollars.

The most promising possibility in terms of both time and cost was a cross suspension system with the conductors supported from wire ropes spanning transversely across the valley. Estimates indicated such a scheme would cost less than one-half of the least of the others, that it could be in service by the end of the working season of 1955 and had the prospect of greater reliability than could be claimed for any of the other proposals. On March 22nd, the decision was made to proceed with the design and construction of such a system.

Five years' experience in the Kildala Pass area has shown that winter can arrive as early as October 1st, making construction work very difficult and expensive. Therefore, the design, fabrication and erection of the system was scheduled for completion within six months.

In spite of the poor weather throughout the latter part of the season, which made working conditions unexpectedly rugged, the right circuit was energized by September 26th, and the left circuit was ready to carry power on October 5th.

Fig. 1. A retouched panoramic view of the cross suspension system from Twin Peaks with Kildala Pass in centre background.

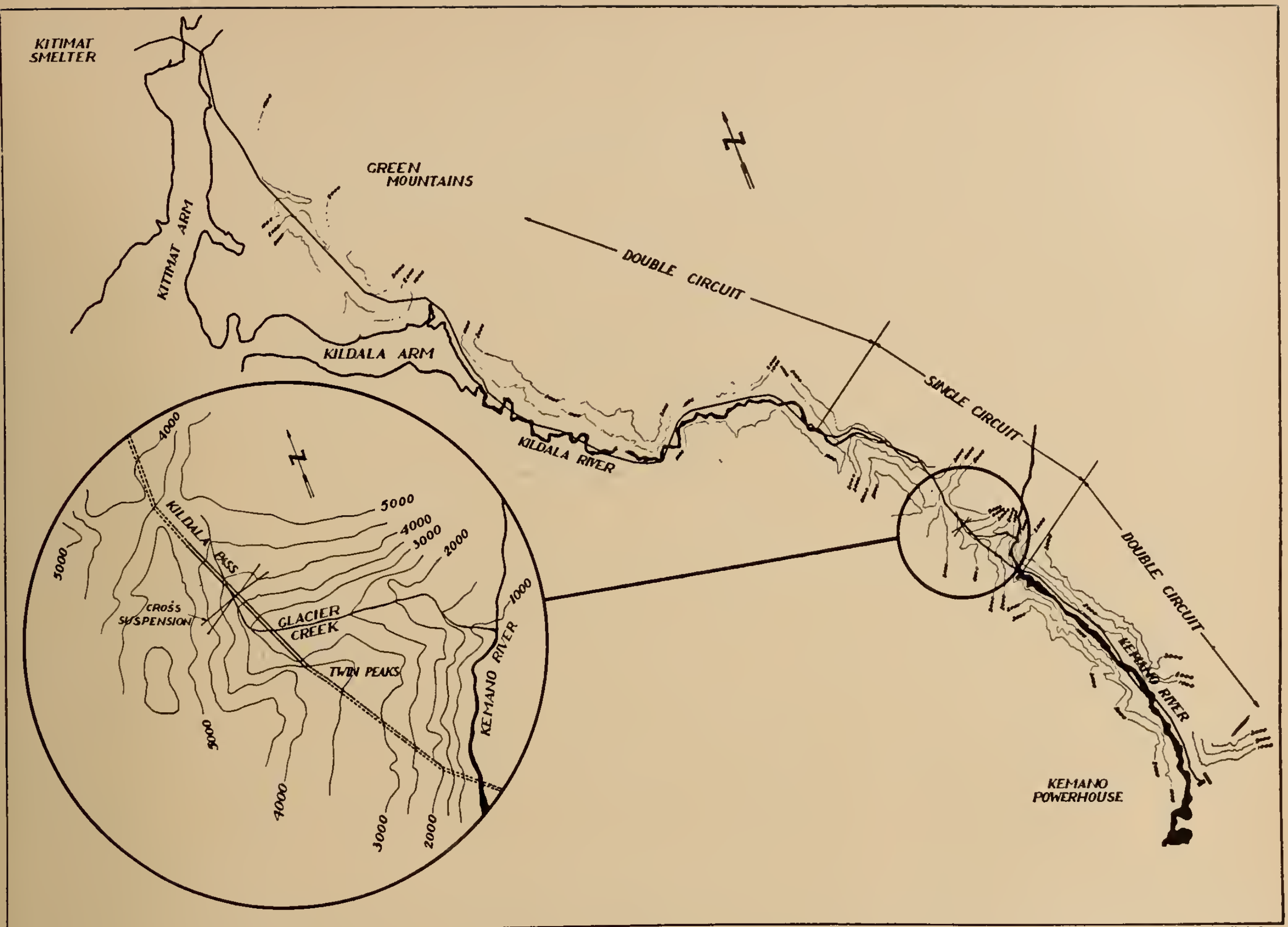


Fig. 2. Map of Kemano-Kitimat transmission line showing location of cross suspension.

Design

A choice had to be made between a suspension of the entire transmission system on one cross rope or a suspension on two or more separate cross ropes. The latter alternative was considered to be no safer than the former because the failure of any one of the ropes would drop it down across the six conductors, shorting out both circuits and damaging the conductors beyond the possibility of immediate repair.

The desired security was obtained by using two cross ropes and yoking them on each side of the centre section that supports the conductor (see Fig. 3). Thus a failure of one rope or one anchorage could drop one of the half sections of rope, but its movement would be arrested at the bridle plate. Each rope is strong enough to support the entire system with an ice loading of 15 lb. per foot on all components.

The design had to be begun while the possible anchorage sites for the cross ropes were still covered by deep snow. A study of photographs taken during previous summers revealed promising locations on both sides of the valley and the southwest anchorages so chosen proved to be satisfactory with only minor adjustments to satisfy very local rock conditions.

The location of anchorages on the northeast side of the valley was a more complex problem as this slope is traversed by many snow slides. A large canyon cuts diagonally across the lower portion of this slope and the first anchorages were located just below the protection afforded by the upper end of the canyon, at an elevation of approximately 3,800 ft. Initial calculations showed a need for back stays to maintain adequate clearances under the upper conductor spans and model tests indicated a marked tendency to severe vibration of the system, if there was even a suspicion of resonance between any of the system components. Early field investigation after the snow had disappeared showed also that the rock at this northeast anchorage would not be reliable.

Fortunately, sound rock conditions were subsequently found at a more suitable anchorage site higher up and closer to the Pass.

The system, as finally arranged, has no symmetry. All four rope anchorages are at different elevations, the wire rope lengths from the bridle plates to the anchorages are all different, the four main conductor spans are unequal and the end towers are each at a different elevation. This lack of symmetry made some of the calculations so very complex that a model (see below) had to be used to confirm stresses and distortions under the various loading conditions.

The suspension system would make use of the existing end towers and was designed to the following requirements:

1. With an ice load of 15 lb. per foot on any or all components of the system, the tension in the cross ropes was not to exceed 535 kips, or 65 per cent of the 824 kip design ultimate strength of the ropes. The maximum rope tension of 487 kips occurs at anchorage B with ice on all components.

2. Assuming the failure of a single rope or anchorage, the remaining rope must support the system with any or all of the remaining compon-

ents carrying an ice load of 15 lb. per foot. The ultimate strength of the rope is the limiting condition for this loading.

3. There must be no failure of any component of the system if an ice load of 40 lb. per foot should be applied to all components simultaneously.

4. Conductor tension under dead load only was limited to 22,000 lb. or about 16 per cent of the ultimate strength of the "Emu" conductor. Experience has shown that with stringing tensions of no more than this, the aluminum strands of the conductor are not susceptible to fatigue failure resulting from aeolian vibrations.

5. Adequate conductor-to-ground clearances must be maintained with an ice loading of 15 lb. per foot on any or all components of the system.

6. Resonance must not exist between any of the components of the system.

Conditions 5 and 6 were the most difficult ones to satisfy.

The very irregular terrain of the Kildala Pass area is conducive to localized icing and riming and it is difficult to maintain conductor-to-ground clearances when ice forms on one span of a line and not on the adjacent spans.

With a 15 lb. ice load on all conductors of the cross suspension system, the minimum clearance to ground is 65 ft. below the lower right conductors. With ice on the lower span conductors only, the minimum clearance is still about 40 ft. because as the cross ropes swing downhill into the lower span, the relatively short upper conductor spans quickly tighten up and limit the distortion of the system. With ice on the short upper spans only, the initial dead load clearance of 180 ft. is reduced to about 10 ft. over an assumed depth of 25 ft. of snow.

The problem of resonance was first encountered while investigating the dynamic behaviour of the model under loadings such as caused by the release of ice, and it was explored until there was a thorough understanding of the mechanics of the phenomena, and their application to the behaviour of the prototype.

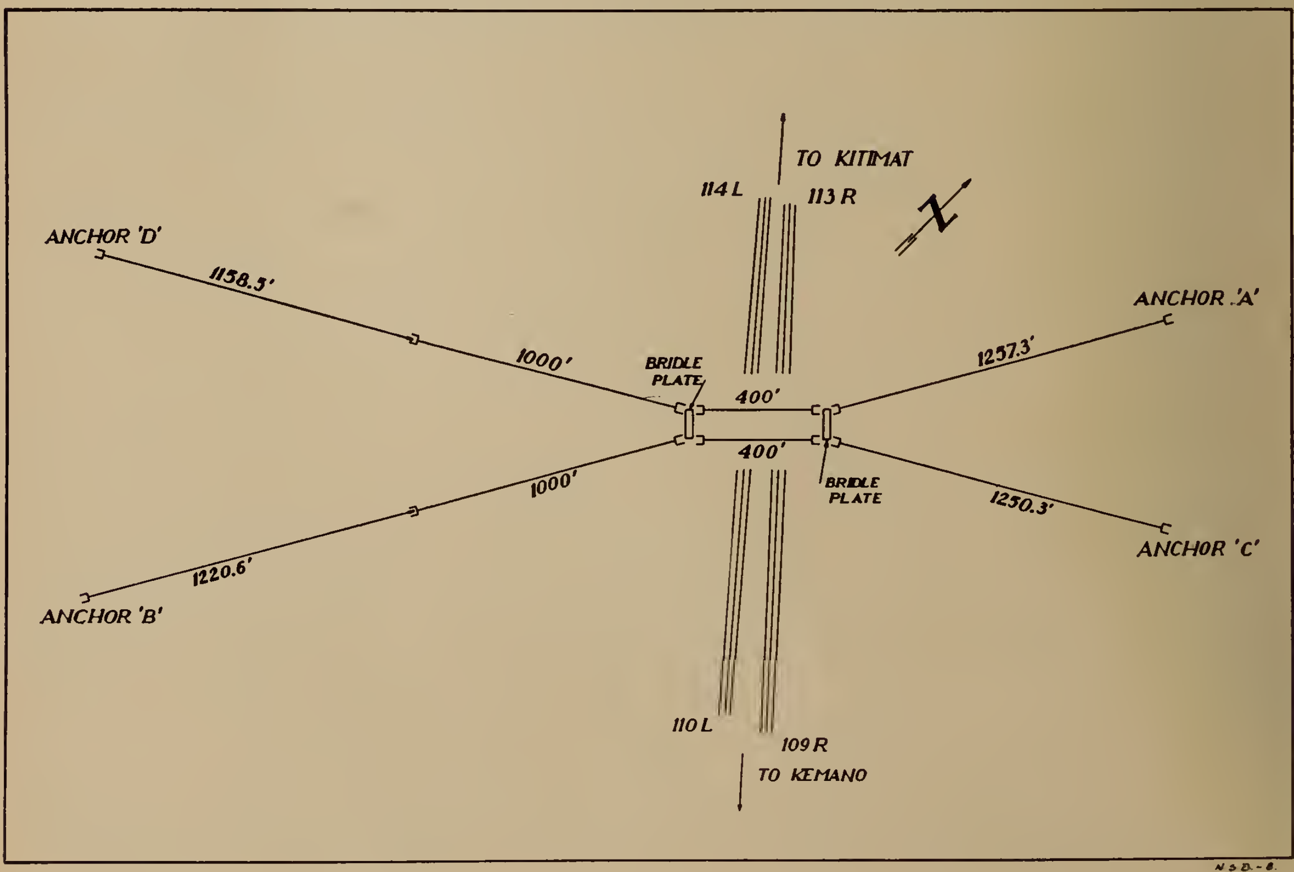
The fundamental vibration mode of the system as a whole can be described as an up and down motion of the conductors together with a pendulum motion of the cross ropes, the six conductors of one span being in phase but lower and upper spans being in opposite phase.

When the cross ropes intersect the conductors at an angle different from 90 degrees, a small "side-kick" is imparted to the conductors by the pendulum motion of the cross ropes. The tests showed clearly that when ths "side-kick" is resonant with a natural transverse mode of a conductor span, large transverse amplitudes will build up and superimpose on the vertical motion. Because of the small differences in sags of the three conductors in each span, they are bound to get out of phase so that danger of collision is imminent. When a typical case of resonance was present in the model collisions were always observed.

It was found possible to tune the system by adjusting conductor sags so that a conductor would vibrate transversely in say three loops which in fact occurred when the fundamental frequency of the lower right conductor span was 33.4 c.p.m. against a system frequency of 49.4 c.p.m. The frequency of the three loop vibrations was 99.6 c.p.m. or almost exactly 3 x 33.4 and 2 x 49.4.

As the frequency of a complete system is difficult to determine theoretically and as it was not found to change perceptibly with minor changes in conductor tensions, the model value of 49.4 c.p.m. (3.5 c.p.m. prototype) was used in the

Fig. 3. Schematic drawing showing components of cross suspension system.



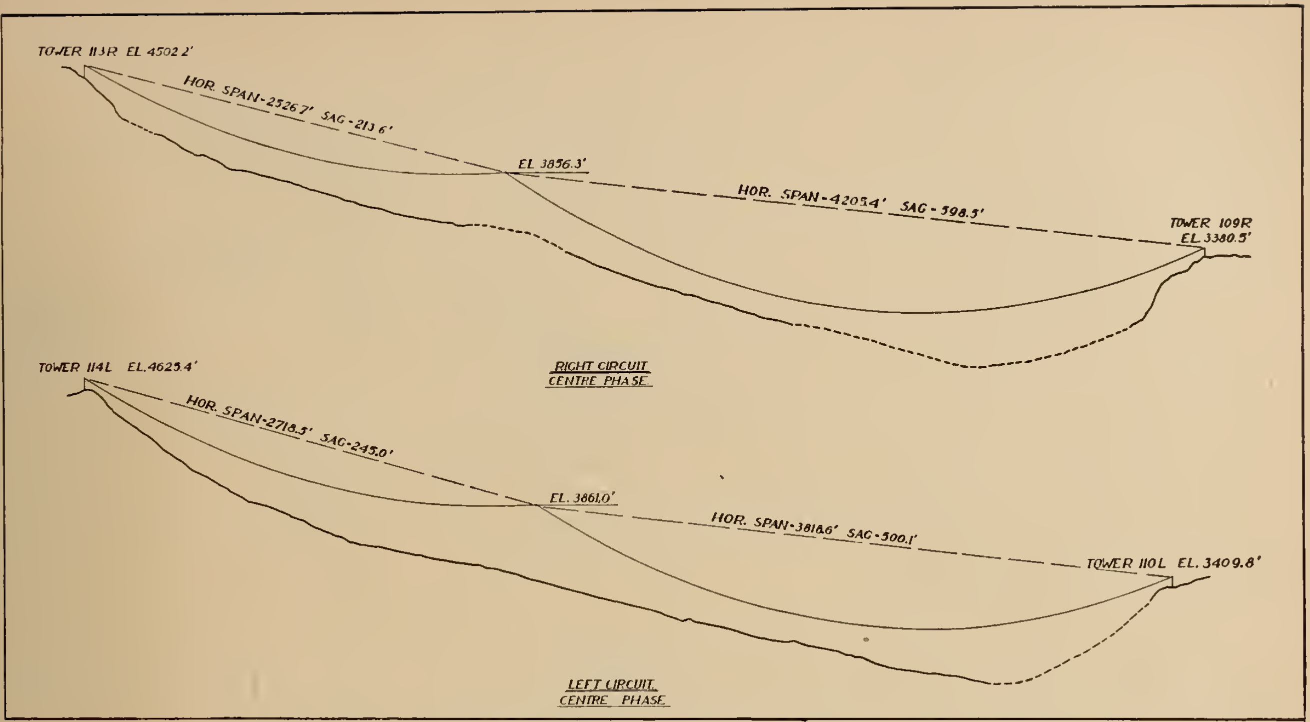


Fig. 4. Profile of conductor spans.

design of the prototype.

The conductor sags were adjusted during the final field design with regard to their frequency of swing according to the formulae

$$F = \frac{60}{2\pi}\sqrt{\frac{ag}{k^2}} \equiv \frac{60}{\sqrt{Sag}} \text{ c.p.m.}$$

where: a is the distance from the support axis to the centre of gravity of the span.
g is the acceleration of gravity
k is the radius of gyration about the support axis.
f is the conductor sag.

and set so that their frequency would differ from that of the complete system by at least 5 per cent.

The amount of "side-kick" imparted to the end of a conductor is reduced by setting the cross ropes at right angles to the direction of the conductors. The change in anchorage location described previously improved the average angle of intersection from about 81 to 87 deg.

Model Study

A model was used to verify the complex calculations necessary to determine the stresses and distortions of the system under applied ice loadings and to study the system's behaviour when subjected to dynamic loadings.

The model was built in the Testing Laboratory of John A. Roeblings' Sons, Corporation, Trenton, N.J., fabricators of the 3 inch wire rope, to a linear scale of 1:200 and as close to true elastic scale as possible. The conductors and cross ropes were represented by piano wire with lead weights added to represent the weights of their prototypes and further lead weights were added or taken off as required to represent the various live loadings.

In order to study the elastic behaviour of the prototype with a model built to a linear scale

$$l_p/l_m = r,$$

the elastic stretch - Pl/AE of all components must be kept to scale.

Thus:

$$l_p/l_m = r = \frac{H_p l_p / A_p E_p}{H_m l_m / A_m E_m}$$

from which we have

$$H_p A_m E_m / H_m A_p E_p = 1$$

We know

$$H_p/H_m = \frac{W_p . l_p . l_p / 8Sag_p}{W_m . l_m . l_m / 8Sag_m}$$

and as

$$\frac{l_p/Sag_p}{l_m/Sag_m} = 1$$

$$W_m = W_p r . A_m E_m / A_p E_p$$

Where:

r = scale factor
H or P = tension, lb.
A = cross section area
E = modulus of elasticity
W = load or weight per foot

The values of W_p, A_p and E_p of each component of the prototype were known and with the selection of a wire (A_m and E_m) for the model, the necessary weight per foot, W_m was obtained.

As such a model can portray accurately but one characteristic, in this case displacement, the characteristics of vibration and damping could only be studied qualitatively.

The model studies were of great

CHART OF MODEL CHARACTERISTICS

	Cross Ropes		Conductors	
	Prototype Wire Rope	Model No. 22 Piano Wire	Prototype ACSR "Emu"	Model No. 26 Piano Wire
Diameter, in.	3.0	0.0286	2.2947	0.0181
Area, sq. in.	4.25	0.642 x 10^{-3}	3.1	0.2573 x 10^{-3}
Mod. of elasticity, p.s.i.	20 x 10^6	28 x 10^6	10 x 10^6	28 x 10^6
E x A pounds	85 x 10^6	18.0 x 10^3	31 x 10^6	7.2 x 10^3
Dead load, W_d lb./ft.	15.1	0.640	4.76	0.202
	* 21.0	* 0.890		
Ice load, W_i lb./ft.	14.9	0.631	14.67	0.621
	* 109.0	* 4.614		
$W_d + W_i$ lb./ft.	30.0	1.271	19.43	0.823
	* 130.0	* 5.504		
Linear scale	200 : 1		200 : 1	
Elastic scale	200 : 1		219 : 1	

* These weights are for the 400′ section of the cross ropes between bridle plates.

value as a means of obtaining answers quickly and with the necessary accuracy. The early studies with the first location of the northeast anchorages clearly showed the need for the backstays to maintain adequate ground clearance under unequal ice loadings. When the problem of resonance was uncovered, it became apparent that a new anchorage location was desirable, preferably one which would set the cross ropes at right angles to the conductors and also remove the need for the backstays. Fortunately such an anchorage was found when the site became accessible.

The model was frequently adjusted to accommodate new field data and after construction was finished the "as built" system was set up on the model as a double check on the work.

Anchorages

The cross rope anchors were designed to transfer the load of the ropes to the rock through anchor bolts loaded in direct tension. Sound rock was a requirement for the safety of such an anchorage. Early studies of the surface of the rock at the final anchor sites indicated satisfactory conditions and these were substantiated when the excavations were completed.

The rock at each of the four locations is essentially a hornblende-diorite-gneiss. In addition, at D anchorage, there were foot-wide bands containing biotite. The rock is jointed to varying extents at all anchorages but is very tight except for the surface rock at D. A programme of pressure grouting is planned at D to stop further loosening of the surface rock caused by the freezing of water in the cracks.

Each anchor consists of six 2½ inch diameter deformed anchor bolts 25 ft. long, upset and threaded for 15 inches at one end. They are grouted into a pattern of 4½ inch diameter holes of which three dip at 15 degrees and three at 45 degrees. In plan the six bolts are splayed up to a maximum of 30 degrees on each side of the centre line. A grout mix of 1:2:2 by volume of Embeco, Portland Cement and sand was firmly tamped in place with care taken to leave no air or water pockets. In some holes, where ground water was present, the mix was placed dry and then tamped.

Under the assumption that a failure of the rock could occur behind the block of rock picked up by the group of anchor bolts, the design assumes a frictional co-efficient of

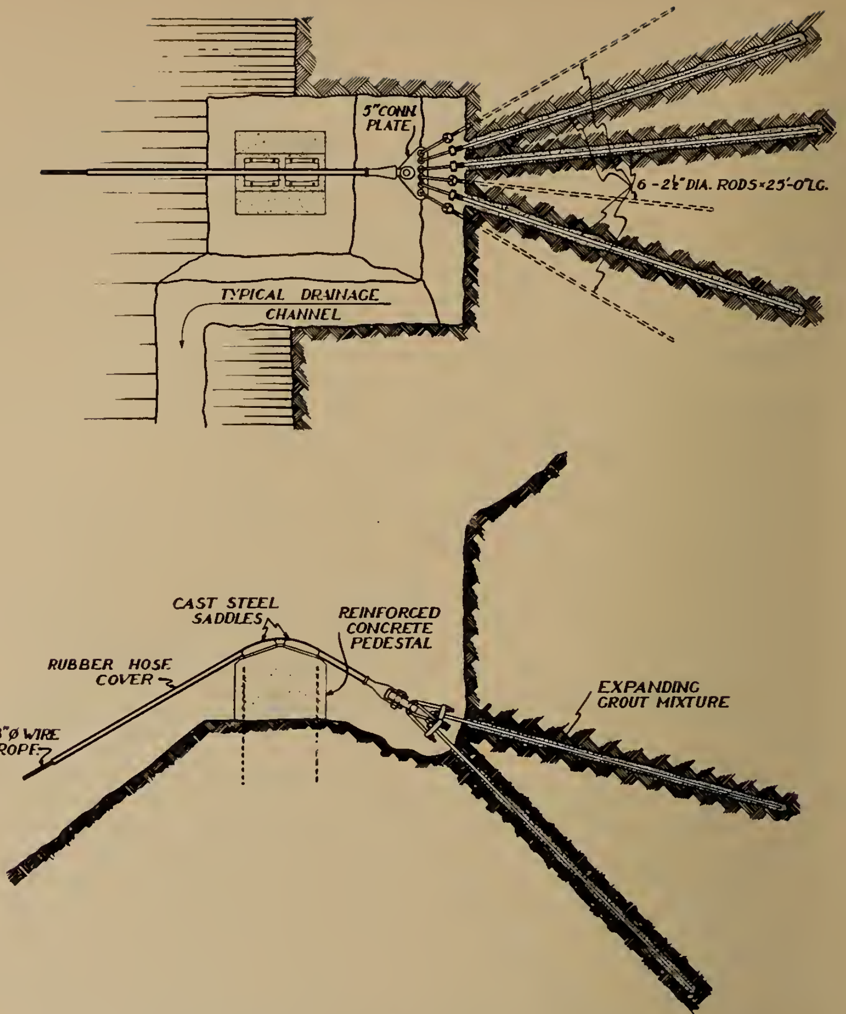
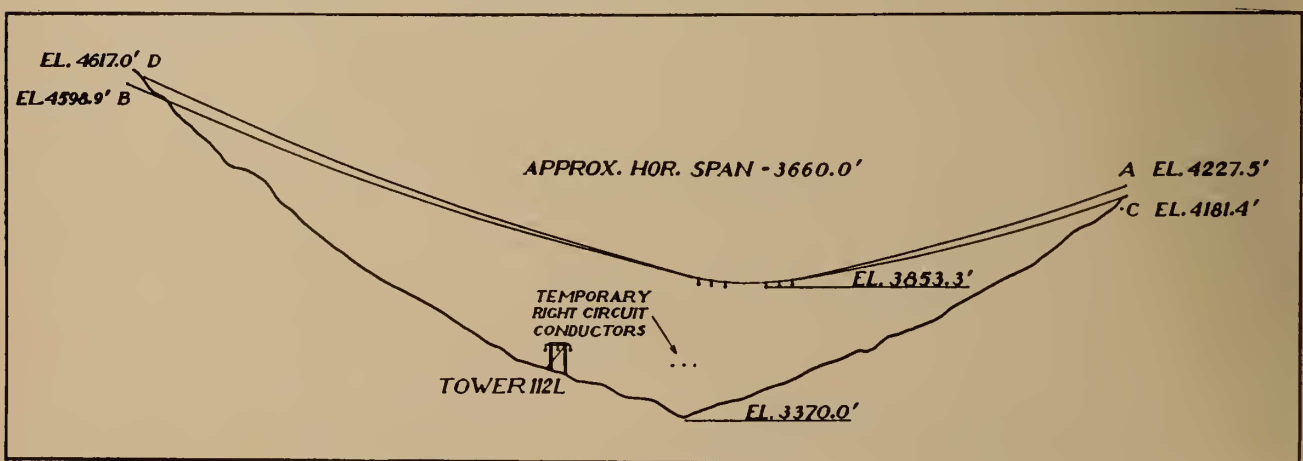


Fig. 5. General arrangement of anchorage of 3-inch suspension ropes.

Fig. 6. Profile of cross suspension showing the existing right and left circuits.



but 0.12 on the lower horizontal plane of cleavage to prevent pull-out under the 900 kip breaking strength of the wire rope.

The six anchor bolts were yoked to a common 5 inch thick steel connector plate through an arrangement of U bolts and nuts which permitted adjustment to divide the load equally among the anchor bolts. The open socket at the end of the wire rope was pinned to the connector plate with a 5¼ inch diameter pin. The wire rope was then led up and over the cast steel saddles which were bolted to the top of the reinforced concrete pedestal.

Suspension Ropes

The 3 inch galvanized bridge ropes that form the cross suspension were delivered to Kemano warehouse area before the anchorages had been definitely located. Thus, while the two 1,000 ft. sections and the two centre 400 ft. sections could be shipped complete with sockets attached in the shop, the four closing sections, one to each anchorage, required cutting to length and the installation of one socket each in the field.

The sockets were of the poured zinc type although much larger than those usually encountered as the socket castings weighed approximately 350 lb. each. A special shed was erected at Kemano for the field socketing and close attention was given to the detailed socketing specification.

Galvanized Bridge Rope Characteristics

Diameter	– 3 in.
Stranding	– 7 x 28
Wt. per foot	– approx. 15.11 lb.
Design ultimate strength	– 824,000 lb.
Test strength	– 900,000 lb.
E	– 20 x 10^6 p.s.i.

The wire ropes were prestressed to 120,000 lb. after fabrication, measured and then cut to length. Those four sections to be cut in the field were marked every fifty feet over given lengths so that field measurement would be simplified. The longest single length of rope on its reel weighed about thirteen tons.

Catwalk

Several means of permitting inspection and maintenance of the erected system were studied. The scheme adopted employs a catwalk suspended from the main wire ropes for the centre 400 ft. section between bridle plates. Access to the catwalk is by a cable car, which is run down from anchorage C.

The catwalk is of 12 ft. sections of Irving type aluminum grating coupled together to form a flexible decking. The 3 inch wire ropes are the "handrails". Shorter removable sections of grating immediately over each conductor suspension point permit direct access to the insulator assemblies. Furthermore, if a conductor requires maintenance, it can be lowered by rigging, run down through the opened grating.

The components of the catwalk were designed to support an ice load of about 600 lb. per linear foot as the catwalk may be subjected to very heavy snow, rime or ice accumulation.

A 25 h.p. gasoline engine, with a single drum, reversing gear and brake, hauls the cable car, which is also equipped with its own emergency brake. The hoist is located immediately in front of the pedestal at anchorage C. No component of the cable car weighs more than 150 lb. so that it can be dismantled by two men for storage beside the pedestal during the winter. Climbing to the hoist at anchorage C will be difficult when deep snow covers the north slope and at such times the helicopter will be the only practical means of access.

End Transmission Towers

Although three transmission towers were removed from each line,

Fig. 7. Socket being lowered for attachment to anchorage at C.

Fig. 8. Final closure at anchorage A.

the static loadings on each of the end towers 109R, 110L, 113R and 114L have been reduced. The cross suspension carries more of the conductor weight than the six replaced towers had supported, and the more direct route between Twin Peaks and the Pass has resulted in a decrease in line angle at all four towers.

Although all structures have been removed from the areas swept by avalanches, the very strong air blast (estimated at up to 200 miles per hour) that accompanies an avalanche, could strike the conductors where they pass over the slide slope. The model was used to study the loadings on the end towers when the system was subjected to such severe dynamic loadings.

It was found that the suspension system absorbed energy and distributed shock loads very effectively. The impact loadings on the end transmission towers were only about one third of those recorded at the ends of similar spans which were fixed at each end.

A further improvement in the capacity of the system to absorb dynamic loads was made by converting towers 114L and 113R from strain type to suspension.

Erection of Cross Suspension Ropes

The ropes had to be raised over existing extra-high voltage power lines while these were supplying the aluminum smelter at Kitimat; and aluminum production procedures dictated that power interruption would have to be limited to three hours duration. However, only one interruption of 44 minutes was required, and the raising could possibly have been carried out with no interruption to the power supply at all, had this been necessary.

When erected the suspension ropes would cross the power lines about 200 feet northwest of tower 112L, at which point the temporary "Partridge" conductors of the right line were already about 170 ft. above the ground. (Fig. 6)

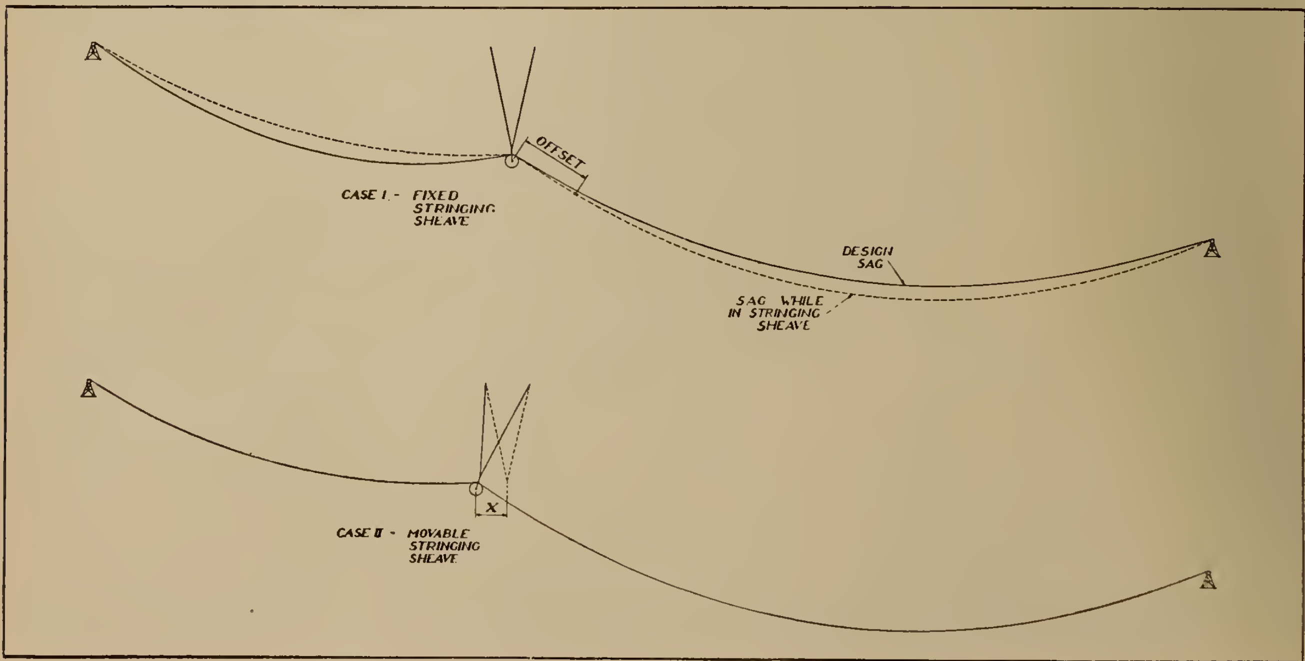
The erection procedure was as follows:

1. The power was transferred to the left line and slack taken out of the 4,200 ft. "Partridge" span in the right line to increase its ground clearance to about 200 ft.

2. The power was switched back on the right line and the conductors of the left line were lowered to the ground at tower 112L. Trestles were built to permit the 3 inch wire ropes to pass over these lowered conductors without damage to them.

3. The wire ropes which had been pulled up to anchorages B and D to the southwest from the reels located near tower 112L, were passed over the lowered left line conductors on the trestles.

Fig. 9. Illustration of the use of "offsets".



4. The 400 foot centre sections together with the sections for the northeast end of the suspension were pulled across the bottom of the valley and for a sufficient distance up the north side to allow the 6 part closing tackle to be connected.

5. With power supplied to the tackle by a hoist at the road heading 900 feet below, the cross ropes were raised clear of the ground and the catwalk was installed.

6. The cross suspension ropes were raised further by the closing tackle to a position where they passed some 45 feet below the live right line conductors and passed over the left line just above the level of the crossarm of tower 112L. A 12 ton weight suspended from the cross ropes at a point immediately below the right line helped to provide these clearances.

7 The left line conductors were raised and clamped in position at tower 112L.

8. Power was switched off the right line (both lines were now dead) and the cross ropes raised up and into the right line conductors, resulting in a clearance of about 45 feet over the left line conductors at tower 112L. Power was then returned to the left line.

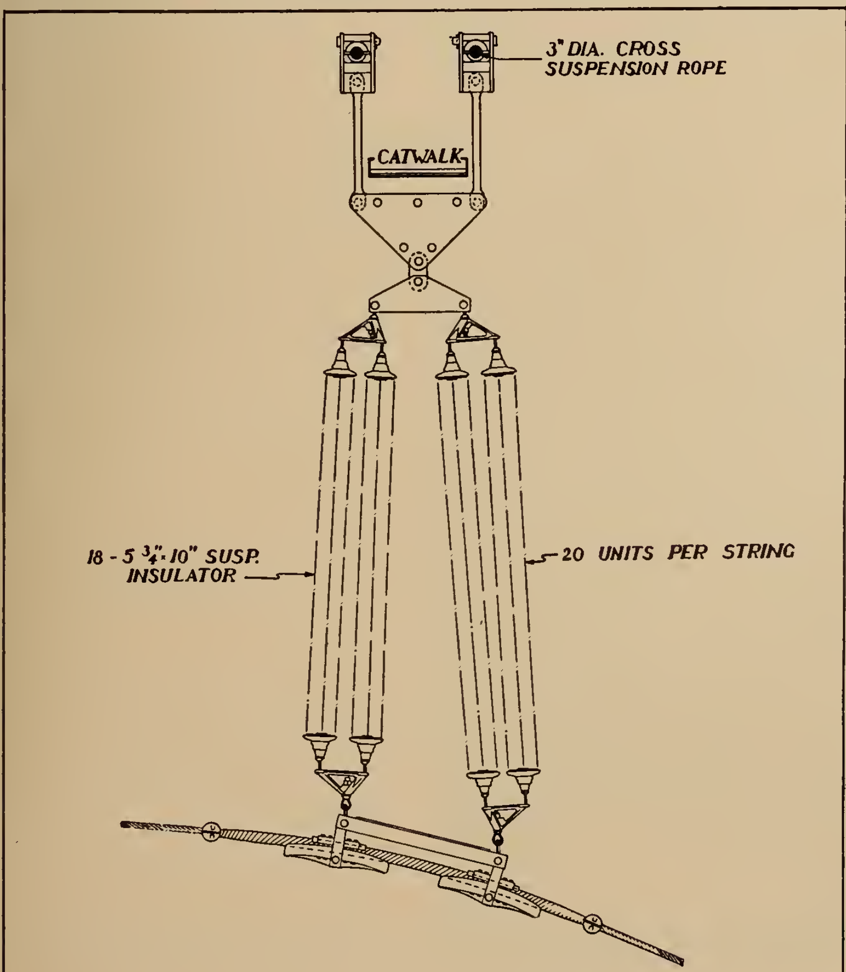
9. The "Partridge" conductors on the right line were disconnected at tower 110R and dropped to the ground as the cross ropes were pulled up to final closure at anchorages A and C. Power was carried on the left line until the right line conductors were raised to the cross suspension.

With the wire rope threaded above one circuit and below the other, its raising had to be carefully controlled. All equipment locations and control points in the area were linked by field telephone and during critical phases of the raising, radio equipped jeeps were used to supplement the telephones. When power was completely shut off, the clearances to proceed were obtained from and returned to Kemano by radio and during this period clear communication was ensured by prohibiting the use of radios elsewhere on the project.

Attention was given to the dangers of working close to charged extra-high voltage lines. Of particular concern was the possibility of the buildup of a voltage on a length of wire by induction from a nearby live conductor. A grounding network was established running across and up and down the valley and every length of rope and each major piece of stationary equipment was carefully grounded. Even with these precautions, it was possible to feel an appreciable shock when touching a wire rope several hundred feet from the live conductors if its grounds were too far apart.

Fig. 10. Conductor and insulator assembly being raised for attachment to cross suspension system.

Fig. 11. Six string insulator assembly and hardware for attachment to cross suspension.



Conductor Stringing

The problems of stringing the right line conductors were in general different from those of stringing the left line although one serious difficulty was common to both. When conductor is being strung on transmission towers in hilly country, the conductor tends to run downhill while it is still in the sheaves, so that although the correct amount of conductor may be in place between the end strain towers, the slack will tend to accumulate in the lowest span.

This condition is usually overcome by calculating the distances by which the clamps are 'offset' from the towers (Case I, Fig. 9) so that when the conductor is taken from the sheaves and clipped in, the horizontal component of tension in each span is the same, the insulator strings hang vertically and the sags in each span are as designed.

When the usual tower support for the sheave is replaced by a cross suspension that will itself tend to swing uphill, it becomes necessary to calculate both the 'offset' and the position of the sheave relative to the final position of the clamp (distance "x" in Case II). As the suspension system is not symmetrical and as the system would change as each conductor was clipped in, the calculations involved in computing both the values of "x" and the 'offsets' become impossible for all practical purpose and measurements of these values of sufficient accuracy could not be made on the model.

This problem was overcome by calculating the exact length of conductor required for each phase of each span, measuring out the necessary conductor length of each span, positioning and applying the armour rods and clamps to the conductor while on the ground and then raising the conductor and attaching the clamp directly to the cross suspension.

Where new conductor was used, as between towers 110R and 113R, it was measured and marked as it was pulled from the reels. The existing conductor in span 109R to 110R of the right line and all the conductor in the left line was reused. The lengths of the existing conductors were obtained by measuring the existing sags and spans and calculating the lengths of the catenaries. All such conductor lengths were adjusted for temperature and tension.

The average error of the twelve conductor spans between design sag and "as built" sag was 1.1 per cent, the maximum being a 2.4 per cent error in the middle phase of the upper left span. This is a finer degree of accuracy than that obtained by usual sagging methods during the initial stringing of the line.

Fig. 12. View from catwalk looking towards north-east anchorages during hook-up of last conductor. Cable car can be seen at far end of catwalk.

New conductors for the right circuit between Towers 110R and 113R were pulled over timber lagging which was used to keep the conductors off the rocks. The existing conductor in the 2,500 foot span from 109R to 110R was swung down from tower 110R and joined to the new conductor, the armour rods and suspension clamps were installed and the conductor raised to position.

The restringing of the left line was perhaps the most spectacular item of the entire project. Even though the existing conductor was to be used, the conductor raising was much more difficult and involved than on the right circuit. Length adjustments had to be made in each conductor to obtain the desired final sags but in addition, the conductors had to be removed from tower 111L, a strain type tower, and from tower 112L, a suspension tower.

To assist in this operation, two blocks had been placed on the 3 inch ropes in such a position that when the cross ropes were raised, a "sky hook" existed, ideally located about 300 ft. above tower 112L. The conductors were then lowered to the ground from tower 112L and the crossarm was removed. By using the "sky hook", and with suitable hold backs to take care of the rather large line angle that existed in the old line, the conductors were raised out of and clear of tower 112L.

This method, however, could not be repeated at tower 111L, a strain type tower. Here, wire rope straps

Fig. 13. Sikorsky S-55 helicopter ready to drop 850-lb. load of two 2-1/2-in. dia. x 25-ft. long anchor bolts at platform near north-east anchorages of cross suspension.

were run over the crossarm and clamped to the conductor some distance out from the dead end clamps. Conductor tension was transferred to the straps, the insulator assemblies were removed and the conductors were in effect left resting on top of the crossarm. Each conductor in turn was then swung over and lowered to the ground nearby, where the strap was removed, final length adjustment was made, and the conductor then raised to its final position on the cross suspension.

Transport

The old construction road that runs from the Kemano Powerhouse to the project site and then on to the Pass was easily re-opened by removing accumulated slide debris, and with a minimum of maintenance the road served as a principal means of access to the work site throughout the working season. There was road access to all towers except 109R and 110L on Twin Peaks.

A section of new road around the head of the valley to a position some 900 feet below the northeast anchorages brought men and equipment as near as possible to this working site. Some material, including the 3 inch wire ropes, was dragged or high-lined up to the anchorages by lines running up to blocks at the top and then down to a hoist located at the road heading below.

In general, however, the principal means of access to the anchorages was by helicopter. Twelve foot square landing platforms were erected at Camp 10, located just below the slide area, and at the two anchorage sites; and two helicopters shuttled between these platforms, moving the workmen, sand, cement, blasting powder, lumber, rigging and all the other materials and equipment necessary to complete the anchorages. It is of interest to note that on one exceptional day one pilot made 52 round trips between the landing platform at Camp 10, elevation 3,000 feet, and the anchorage sites which were from 1,200 to 1,700 feet higher.

Fig. 14. Installation of rigging in preparation for raising of sixth conductor.

When the single loads exceeded 300 lb., which is the capacity of a Bell helicopter at these elevations, a Sikorsky S55 helicopter was used. It carried its load by sling from Kemano direct to the platforms at the anchorages, where the loads were dropped from a height of several feet. Landings were considered to be both hazardous and unnecessary.

Compressed air had to be provided at the anchorage sites for drilling the anchor bolt holes. Suitable compressors could not be flown in to the sites, neither could they be dragged up from the valley. The problem was solved by placing diesel compressors at the nearest road headings and delivering the air from these points to the anchorages through 20 foot sections of 3 inch light wall aluminum alloy tubing joined by a flexible type of quick coupling. Pipe friction and leakage were negligible even though the distance up the north face was some 1,200 feet and the pipe line up and across the south face was about 2,700 feet long. Over a period of three months maintenance was negligible and recovery of the pipe and couplers after completion of the work was more than 90 per cent.

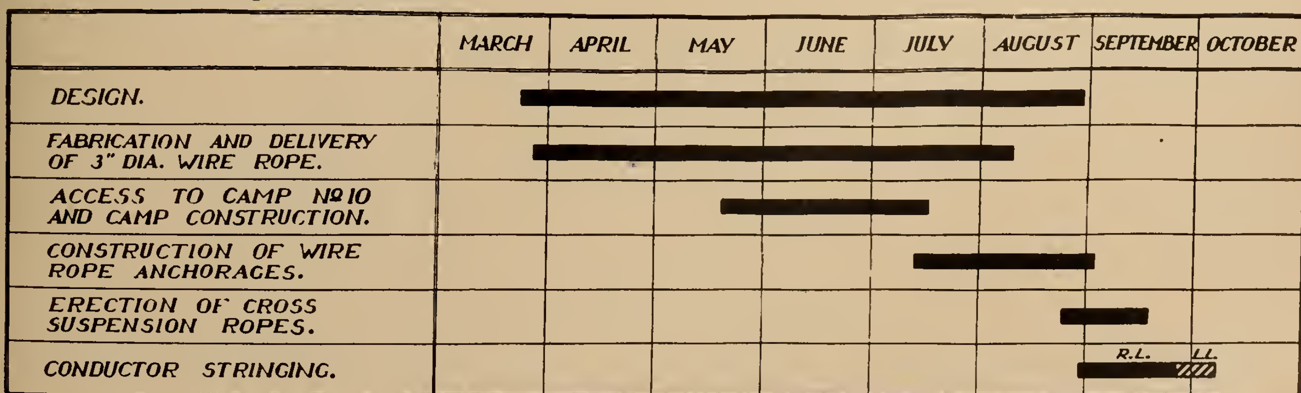
Survey

The early studies of the suspension system were hampered by the lack of accurate topographical data of the area. A stadia survey of the old tower sites, aerial photographs and an aerial map of one side of the valley, was all that was available during the initial planning. A rough aerial map of the whole area was made in April, but it was not until the end of June that the disappearance of much of the snow and the cessation of slides permitted a stadia survey of several of the anchorage sites then under study.

Following this, a grid, accurate to within 1:50,000, was established by triangulation and survey monuments

(Continued on page 926)

Fig. 15. Schedule of design and construction.



Canada's Economic Prospects

H. Carl Goldenberg, O.B.E., Q.C., *Barrister-at-Law, Montreal*

CANADA'S economic prospects have been very much to the fore for the past few months. A Royal Commission has crossed the length and breadth of Canada and has received many representations on the subject. It expects to present its findings to the Federal Government by the end of this year. It would be presumptuous for me to try to anticipate its conclusions.

I propose for the purposes of this talk to point to certain features of Canada's past economic growth, to examine its present economic position, and to look at the direction which its further growth may take. If I venture to make any forecasts, it is not in the role of a prophet.

Canada's economic growth has in the main been associated with the development of its natural resources. Wheat was the principal stimulus in the first quarter of this century which saw the building of our wheat economy and the settlement of the West. Our large investment in railways and in storage and grain-handling equipment is associated with wheat. While considerable progress had been made by the end of the 1920's in mining, pulp and paper manufacturing, and hydro-electric power development, agriculture was still the centre of our economic structure. Its importance was very evident in the 1930's when a combination of low wheat prices, successive years of drought and declining export markets destroyed the basis of national prosperity.

Comparing the Canadian economy of to-day with that of twenty-five years ago, we note marked changes. While wheat continues to play a major role, it does not dominate the economy to the extent that it did as recently as twenty-five years ago. The stimulus since then has been provided chiefly by our forest resources, our minerals, our hydro-electric power and by related manufacturing industries. These industries have reached their present status at different times and by varying rates of growth. Wars and depressions have led to an uneven expansion in the twentieth century.

Periods of Growth

The 1920's represented a period of rapid growth; the 'thirties showed scarcely any net increase in production; the early 'forties saw a great expansion particularly in industries whose products were required for war purposes. The expansion since the end of the war has been phenomenal and is continuing. I do not propose to burden you unduly with details but a few statistics will illustrate our recent economic history.

Gross national product, that is, the dollar value of all goods produced and services rendered—the most basic and comprehensive measure of our economic position — has risen from $12 billion in 1946 to an estimated $26.6 billion in 1955. While the rise in non-farm gross national product was from $10.9 billion in 1946 to an estimated $25.2 billion in 1955, accrued net income of farm operators from farm production increased in the same period from $1.1 billion to $1.4 billion. These figures are illustrative of the relative change in the position of agriculture in the Canadian economy.

While measurements in terms of dollars exaggerate the actual expansion because of the rise in prices which has taken place, volume indexes show that it has been very large. The index of industrial production (basis 1935-1939 = 100) rose from 171.9 in 1946 to an estimated 265.9 in 1955, of mining production from 97.1 to an estimated 242.4, of manufacturing production from 189.9 to an estimated 270.1, and of electricity and gas production from 157.8 to an estimated 275.7. These are a few selected economic indicators.

The volume of production is determined by the effective demands of individual consumers, government, investors and foreign buyers. Exports and capital investment are the most dynamic determinants of the level of national prosperity. Being subject to sharp and wide variations, they exert an influence on general economic activity out of proportion to their actual size. In the economic climate which has prevailed since 1946, both of these factors have served as a

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Read at a meeting of the Engineering Institute of Canada, Montreal Branch, March, 1956.

powerful stimulus to expansion. In terms of current dollars, capital expenditures on new construction, machinery and equipment rose from $2.5 billion in 1947 to $6.2 billion in 1955; the forecast for 1956 is $7.5 billion. In terms of 1949 constant dollars the increase was from $2.9 billion in 1947 to $4.8 billion in 1955.

Value of Exports

Canada's exports have risen in value from $2.4 billion in 1946 to $4.35 billion in 1955; in 1939 they amounted to $900 million. It is of interest to note that 60 per cent in value of our total exports in 1955 went to the United States while 73 per cent in value of our total imports of $4.7 billion came from that country. Our principal exports to the United States were forest products, base metals, chemicals, iron ore and petroleum, while our principal imports from this source were iron and steel products, engines, machinery, aircraft and electrical apparatus. In 1955 our total foreign trade reached the record figure of more than $9 billion.

I have said that exports, which in 1955 totalled $4.35 billion, and capital expenditures or investment, which totalled $6.2 billion, are considered to be the most dynamic determinants of economic activity because they are subject to sharp fluctuations. Another determinant of increasing importance is government expenditures on goods and services, which in 1955 rose to $5.2 billion. By far the largest expenditure, however, is represented by personal expenditures on consumer goods and services. These have risen from $7.9 billion in 1946 to $16.8 billion in 1955, in terms of current dollars. This constitutes the largest single claim on our production and is determined by population, the distribution of income and the apportionment of disposable consumer income between spending and saving.

Canada's remarkable growth and development in the twentieth century has been associated with the increase in its population. The relative increase has been among the largest in the world; its population of 15.8 million is three times as great as in 1900. It increased by about one-third since the end of world war II and the trend continues upward.

This is Canada's position to-day: a population of approximately 16,000,000 and still rising; a gross national product of $27 billion and still rising; rich, vast and varied natural resources being profitably developed, new resources in process of discovery, and large undeveloped resources; a large industrial plant which continues to expand; a growing domestic market and an almost insatiable foreign market, particularly for the products of its natural wealth; and a growing economic maturity as the frontier is being pushed back. Knob Lake and Seven Islands, Blind River, Beaverlodge, Leduc and Pembina, and Kitimat — these and many others reflect our economic transformation.

Future Economic Growth

And now, what of our future economic growth? The first major factor to be considered is population. Projecting present trends in the annual rate of natural increase, which has always accounted for the greater part of our population growth, and assuming a continued high level of economic activity, which will mean a continued flow of immigrants, it may be forecast that Canada's population will be 26 or 27 million by 1980. Whether this figure will be attained depends on a number of factors. The effects of another war could not be forecast. A major economic depression would, as in the 1930's, reduce the birth rate and immigration. I venture to predict, however, that, while moderate and short recessions may and will occur, for example, because of a temporary decline in foreign demand, a major depression like that of the 'thirties will not recur. Society has gone a long way since then and has learned how to use fiscal and monetary policy to prevent a major depression. President Eisenhower's most recent economic message to Congress shows that even the Republican Party is now firmly of the opinion that the Federal Government must intervene in the economy of the country to help smooth out or to prevent violent fluctuations.

The author indicates certain features of Canada's past economic growth, examines her present economic position, and views the direction which further expansion may take, without, as he says, making forecasts in the role of a prophet. The paper is much to the point and comes at a time when the findings of the Royal Commission on this subject are being deliberated.

Stabilizing Factors

In addition to fiscal and monetary policy which can be used to promote economic stability and expansion, our economy now has certain "built-in" stabilizers. These provide a supporting floor which, with few exceptions, did not exist in the 'thirties. We have guaranteed minimum prices for certain basic commodities. We provide a minimum income for the aged through old age pensions and for the unemployed through unemployment insurance and unemployment assistance. Other welfare measures provide family allowances, disability pensions, forms of health insurance, widows' allowances, and so on. These are now an integral part of our economic system and of our way of life. If they make us a welfare state, we need have no fear. The state after all exists primarily to promote the welfare of its citizens. Why should we fear measures which promote this end? Fiscal and social policies which effect a wider distribution of income among low income families, apart from other considerations, are in the national economic interest since they enlarge the market for goods and services.

It has been suggested that, since Canada is so dependent on foreign markets for the sale of a very large part of the products of its natural resources, a prolonged weakness of world demand for such products may retard our growth. In my opinion, while occasional moderate recessions arising from a decline in foreign demand are probable, a prolonged period of decline in such demand is unlikely in the foreseeable future. It is important to remember that while we anticipate an increase of 10 or 11 million people in Canada over the next 25 years, the United States anticipates an increase of about 60 million in the same period with a correspondingly greater increase in consumption in that country. This is of major importance to Canada.

Future of Basic Materials

The Paley Commission, which reported to the President of the United States in 1952, assessed future consumption and imports of basic materials. It forecast that the consumption of such materials in the United States in the decade from 1970 to 1980 will be two-thirds greater than in 1950 and that about 20 per cent of this much larger consumption will have to be imported as compared with 9 per cent of the consumption imported in 1950. This will have a marked effect on the development of the Canadian economy and will further increase the dependence of the United States on imported materials from Canada. The Paley Report forecasts that the production of copper, lead, zinc, nickel and iron ore in the free world outside of the United States in 1975 will have to be approximately double the production of 1950 and that much larger increases will be required in petroleum and aluminum. When it is considered that the United States was virtually self-sufficient in copper, zinc and lead only 20 years ago, it is striking that the Report forecasts that in the 'seventies it will be importing half of its copper and zinc and three-quarters of its lead. In other words, in these and in other materials the United States faces an increasingly large deficit position. Having regard to Canada's actual and potential resources, the prospective increasing dependence of the United States on Canada as a source of supply points to very favourable long-term prospects in the demand for the products of our natural wealth. It is, of course, probable that the almost untouched resources of Asia, Africa and South America will be opened up to meet not only demand from the United States but the growing demands from other countries in the free world with rising populations and living standards and with increasing industrialization. If these untouched resources are not developed, there is bound to be an even greater acceleration in the rate of development, and, therefore, of exhaustion, of Canada's resources, particularly in minerals. Conservation policies now become all-important.

Productivity

I have spoken of population as the first factor in economic growth. The other major factor is the productivity of the economy. Productivity per man employed, that is real output per capita, has over the past 25 years risen by 1¾ per cent to 2 per cent per annum. This accounts as much as population growth for the doubling of our national production. With continued technological improvements and innovations, which are the basis of higher productivity and rising living standards, it is conservative to forecast a continued annual rate of growth of at least 2 per cent in real output per capita. On this basis a gross national product of about $65 billion, at present prices, is forecast for 1980.

The implications of the expansion which is forecast — a population of 26 or 27 million and a gross national product of $65 billion by 1980 —are vast. I shall only refer to a few. The first consequence that comes to mind is the great increase in the home market. For the Canadian farmer it would mean that he would be independent of export markets for some of the products now presenting serious marketing problems. Increased production of meats, dairy products, vegetables and fruits would be necessary. This would call for the opening up of new agricultural areas, such as the Peace River district and the Mackenzie Basin. Canada would, however, remain a major exporter of wheat. For the Canadian manufacturer, while the enlarged domestic market would still not compare with the mass market of the United States, it would be large enough to enable many more industries than at present to operate on an efficient and competitive basis and would require the expansion of others. It would also reduce dependence on export markets.

While exports as a proportion of the gross national product will decline — it has been estimated from about 24 per cent to 20 per cent— they will continue to be a major influence in the economy and to offer by far the largest outlet for our basic industries. Canada is essentially a producer of raw and semi-processed goods. These now account for about 85 per cent of our exports. Our economic prospects are in very large part based upon the further development of our natural wealth. As our population increases and as we improve the efficiency of our manufacturing operations, I anticipate a large expansion in manufacturing industries. We must, nevertheless, face the fact that we shall continue to be a major exporter of basic materials. We should process these at home to the extent that we can do so on an economically competitive basis. It would be unsound, however, to restrict the development of our primary industries in order to build up secondary industries which could only be maintained at an unduly high cost to the Canadian economy.

Population Increase

The prospective increase in Canada's population will not only enlarge the market for consumers' goods and services but will also require a capital investment programme of very large proportions. It is anticipated that the population increase will be concentrated very largely in cities and towns. In 1871 less than 20 per cent of the Canadian population was urban; by 1951 the figure rose to more than 57 per cent; the forecast for 1980 is as high as 75 per cent. The implications in terms of requirements for housing and social capital are clear. Enormous sums will have to be invested in the construction of schools, hospitals, roads, water and sewerage systems and other facilities. Provincial-municipal investments in social capital in Ontario alone are estimated at $7 billion to $8 billion over the next decade. In addition to social capital, a continued high rate of housing construction in Canada is inevitable. I have already pointed to the importance of capital investment as a dynamic factor in determining the level of economic activity. The public and private capital investment which will be required to meet the demands of a population and an economy expanding at the rates which have been forecast will, therefore, play a major role in sustaining that economy and stimulating its further expansion.

Long-term Prospects

The long-run economic prospects of Canada are bright indeed. While occasional set-backs must be anticipated and many problems—social, economic, financial, and political— will arise and will require solution, I am confident that they will be faced with the maturity which we are acquiring. We will face them more successfully, however, if we have regard to the fact that the expansion of our economic output is not an end in itself. The end is the improvement and development of our human resources. It is urgent that we keep pace with the technical and scientific requirements of economic growth, and in this the engineer plays a major role. It is also urgent that we concern ourselves with living standards not only in our own country but in other countries, particularly where the masses are only now awakening. The full realization of our economic prospects will not be determined by ourselves alone; events in far-off countries can and will affect us very seriously. Economic self-interest as well as humane considerations make it urgent that we assist more effectively in developing under-developed countries and raising the living standards of the masses of humanity which are still submerged. In the modern world economic prosperity, like peace, is indivisible.

Moving-Bed Processes

E. H. Lebeis, *Catalytic Construction Company, Philadelphia, Pa.*

TWO of the earliest industrial processes which are still in use today are the manufacture of iron in vertical blast furnaces and the calcination of limestone in a vertical shaft kiln. Modern blast furnaces and lime kilns differ from early models primarily in size and mechanical refinements. Basically, the processes and equipment have undergone relatively little change. In recent years, however, the mode of solid-fluid contacting characteristic of these units has been extensively modified to adapt it to other and more complex processes. This paper deals with some of these complex adaptations, which have been termed moving-bed units to distinguish them from simple vertical shaft furnaces.

At the outset, the distinction between moving-bed processes and fluidized-solids processes should be clearly stated. In a moving-bed process relatively large solid particles, generally larger than one-tenth of an inch, gravitate through one or more reaction chambers in essentially straight line flow. In a fluidized-solid process, fine powders are usually fed, and these particles are constantly moved in all directions by the "boiling" action of the fluid stream. This distinction is shown pictorially in Fig. 1 and 2.

In a moving-bed the solids flow at a density slightly lower than the bulk density at repose, whereas in a fluid-bed a larger percentage of voids is created between the particles by "boiling" action. The existence of large gas bubbles in fluid-beds has been well established. Efficiency of contact between solid and gas is hindered by bubble formation.

Probably the biggest difference between the two types of process is the kind of contact achieved between solid and fluid. In a moving-bed process the fluid can flow in a direction opposite to the direction of solids flow as shown at the top of Fig. 1. This is true countercurrent contact. It is also possible to achieve true concurrent flow with both solid and fluid flowing in the same direction, as in the bottom portion of Fig. 1. By inspection of Fig. 2 it is clear that in a fluid-bed the solid and fluid are quite intimately mixed and that the type of contact is neither true countercurrent nor concurrent. If a number of fluid beds are arranged in series, a partial approach to true countercurrent or concurrent contact can be achieved. Providing a number of fluid-beds in series would also minimize the tendency for some of the feed to short-circuit to the discharge points.

In a fluid-bed unit the fluid rate cannot be decreased below the value at which fluidization stops. On the other hand, the fluid rate cannot be increased above the value at which the dust loss is excessive. This means that the gas or liquid feed rate to a fluid-bed unit cannot be varied far from the design value. For many processes, this in turn fixes the solid feed rate within rather narrow limits. In contrast with this, a moving-bed unit can be operated over a wide range of feed rates. It should also be noted that dust losses may be quite high in fluid-bed units operated at design rate; these losses increase rapidly at rates higher than design. Other distinctions between the two processes will become apparent in the course of the discussion.

The moving-bed technique has achieved widest usage in the petroleum field, mainly for the catalytic cracking of selected fractions to produce optimum yields of high quality gasoline. To illustrate some of the features which may be found in a modern moving-bed process, a schematic diagram of a recently erected Houdriflow catalytic cracking unit is shown in Fig. 3. Fig. 4 is a photograph of one of these units shortly before it was placed in operation.

Starting at ground level, catalyst particles are conveyed by a pneumatic lift to the lift disengager at the top of the unit. In the disengager, the particles lose their upward velocity component and fall to the lower portion of the vessel. From the disengager, the catalyst gravitates through a pipe called a seal leg into the top of the reactor vessel. Here the heavy hydrocarbon charge is introduced, part as liquid and part as vapour. The liquid portion is vaporized on contact with the hot catalyst particles. The vaporized feed and catalyst flow vertically downward concurrently at a temperature in the neighborhood of 900 degrees F., with the hydrocarbons cracking and undergoing molecular rearrangement. Carbon is deposited on the catalyst during the cracking operation. The cracked vapours are separated from the solid catalyst at the bottom of the reactor. These vapours flow to distillation equipment for fractionation.

The catalyst particles next flow through a section in which hydrocarbon vapours are stripped or desorbed from the particles by a countercurrent flow of steam. The steam-hydrocarbon mixture flows upward

Read at the 70th Annual General and Professional Meeting of the Engineering Institute of Canada, Montreal, May 1956.

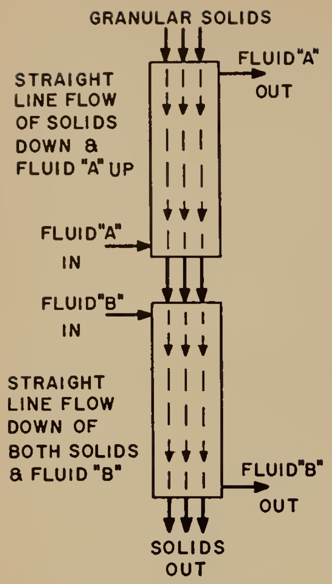


Fig. 1. Moving-bed process

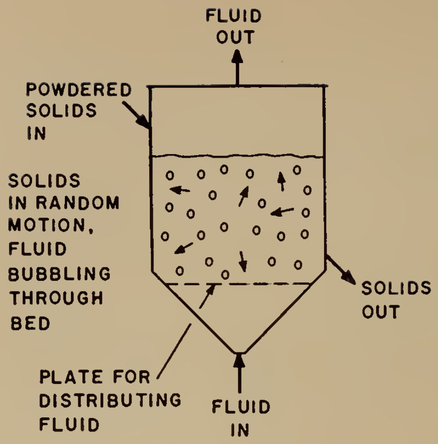


Fig. 2. Fluid bed process

into the bottom of the reactor to join the cracked vapours. From this purge section, the catalyst gravitates through a number of "seal pipes" into the regenerator, or kiln.

In this part of the unit, the carbon deposit formed during the cracking reaction is continuously removed by burning with air at temperatures in the range of 900 degrees to 1100 degrees F. Burning is accomplished in two or more stages, with cooling zones between stages. Cooling is usually accomplished by flowing the catalyst over horizontal coils through which water is pumped at a high rate. The steam generated is used for driving the regeneration air blower and various pumps.

In order to maintain the catalyst in a highly active form, it is imperative that the temperature be kept below a maximum value. The regenerator is engineered so that substantially all of the carbon deposit is removed without exceeding this maximum temperature. Air flow is generally countercurrent to the solids flow in the regenerator, although in some units one or more of the zones may be operated concurrently.

Catalyst leaving the regenerator at about 1100 degrees F. flows into one or more lift engagers whence it is returned to the top of the unit by a hot gas stream. Part of the hot flue gas leaving the regenerator is used for lifting following a moderate amount of recompression in a steam jet thermocompressor. The number of lift pipes employed varies from one to as many as 12, and lift pipe diameters vary from 8 in. to 19 in. I.D., depending upon the size and requirements of the unit. As an indication of lift capacity, 12 in. pipes are usually designed to move about 50-60 tons per hour per pipe.

Despite the rapid recirculation of catalyst through the unit and the high velocities attained in the lift pipes, loss of catalyst by attrition is remarkably small. To prevent choking of the unit with fines, part of the catalyst steam is continuously diverted to an elutriator. Another portion of hot flue gas from the regenerator is used for elutriation. The large particles are returned to the system and the fines rejected. The particle size of the catalyst in the unit is generally beween 0.08 and 0.20 inch, averaging about 0.13 inch.

One of the interesting features of these units is the way in which combustible hydrocarbons and air are handled in adjacent vessels interconnected with piping, containing no valves. The keys here are close attention to pressure balances and the use of steam as a sealing medium.

The hydrocarbons in the reactor are under a pressure of 5 to 10 pounds gauge. The lift disengager contains oxygen-bearing flue gas and, furthermore, is vented to the atmosphere. Steam is introduced at the top of the reactor. Part flows down into the reactor and the major portion flows up the pipe, or seal leg, connecting the disengager and reactor. The quantity of steam is controlled so that the pressure drop of the upflowing steam is always greater than the static pressure in the reactor. This ensures a downflow of steam into the reactor, so that there can be no upflow of hydrocarbon vapours.

A similar steam-sealing system prevents hydrocarbon vapours at the bottom of the reactor from coming in contact with oxygen-bearing flue gas at the top of the kiln. By coupling modern instrumentation with sound engineering design, these steam-sealing systems have been developed to a virtually foolproof point.

The advantages of the moving-bed cracking system can best be illustrated by comparison with the fixed-bed reactor system which it supplanted. In the fixed-bed system, three or more reactor vessels were required. In each reactor the following sequence of operations took place. First, hydrocarbon vapours were admitted for cracking. Then the hydrocarbon flow was stopped and the vessel was purged by evacuation and steaming. Next, air was admitted to regenerate the catalyst by burning off the carbon deposit. After another purging operation, oil vapours were again admitted.

To allow continuous operation, one or more banks of three reactors were used. While one reactor was in cracking service, another was purging, and the third was undergoing regeneration. Complicated piping manifolds and valving were required, together with an ingenious cycle timer for opening and closing valves in such a way that oil and air were never mixed.

Because the cracking reaction absorbs heat and the regeneration reaction liberates heat, molten salt was circulated through tubes in the bed to supply heat during cracking and absorb heat during regeneration. To add to the reactor complexity, other tubes were necessary so that hydrocarbon and air could be admitted to and withdrawn from the vessel.

The moving-bed process made possible great simplification in piping and reactor internals. By circulating the catalyst at a high rate a large amount of heat capacity is available in the solid, so that the heat necessary for cracking and the heat absorption in regeneration can be supplied by relatively small changes in solid temperature. This eliminated the necessity for the molten salt heat transfer system. Among other advantages is the elimination of downtime to empty fixed-bed reactors and recharge with fresh catalyst periodically.

Applicability of The Moving-bed Technique

For convenience the applicability of the moving-bed technique will be discussed under three different categories. These categories are as follows:

1. Systems in which the fluid flow is countercurrent to the solids flow.
2. Systems in which the fluid flow is concurrent with the solids flow.
3. Systems in which the fluid flow is perpendicular to the direction of solids flow, or cross-flow systems.

Countercurrent Systems

The applicability of countercurrent moving-bed systems may be illustrated by analogy with tubular heat exchange systems. Tubular exchangers are operated in counter-flow to achieve the closest temperature approach between the two fluids at one or both ends of the exchanger. This permits the closest approach to the theoretical maximum amount of heat exchange. From a heat transfer standpoint, a countercurrent moving-bed system is directly comparable.

The pebble heater shown in Fig. 5 is an illustration of a countercurrent moving-bed heat exchanger. The pebble heater derives its name from the fact that ceramic pebbles circulating through two moving-bed vessels in series are used to heat gases to very high temperatures above the range where metallic exchangers are feasible. In the upper vessel, the pebbles flow countercurrent to a stream of hot combustion gases admitted at, say, 2400 degrees F. The pebbles are heated to a temperature close to the gas temperature, 2380 degrees F. for example.

The pebbles at this temperature flow into the lower vessel through which the gas to be heated (air in the illustration) flows upward countercurrent to the pebbles. Let us assume that the air enters at 60 degrees F. The air will leave the top of the vessel at a temperature close to the entering pebble temperature, or 2000 degrees F. in the example shown in Fig. 5. The pebbles also closely approach the inlet air temperature and leave the vessel at 200 degrees F. They are then continuously elevated to the top of the unit by mechanical or pneumatic means and fed to the top of the upper vessel.

It can be seen that the solid and gas temperatures approach each other closely at each end of each vessel. Aside from radiation loss the only heat rejected from the system is in the flue gas stream which is shown leaving at 300 degrees F., or 100 degrees F. above the entering pebble temperature. It is clear that the thermal efficiency of the process is extremely high.

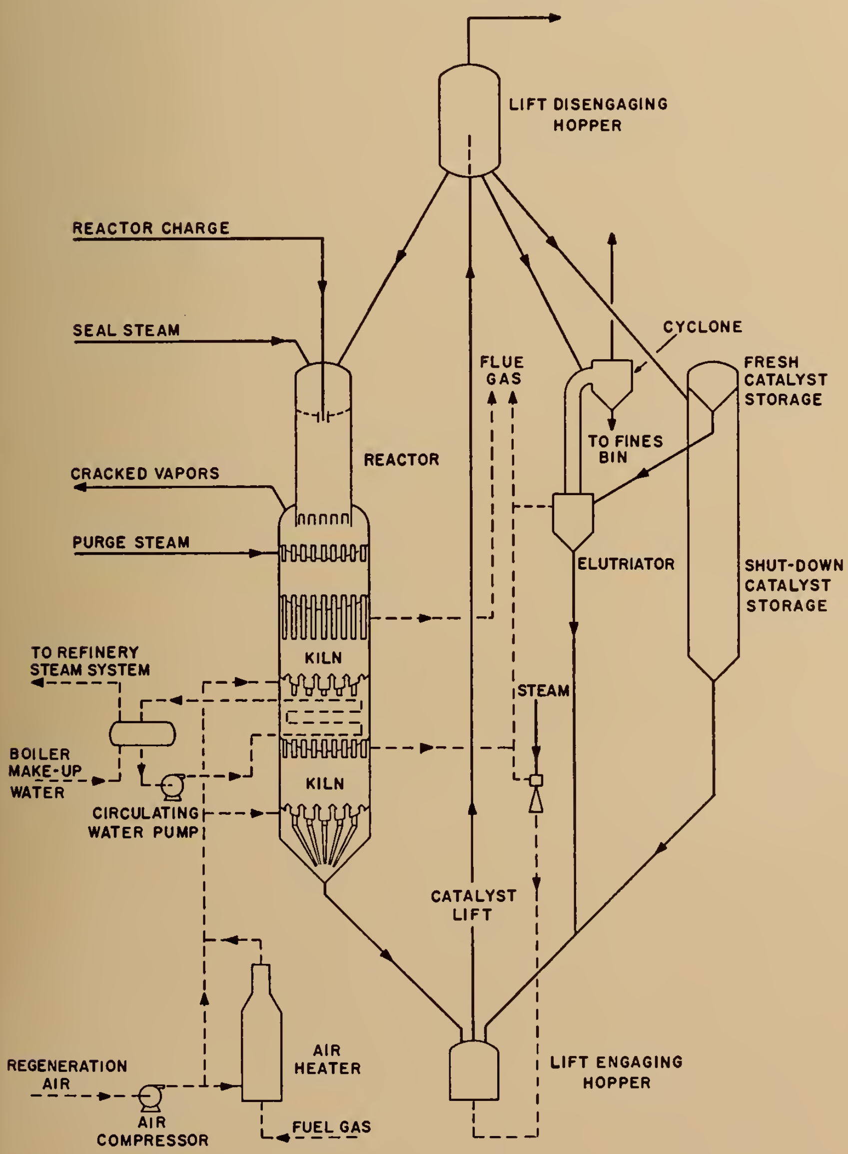
For some processes the most desirable pattern of temperature gradients can be achieved using countercurrent operation. In the heat treating or calcining of catalysts and other solids it is possible to exercise precise control over the maximum temperature reached by the solid by operating countercurrently. In this operation air or air-steam mixtures heated to elevated temperatures are admitted to the bottom of a vertical shaft calciner. The operating conditions are so selected as to make possible very close approach of solid and air temperatures at the bottom of the unit. The maximum solid temperature is thus controlled by the inlet air temperature.

The rate of temperature change of the solid depends upon the ratio of the product of weight flow rate of fluid and specific heat of fluid to the corresponding product for the solid. If this ratio is close to 1.0 the rate of solids temperature change will be very gradual, with the solid temperature approaching the gas temperature only near the bottom of the contacting zone. This is illustrated in Fig. 6.

If, on the other hand, a high weight ratio of gas to solids is employed, the solids will be heated very rapidly and will remain at a temperature close to the gas temperature throughout most of the contact zone, as shown in Fig. 7.

The temperature profile most desirable for the system can be established by selecting the proper "heat capacity" ratio. In many cases involving gases and solids, the specific heats of the two phases are essentially equal, so that the weight ratio of the two streams can often be used.

Fig. 3. Flow diagram of Houdriflow catalytic cracking process.



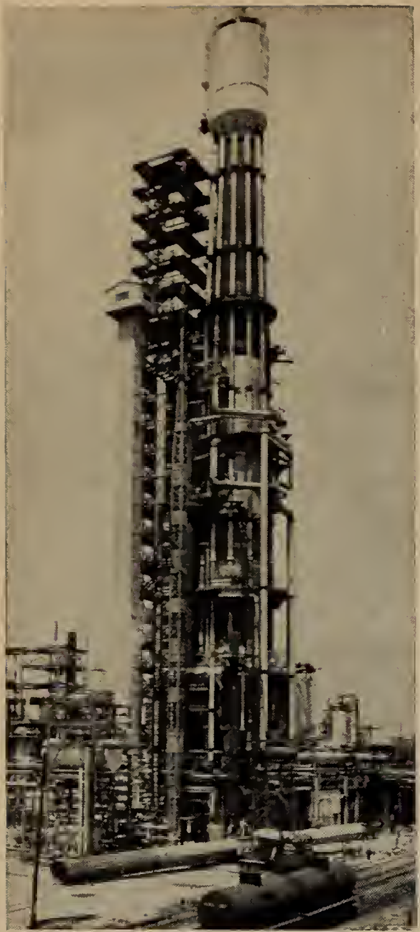


Fig. 4. A Houdriflow catalytic cracking unit.

When mass is transferred in countercurrent systems, concentration gradient patterns are established which are similar to the temperature gradient patterns in counterflow heat exchange. The same advantage accrues: the closest approach to the maximum possible amount of mass transfer is achieved. This advantage of countercurrent moving beds is utilized in Hypersorption units and moving-bed ion exchange units. In these cases, the last contact of the effluent fluid is with a solid which is freshly "regenerated" and has the maximum removal capacity. Therefore, the concentration of the component being removed can be reduced to a very low value.

If an ion exchange operation is performed in a fixed-bed, only a small portion of the bed is in actual use at any instant. The zone of "active solids" moves through the bed. As this imaginary zone approaches the effluent end of the apparatus, the efficiency falls off and increasing amounts of unwanted components appear in the product. To avoid excessive product contamination, it is necessary to switch over to a freshly regenerated bed.

By contrast, all of the bed is in use in a moving-bed unit. Efficiency is high and the composition of the liquid effluent is unvarying.

In the regenerators of Houdriflow catalytic cracking units, mass transfer, heat transfer, and generation of heat within the solid occur simultaneously. Countercurrent contact enables very close control over temperatures in this case.

The factors of prime importance are carbon concentration on the catalyst, oxygen concentration in the gas, and temperature. The burning rate is directly related to all of these variables. The carbon concentration is at the maximum at the point where the solids enter the regenerator. However, at this level the temperature is lowest and the oxygen concentration is lowest. The latter two factors offset the tendency toward too rapid burning because of the high carbon concentration.

As the solids progress downwards, they contact gas which is progressively richer in oxygen. At the same time, the solid temperature progressively rises because of the heat liberated by combustion. The increase in temperature and oxygen concentration offsets the tendency for the burning rate to fall from the decrease in carbon content. The air admitted to the upper zone is restricted in amount to keep the solid temperature rise within well-defined limits.

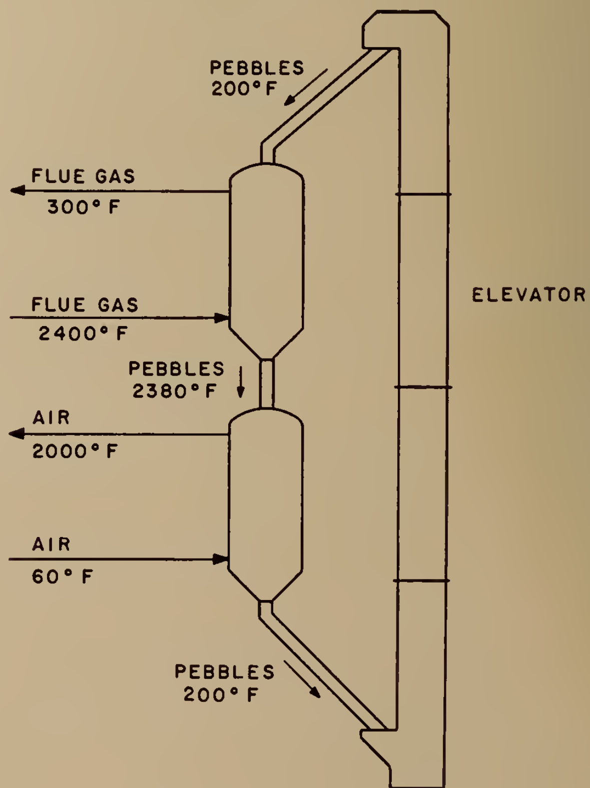
The incompletely burned solids leaving the upper zone flow through a cooling zone. The solids, now at a lower temperature, flow into the lower regenerator zone where the remainder of the carbon is burned off under essentially the same conditions as before. Throughout the entire operation, close control over solid temperature is made possible by the true countercurrent contact of the gas and solid. The same type of control can be achieved in other combustion reactions, such as the roasting of ores and concentrates.

Concurrent Systems

Just as it is sometimes preferable to operate shell and tube heat exchangers in concurrent or parallel flow, it is also sometimes desirable to operate moving-bed units concurrently.

There is no limit to allowable fluid velocity in concurrent flow, whereas in counterflow the fluid velocity is limited to a value below that at which lifting of the solid particles will occur. The corresponding limiting pressure drop is generally of the order of about 8 to 20 inches of water per foot of bed depth. Lifting of the bed occurs when the pressure drop in pounds per square foot per foot equals the solids bulk density in pounds per cubic foot.

Fig. 5. Pebble heater for heating air.



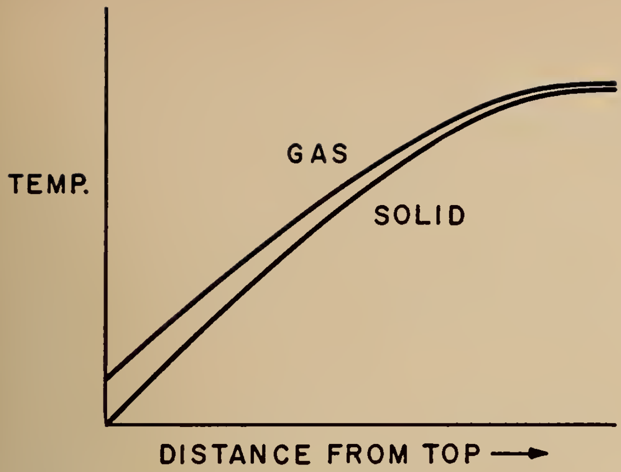


Fig. 6. Heating curve, low gas rate.

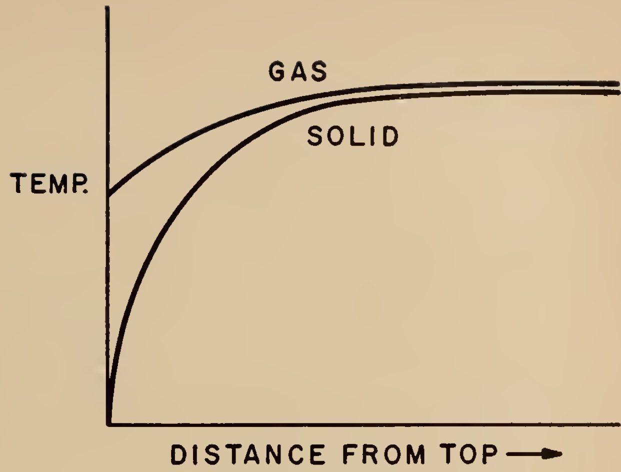


Fig. 7. Heating curve, high gas rate.

Houdriflow units operate with concurrent flow in the reactor. The regenerated catalyst enters the reactor at a temperature in excess of the temperature at which the cracking is to occur. The excess sensible heat content of the catalyst is used to vaporize the liquid portion of the feed. If, as in earlier cracking units, the reactor is arranged for counterflow, all of the feed must be in the vapour state. In the concurrent scheme, vaporization of liquid feed in the reactor has the advantages of removing part of the cooling load from the regenerator and removing some of the heating load from the feed preparation system.

Cross-flow Systems

The cross-flow technique has been utilized on a commercial scale to a limited extent, mainly for drying. A large-scale installation for the drying of clay catalyst pellets has been described which employed the cross-flow technique because large volumes of water had to be evaporated into the drying air stream and it was not possible to evaporate this quantity of water with countercurrent or concurrent flow. The difficulty here is that the drying air is cooled by the evaporation of the water. The more the air is cooled the lower its saturation humidity becomes. By blowing air through a number of cross-flow units in parallel it was possible to evaporate a large quantity of water at the rather low temperature level required to produce catalyst of satisfactory physical properties.

In this installation, the drying air was blown horizontally through the downwardly gravitating solids. The solids were confined by louvres to beds which were rather thin in the direction of air flow.

Limitations

In this section some of the limitations which must be considered in determining the applicability of the moving-bed technique to a new process will be outlined.

Solid Properties

One of the first solid properties which should be considered is particle size. Moving-bed units can be designed to process very small or very large particles. The factor which plays the biggest part in determining the optimum particle size is fluid pressure drop. Fluid pressure drop is an inverse exponential function of particle diameter. The power required to move the fluid through the bed increases, in turn, with pressure drop. In order to keep power costs low, it is obvious that the particle size should be as large as possible.

In many cases, pelleting or other preforming operations are indicated for fine materials. Several techniques are available — briquetting, extrusion and nodulizing in drums or pans. In some cases, more expensive casting or tableting procedures can be justified. There has been a large growth in the use of pelleting techniques in recent years, with the result that a variety of dependable equipment is now available. Low cost binders, such as those derived from sulphite waste liquors, are available in quantity. Pellets formed by any of these techniques are quite porous, so that mass transfer into and out of pellets is usually not unduly hindered by aggregation.

It is desirable that the range of particle sizes be kept as small as possible in order to avoid segregation problems. This is ordinarily not too burdensome a limitation, especially if the feed is pelleted.

The solids must have sufficient strength to pass through the unit without undue breakdown or attrition. Fortunately, the pressures exerted upon a particle are not large and the solids velocity in the gravitating bed is usually quite low, often being measured in inches per minute. Many materials which would be too weak to withstand repeated recirculation, as in a catalytic cracking unit, can be processed in a once-through operation with little breakdown. If some fines are formed they are generally trapped between the larger particles so that the loss in effluent gas streams is low. If rapid temperature or composition changes will occur, it is important to determine that these will not result in excessive breakage.

Temperature

This factor can affect the investment cost of a moving-bed unit quite markedly. The devices for engaging and disengaging gases are generally fabricated of metal. As the operating temperature is raised, the allowable stress decreases and costs increase. Above about 1400-1500 degrees F., refractory construction will usually be more economical.

The walls of high-temperature units are generally lined with firebrick or castable refractory and no particular problems are encountered here.

Pressure

Although moving-bed catalytic reforming units have been designed to operate at several hundred pounds pressure, fewer complications are involved at low or moderate pressure levels. Since the feed will enter and the product will leave at atmospheric pressure, sealing devices must be provided to maintain the desired pressure within the unit. At low pressure levels, this is easily accomplished by the use of fluid seals of the type described earlier. At higher pressure levels, longer seal legs and/or more sealing fluid is required. At some point it becomes more economical to use mechanical sealing devices such as lock hoppers or rotary valves.

Heat Transfer

If strongly exothermic or endothermic reactions are involved, heat transfer problems may arise. Heat may be added or removed by flowing the solids over horizontal tubes, preferably staggered at adjacent levels. The overall heat transfer coefficients from the bulk solid to the tube are in the neighborhood of 15 B.t.u. per hour, square foot of exchanger surface, degree Fahrenheit.

If the heat transfer surfaces are oriented vertically, the mixing effect of the staggered tubes is lost. In this case, heat transfer coefficients of the order of 5 to 10 B.t.u./(hr.)(sq. ft.) (degree F.) are obtained.

If a substantial portion of the heat addition or removal is by a change in the heat content of the solids, the specific heat of the solids becomes a factor of importance. The specific heats of solids vary widely on a weight basis. However, the specific heat is generally inversely proportional to the density, so that specific heats are remarkably constant on a volume basis. The volumetric specific heat of most solids will fall between 15 and 30 B.t.u./(cu. ft.) (degree F.).

This means that with a reactor of given volume and a process which requires a certain residence time, relatively little change in heat absorption or liberation by the solids can be achieved by changing the solid composition. However, the heat change of the solids can be increased by adding an inert diluent provided the reactor volume is increased to maintain the required residence time for the active material.

Considerable heat can be absorbed or given off by the fluid stream. In order to handle high fluid mass rates, a compromise design must be developed which considers both pressure drop and fluid flow distribution. It is possible to lower pressure drop by increasing the bed diameter and decreasing bed height. At the same time, this gives the fluid more opportunity to channel through certain parts of the bed. It is advisable that the bed depth be at least equal to the bed diameter to avoid channelling problems.

History

As mentioned earlier, blast furnaces and vertical shaft lime kilns have a long history. The gas producer has also been in use for many years. It was not until the late 1930's that the moving-bed technique was adapted to the first of many petroleum industry applications. The Thermofor kiln was developed in 1939 by Socony-Vacuum Oil Company for the regeneration of percolation clay used in oil refining. In 1942 the Thermofor catalytic cracking process was commercialized. The Houdriflow process described earlier is an outgrowth of the Thermofor process. Among the many process refinements which it incorporated was the substitution of pneumatic lifts for the bucket elevators used in the early units. The pneumatic lift was also adopted by Socony in its TCC Airlift design.

The pebble heater for high temperature heat exchange applications was developed in 1946. The pebble heater has been proposed for a number of processes, including the pyrolysis of selected hydrocarbon fractions to obtain valuable products such as acetylene.

In 1946 the moving-bed technique was adapted to an adsorption process for the separation of light hydrocarbon gases. In this Hypersorption process, activated carbon is circulated through the unit and recirculated by a pneumatic lift.

A moving-bed coking process has been developed which is novel in that the petroleum coke formed in the reaction is deposited on a circulating stream of coke particles. The rate of withdrawal of coke from the unit is balanced against the production so that a constant inventory results.

Several moving-bed catalytic reforming processes for the upgrading of selected gasoline fractions have been developed in the past several years.

Moving-bed catalytic cracking, as exemplified by the Houdriflow unit described earlier and by Socony TCC Airlift units, has enjoyed the greatest commercial success. About 100 moving-bed crackers are in operation, processing a total well in excess of one million barrels of feed per day. The largest of these units has a feed rate of 27,000 barrels per day (35 Imperial gallons per barrel). Two units are installed in Canada, one with a daily feed rate of 16,000 barrels and one with a daily rate of 11,500 barrels.

Outside of the petroleum field, moving-bed applications have been relatively few to date. Shaft furnaces have interested metallurgists for many years. Much research has gone into their utilization in such fields as the production of sponge iron. This process was brought to commercialization by Wiberg in Sweden in 1941 after 20 years of development.

Beneficiation of low grade iron ores has been given intensive study in recent years. It is reported that Erie Mining Company will utilize the moving-bed principle for hardening 20,000 tons per day of pelleted taconite concentrate. This decision was apparently dictated primarily by the extremely high heat economy that can be achieved.

Future Applications

One of the deterrents to wider use of the moving-bed technique has been insufficient knowledge concerning the fundamentals of solids flow, especially in the presence of gases or liquids. In a number of cases experimental work on promising moving-bed applications has been terminated prematurely for this very reason. An impressive amount of information has been accumulated in the field of solids flow in recent years, so this is no longer an obstacle. In addition, new materials of construction and new instruments can make feasible many processes which formerly defied commercialization.

One of the very promising fields is ion exchange. This unit operation has grown by leaps and bounds in recent years. Because true countercurrent contact affords so much advantage over conventional fixed-bed operation, it is probable that many installations will be converted over to moving-bed operation. This has received a lot of study, especially in the field of extractive metallurgy.

Another promising field is pyrometallurgy. Because of the high degree of heat economy and temperature control achievable in moving-beds, a large increase in the use of moving-bed roasters of various sorts is foreseen.

Last, but not least, a host of chemical and metallurgical reactions involving solids and fluids will be adapted to moving-bed processing. Oxidation, reduction, halogenation, dehalogenation, and decomposition are a few of the chemical reactions for which the technique is admirably suited.

Geothermal Energy

With Special Reference to New Zealand

NUMEROUS people have suggested that use should be made of the heat resources of the New Zealand thermal area, and two papers, in the early thirties, dealt with the matter in some detail outlining "the future of the recent developments in the utilization of subterranean heat, with a view to emphasizing the great possibilities of this source of natural energy." They reviewed the use made of thermal heat in Iceland, at Larderello in Italy, and in California.

In a later publication, about 1943, it was suggested that subterranean heat might possibly be experimented with on a comparatively small scale as a commencement in some of the following directions:

(1) Heating of glasshouses, production and ripening of out-of-season vegetable, salad and fruit crops.

(2) Heating of soil in frames, Dutch lights, open beds and tree nursery beds.

(3) Heating of homes and buildings as well as for various other domestic purposes, such as laundering, baking, and home drying of vegetables and fruit, etc.

(4) For dehydration and drying, including the drying of timber, wood pulp, eggs, wool, meat, milk, vegetables, fruit, fertilizers and manures.

(5) The recovery from natural steam or hot springs on a small scale of certain chemicals and gases, e.g., sulphur, boric acid and carbon dioxide.

(6) Production of power in a small way for purposes of study. A small geothermal plant would answer this purpose.

(7) The use of natural heat sources near the sea for evaporation of salt water to make salt.

(8) Heat processes for the synthetic production of phosphatic fertilizers.

Developments in Italy

The geothermal area in Tuscany occupies some hundred square miles to the south of Pisa on the west coast of Italy. Powerful steam jets (soffioni) occur and form, by condensation, pools of water known as lagoni. The lagoni contain boric acid, which has been exploited commercially since early last century. Bruce and Shorland state, "Towards the end of the eighteenth century attempts were made to recover the boric acid by evaporating the lagoni waters with the aid of ordinary fuel. In 1827 Larderello greatly improved the method by employing the steam from the soffioni to evaporate boric acid."

A condensed version of an address by W. M. Hamilton, D.Sc., assistant secretary of the New Zealand Department of Scientific and Industrial Research, to the Cawthron Institute, Nelson, N.Z.; published here through the courtesy of the author and of the *New Zealand Electrical Journal.*

Following 1899 Prince Ginori Conti made a substantial advance by sinking wells to tap the steam at depth. The recovery of boric acid developed into a large-scale industry and was the chief source of the world's supply for nearly a century.

Conti showed "as early as 1904 that cylinder steam engines could be worked directly from the soffioni steam with entirely satisfactory results." In 1913 the first steam turbine, driving an electric generator of 250 kw., was installed at Larderello. About 1916 three units, each of 3,000 kw., were added.

At the end of 1944 the installations for electric powered generation totalled 135,000 kw. and the total output of electric energy in 1943 was 908 million kwh.

During the retreat of the German forces through Italy the installations at Larderello were wrecked and many of the wells destroyed. Since the end of the war the area has been vigorously redeveloped with improved techniques.

Progress in Iceland

Some use of the natural hot waters from the thermal areas in Iceland has been made from the earliest times because of the great scarcity of fuel. A small thermal area on the outskirts of Reykjavik has been used for laundering from the earliest times, and this was also the first area to be harnessed for hot water reticulation. The system of hot water reticulation now in use was conceived in 1928, when the city water board suggested that the nearby volcanic springs should be used for central heating. A small scheme installed at this time proved a success and a much larger scheme was commenced in 1934.

The nearest source of sufficient size lay at Mosfellssveit, about ten miles to the east of Reykjavik. The natural flow being about 1,320 g.p.m. this was augmented by boring operations. The diameter of the holes ranges from 4 in. to 8 in. and the borings, which cover an area of less than 160 acres, descend to 450 to 1,200 ft. Boring not only increased the flow but also increased the average temperature of the water from 80° C. to 87° C. The wells are cased for only 7 to 10 ft., the casing being suitably secured to a concrete anchor-block. The water is piped to insulated holding tanks from which pumps deliver it through two 14 in. insulated pipes to the main holding tanks above the city. From these holding tanks there is gravity feed to the city, with booster pumps brought into action when the load is heavy. The temperature drop from the springs to the consumer is only 5° to 6° C.

Extensive use is also made of natural heat for greenhouses for growing vegetables, flowers and fruit.

Developments in New Zealand

At various times during the thirties there were discussions on the possibility of utilizing natural heat in the thermal areas and an investigation was considered by the Council of Scientific and Industrial Research early in 1940. They recommended that steps be taken to investigate the problem of utilizing natural heat. S. H. Wilson of the Dominion Laboratory surveyed the possibilities and thought the most promising outlet for volcanic steam would be for power generation. At that time, however, it was considered that the North Island was well provided with water resources for power generation and there was little need to consider the possibility of natural heat power generation for some considerable time.

At the same time in Rotorua, where heated ground water could be tapped at relatively shallow depths, a number of wells had been sunk for space heating and hot water services. Modriniak estimated that in 1944 fifty wells had been sunk in the Rotorua area for this purpose and this number has now greatly increased.

Approval for a general programme of investigation in the thermal area was given in 1946. Arrangements were also made for engineer officers of the armed forces in Italy and Japan to collect all information available on the utilization of thermal resources in those countries.

It also became evident that the demand for electric power was growing more rapidly than had been realized and that the hydro-electric resources of the North Island would, within the foreseeable future, be inadequate to meet the rising demand. With this in mind the present Commissioner of Works and the Director of the Geological Survey visited Larderello in Italy in 1948 to examine developments there. Following the return of the Director of the Geological Survey, a meeting was held to formulate a programme of investigation on geothermal power and a small inter-departmental committee was established to supervise the general programme and policy associated with the investigations of geothermal energy in New Zealand.

A programme estimated to take five years was drawn up and the programme was approved by Cabinet in November 1949. Before it became fully operative, however, as the power situation became more pressing, it was decided that the search for geothermal steam should be speeded up and that exploratory drilling should be undertaken simultaneously with the scientific investigations. With this in mind it was decided to concentrate the scientific effort on an area approximately 13 miles square at Wairakei, since this seemed one of the most promising areas.

Steam Production

The heat escaping at the surface in the Wairakei zone is assumed to have its origin in a mass of intruded cooling magma at depth. The steam and gases given off from the magma rise through fissures in the basement greywacke into the more permeable volcanics filling the graben. As yet we have no evidence of what type of beds fill the graben below the ignimbrite sheet into the permeable Huka beds above. These permeable surface beds are saturated with ordinary ground water which is heated by the rising steam and gases. The number or location of the feeding fissures from the magma below is not known, but the hottest areas at the surface appear to be associated with northeast trending faults.

Chemical analysis of the geothermal steam and waters for various constituents enables deductions to be made concerning the ultimate source of the steam and the layers through which it has passed. Practical problems associated with the utilization of the steam also require determination of the amounts of gas remaining after condensation and of constituents likely to be corrosive to turbines and valves.

Comparison With Larderello

The geological conditions at Wairakei differ substantially from those at Larderello. At Larderello the magmatic steam is trapped under an impermeable cap rock. Surface temperatures are low until the drill nears the lower edge of the confining rock cap. The steam produced is dry and often with a substantial degree of superheat. At Wairakei, drilling takes place through beds of permeable volcanic material at temperatures approaching the boiling point for depth, thus adding substantially to the difficulties of drilling.

It is now clear that production of natural steam at Wairakei may be possible from three entirely different types of sub-surface accumulations:

(1) Production, as at present, from the surface layer of permeable volcanics.

(2) Production from a permeable layer below a cap rock structure, if such can be located. This condition might be realized near the west end or in the vinicity of Karapiti.

(3) Production from the deeper rocks lying between the ignimbrite sheet and the greywacke basement.

Only the first of these possibilities has so far been explored.

Utilization of Steam

The demand for electric power in the North Island has been increasing rapidly in recent years. Even with restrictions in force during the war and post-war period consumption doubled in ten years. With removal of restrictions the growth of demand has been much more rapid and it is obvious that the limit of hydro-electric capacity to meet the demand will be reached within the next decade unless restrictions are again applied.

The urgency in geothermal development has therefore been to evaluate its role in the future power supply situation. To this has been added the request from the United Kingdom that the possibility of producing heavy water in conjunction with power development should be considered.

Power Potential

As mentioned the production of natural steam at Wairakei may be possible from three different types of sub-surface accumulations. At the present time we are using only the heated ground water from the surface layer of permeable volcanics and on this basis it is conservatively estimated that the central area at Wairakei can provide the equivalent of approximately 33,000 kw. of power from shallow bores, and including flash recovery, the estimated power production is 62,600 kw. By harnessing other areas in the Wairakei vicinity it is estimated that a further 72,000 kw. could be obtained, making a total for the Wairakei area of approximately 134,600 kw. The full utilization of geothermal resources at Wairakei would almost certainly

(Continued on page 926)

ABSTRACTS

BASED ON CURRENT LITERATURE AND EVENTS

DOCTORS AND ENGINEERS STUDY BONE AND METAL SPLINTS

Electrical Engineering, 1956, v. 75, n. 2, February, p. 209.

Two Yale faculty members, one a medical authority on bones and the second an engineering expert, have joined forces in a unique study of "bone engineering".

The materials used in studying the problem of splints are bone and metal. Bone splints in use today are made of vitallium or stainless steel, and are fastened to bones by screws inserted in holes drilled into the bone on opposite sides of the fracture.

But, few doctors are convinced of the complete success of this type of operation. It has been found in the engineering lab that drilling holes in bones reduces strength by as much as one third.

Supported by a grant from the Erdle-Prange Foundation, the study of bone and of metal behaviour is being made. In the laboratory of the civil engineering department, bones are subjected to a variety of tests, before and after drilling, to determine the inherent strengths.

University civil engineers and medical researchers have also found that it is extremely difficult to design and install a bone splint which can absorb the same stresses as the bone to which it is attached. For example, a person standing on one leg imposes on the corresponding hip joint a weight two and a half times his body weight; thus, a 200-pound mant standing on his right foot bears 500 pounds on his right hip. This is because of "body engineering" with various interconnections between the bones and muscles of the body.

The bones of the leg have a safety factor of about 30; that is, they will withstand pressures 30 times those caused in normal use, so that designing and installing a lightweight brace with the same safety factor is not easy.

"Bones are remarkable structures as far as design goes," says the Yale doctor, "and nature won't let you tamper with them to any great extent." But even with their remarkable "economy of design", bones fortunately are the strongest where the pressures on them are the greatest.

However, bones pose engineering problems of no small scale. Bone substance has an amazing amount of flexibility—up to a point. Beyond that point bones are exceedingly brittle. Then too, if abnormal constricting pressures are applied to the bone, it disintegrates in a very short time.

Thus, any type of splint must be applied only on one side of the bone —and this increases the difficulty of designing splints strong enough to provide the needed support, yet light enough to avoid complications. Engineering investigations found, for example, that narrowing the centre section of a particular splint weakens it severely, but routing out the centre section of the same splint actually strengthens it.

The Yale doctors and engineers have also found that if the screws used to fasten the splint to the bone are small enough to avoid weakening the bone appreciably, they may be too small to withstand normal pressures.

The problem of bone splinting is one that cannot be ignored or avoided, because bone splints are necessary on fractures requiring considerable length of time to heal. A fracture of the thigh bone may require as much as six months to one year to heal completely; if the entire limb is enclosed in a cast for that length of time, permanent stiffness is a "definite possibility".

Casts probably will always be used for some fractures, especially minor ones, but more serious fractures do require bone splints for successful healing.

A SIMPLE RELIABLE IMPACT TEST

Modern Plastics, 1956, v.33, n. 8, April, p. 149.

For years the designer of load-bearing parts has had almost no fundamental data on which to base a choice of materials for impact service. Now an inexpensive, simple, unambiguous tensile-impact test is available, which uses standard Izod equipment modified to hold a variety of specimens so that they are tested in pure tension rather than bending. Both stiff and limp materials may be tested.

Notched-Izod is Traditional

The notched-Izod test, popular because the required apparatus is relatively inexpensive, has long been accepted for testing metals. However, the design of metal parts is usually based on keeping the metal within its elastic limit; a slight degree of plastic flow is often fatal. Thus elastic modulus and yield strength, on the basis of weight of material used, are far more important design criteria for metals than notched-Izod (or other) impact measurements.

As plastics came into use, they were not used for structural parts of bridges, buildings, and heavy machinery because they had insufficient rigidity per unit cost. They did, however, find wide acceptance in housewares, toys, machine parts, electrical apparatus, and packaging. In these uses they were often subject to severe and sudden mechanical loads, and soon the notched-Izod test was in wide use as almost the only official measure of impact strength for plastics. Another measure is the area under the stress-strain curve in the standard tensile test. But plastics are very sensitive to the time rate at which the load is applied, and the standard tensile test is run at a rate of loading thousands of times lower than is encountered in normal service impacts. The Izod test offered the advantage of applying load at a reasonably high rate.

Izod not Reliable

It was soon realized that the results of this test and the actual field performance of plastic materials under impact loads corresponded only coincidentally. But, any high-rate test is better than none, so notched-Izod has continued in wide use as a basis of design even though it estimates an ill-defined and changeable combination of material properties. Mostly it appears to measure the notch-sensitivity of materials under the influence of a high-rate, three-dimensional system of assorted stresses. For the more flexible materials, like polyethylene, the test is meaningless since these materials are not broken, but twist aside and escape the brunt of the impact.

Basis of New Test

Most impact failures begin because somewhere in the specimen there is a too-high tensile stress. Thus, we should attempt to measure the ability of plastics to withstand sudden tensile loads. This kind of measurement would have the additional advantage that, since more is known about the analysis of tensile stresses than any other kind, the results would be more widely applicable to objects of various shapes. Apparatus to do this has been built but it is expensive and complicated. Test pieces must be carefully prepared in a particular shape, and testing is relatively slow.

Measures Impact in Tension

The new tensile-impact test changes all this. At the Cleveland S.P.E. meeting, Dr. Chester Bragaw (Du Pont Polychemicals Dept.) showed how anyone can alter Izod equipment to make impact measurements in pure tension. The new method also permits the tester to measure notch-sensitivity directly. A wide variety of shapes may be tested and specimens can be moulded, cut from sheets, machined from rods, or cut out of commercial products. Materials need not be stiff. In thin-film form they may be tested by cutting a number of strips from the film and stacking them together for the impact blow. The gauge-length and cross-sectional area under stress of the test specimen are accurately known, and the stress has the same value over the entire cross-section being stressed.

Results indicate that tensile-impact measurements correspond well with failure of various plastics in several types of impact service.

COMMERCIAL HIGH OCTANES FROM COAL

Chemical Engineering, 1956, v. 63, n. 2, February, p. 130.

The world's first commercial plant for making high-octane gasoline from coal has started up near Vereenining, South Africa. Representing the first large-scale use of the M. W. Kellogg fluidized-bed version of the Fischer-Tropsch process, the plant is owned by the South African government's SASOL organization, bent on freeing the country from dependence on foreign petroleum. The plant will produce 55 million gal. per year, one-sixth of the country's requirements.

Justification for the $90 million spent on the project rests on economic as well as strategic grounds. From thick seams of coal at shallow depths located 1½ miles away, raw material can be delivered to the plant at a remarkably low 70c per ton. And Kellogg claims economic advantages for its process over other versions of Fischer-Tropsch: the high octane of its gasoline product; high over-all conversion efficiency; lower initial investment.

The Kellogg process uses powdered iron catalyst which, after separation from reaction products, is recycled to the fluidizers. Catalysis products are recovered, separated and purified by conventional oil refining techniques. Interestingly, light hydrocarbons recovered are in so little demand in South Africa that they are reformed to carbon monoxide and hydrogen (with steam and a nickel catalyst), then recycled to the fluid unit.

Besides the Kellogg fluidized-bed reactor, a fixed-bed unit—the new German Arge version of Fischer-Tropsch—has been installed at SASOL. However, its main product is high-boiling wax for export. Because high octane gasoline is South Africa's main concern, the Arge unit hasn't yet been started up. Both the fluidized and fixed-bed processes give diesel oil as a minor product.

High-purity oxygen is made in six Linde-units—1,800 tons per day total. At full production, 3,200 tons of coal will be gasified daily in eight Lurgi units to give 4.25 million cu. ft. per hour of purified synthesis gas. Alcohols, ketones, aldehydes and acids are plant by-products which will be consumed domestically.

HOW RUSSIAN PLAN TO HEAT ARCTIC HITS CANADA

The Financial Post, March 3rd, 1956.

Co-author W. R. G. Cameron is an economist who has devoted special study to announced Russian plans to change the northern hemisphere. His article is based on Russian announcements and on the interpretation thereof by Canadian scientists.

Damming of the Ob and Yenisei rivers in northern Russia is now under way to provide water and power for the vast Russian farmlands near the Caspian Sea. Probable completion date is 1975. The Russians also plan to close Bering Strait between Siberia and Alaska, to block off cold arctic waters from the north Pacific. Building of atomic power and heating stations on Arctic islands is also planned to counteract the effect of the added flow of cold water past Canada's eastern seaboard and Europe's west coast once the two dam projects are completed.

Warm winds will blow over Siberia, Alaska and Northwestern Canada, creating millions of acres of new farmlands. But scientists believe the Bering dam will result in an increased flow of arctic water across the top of North America to augment the icy Labrador current down Davis Strait and the Maritimes coast, thus adding to early frosts and storms in the fall, perhaps tying up Halifax and St. John's as winter ports.

Disruption of the delicate climatic balance over Europe by melting of Greenland ice may bring longer more severe winter weather, and bring an estimated five foot rise in the world's ocean levels, flooding parts of London, New York, the Netherlands, and many other Canadian and American coastal lands, and causing a shorter growing season. Implementation of the plan involves three giant steps over a 50-year period.

THE CANADA-INDIA REACTOR

In April 1955, under the Colombo Plan, Canada offered to India a high-powered atomic research and experimental reactor similar to the NRX reactor at Chalk River, Ont. This offer was accepted and, just a year later, an inter-governmental agreement on the project was signed in New Delhi. Costs of the joint enterprise will be shared, Canada contributing some $7.5-million of the total $14-million, and final control of the completed project will pass to the Indian Government.

The reactor will be erected at the government nuclear energy establishment at Trombay, near Bombay, and will be housed in a rotunda consisting of a hermetically sealed steel shell, about 135 ft. high by 120 ft. diameter. Surrounding buildings will contain auxiliary equipment and laboratories.

Canada is designing and providing the reactor and the steel rotunda, and will be responsible for the engineering and erection; most of the construction will be done by Indian contractors and labour.

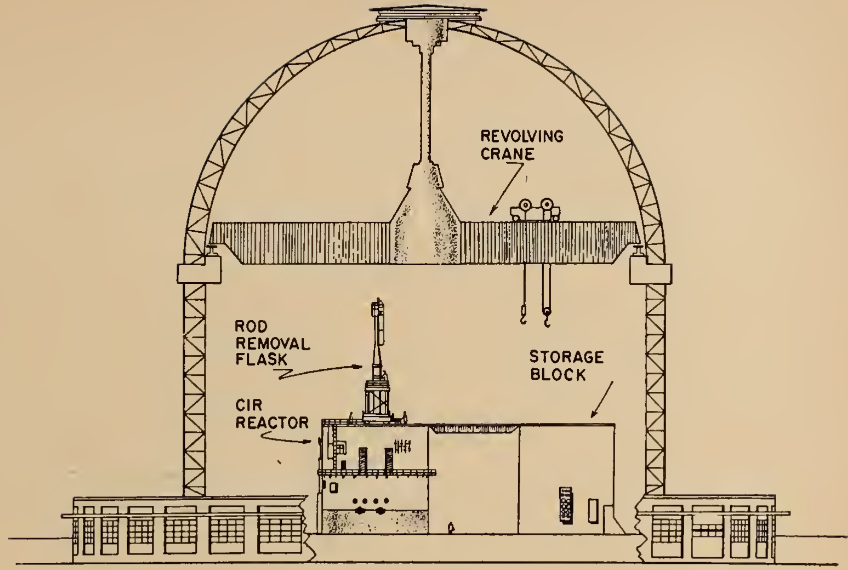
Work is already under way on the foundations and basement of the reactor, and the steel rotunda should be nearly complete by the end of 1956. It is hoped to have the reactor in full operation by the middle of 1958.

Selected Indian scientists and engineers will visit Chalk River for training and experience, under the normal Canadian technical assistance program. First-hand knowledge of reactor operation will be obtained by working with the Canadian design staff.

The Canada-India reactor is designed as a fundamental research tool for nuclear energy, and will produce radioactive isotopes for use in medical therapy, agriculture, and industry, and for tracer element research studies.

In particular, the reactor is specially suited for engineering studies and research on reactor materials, which can be tested under conditions of high neutron intensity. This will enable advanced engineering experiments to be made in connection with the design of future power reactors.

India has offered the experimental facilities of the reactor to approved scientists from other countries, including those belonging to the Colombo Plan in south and south-east Asia.



Cross-sectional diagram of the Canada-India Reactor building and the reactor proper, which is a modified version of the NRX research reactor of A.E.C.L., at Chalk River.

INDUSTRIAL ACCIDENT PREVENTION IN BELGIUM

Though one of the smaller European countries, in area, Belgium is highly industrialized and is well equipped to maintain a proper standard of machine design and industrial safety, to judge by the work of the Association des Industriels de Belgique.

This non-profit organization, which has been operating for over 65 years, has as its aim the supervision of industrial establishments from the point of view of safety from accidents, occupational diseases, and fire. This is carried out by plant visits, literature, instruction with visual aids, training courses, and through physical tests in well-equipped laboratories.

The laboratories can carry out most of the accepted proving methods and investigations in the fields of non-destructive testing, metallography, corrosion, physico - chemical testing, and so on. The mechanical testing equipment is of particular interest to the engineer, and the Association has recently issued an illustrated record of the work that can be done on their large installation (known as G.I.M.E.D.), which is used for dynamic and static tests on large units and structures. Loads may be applied in any direction, and it is possible to obtain complex combinations of static (tension and compression) and vibratory loads by the use of auxiliary equipment. The maximum static single loads obtainable are 300 tons vertically or 200 tons horizontally; fatigue tests may be carried out up to 100 tons (vertically) at 250-500 cycles/sec. The base of the machine is of heavy reinforced concrete with a planned system of anchor-points and fixtures to which the test piece and auxiliary test equipment can be secured.

Some of the tests shown as examples are: simple and complex beam loadings; static and dynamic proof of drill pipe; stresses in concrete structural shapes; multi-directional loading of a pylon; a nine-point dynamic test of a steel rail bogie; and other interesting indications of the work of the Association in this field.

SURPLUS POWER FROM NUCLEAR TEST PLANT

Canadian Isotope Newsletter, 1956, v. 5, n. 4, April

Holyoke, Massachusetts, and Ilion, New York, have contracted to purchase excess electric power from the United States Atomic Energy Commission's prototype submarine reactor at West Milton, N.Y. The municipal hydro systems have to transmit the power from West Milton. They will pay three mills per kilowatt-hour, but no guarantee has been made as to the amount and timing of available power, because of the experimental nature of the West Milton nuclear plant.

BRITAIN'S TECHNOLOGICAL SHORTAGE

EMC-SMC Newsletter, 1956, n. 89, Feb. 14.

Great Britain's Advisory Council on Scientific Policy, through its Committee on Scientific Manpower, has issued a "Report on the Recruitment of Scientists and Engineers by the Engineering Industry" that indicates an earlier appreciation of specialized manpower needs in that country than in the United States. In 1946 the Committee "recommended that the immediate aim of the universities, aided by the University Grants Committee, should be to double their existing output of scientists and technologists. This was in fact achieved by 1950. But the demand continues unabated. Any fears there may have been about the overproduction of scientists and engineers have been completely dispelled by events."

The report reveals that, for all its recruiting efforts, the engineering industry obtained only 75% of the men it needed. Complaints about the caliber of the recruits were numerous, and the decline in the quality of graduates was attributed in part to rapid postwar expansion that enabled the universities to double their output. The impression that quality has been sacrificed to quantity is widespread.

"That there is an urgent need to increase the number of graduates is obvious. The demand for such men is rising all the time with the increase in the general level of industrial activity . . . The gap between supply and demand is thus bound to grow unless the steps now being taken to increase the volume and quality of engineering education become even more vigorous than they are."

The industrial firms surveyed prefer first-degree graduates to men with graduate training, and some expressed the fear that the expansion of university programs and enrolments is merely drawing off the brighter boys who would normally have gone into the student apprentice program and for whom there is equally urgent need in apprenticeships. The Committee on Scientific Manpower reminds industry that, even with the doubled output of graduates, the engineering departments of the universities are not meeting current demand. In appealing to "those who influence the choice of careers, particularly parents and masters," to steer more young people into industrial science and technology, the Committee reveals that it has not succeeded in discovering any sure way of closing the gap between supply and demand.

Cross Suspension System, Kemano-Kitimat

Transmission Line *(continued from page 910)*

were set. This degree of accuracy was necessary as the wire rope lengths had to be calculated, measured, cut and socketted to ±0.1 foot if the system was to be placed in space with sufficient accuracy and if the tensions in the almost parallel pairs of ropes were to be close to designed values.

Once the anchorage rock was proven and the anchor positions established, the anchorage working lines and the saddle locations were tied into the grid and this data was used to calculate the rope lengths.

After completion of the project, the erected system was re-surveyed to determine the "as built" condition and the bridle plates at each end of the catwalk were found to be within 15 inches of their designed locations.

The cross suspension system has been observed closely during the eight months that it has been in service. It has behaved in a very docile manner through what was apparently a normally severe winter. Observations were made several times of its reaction when large amounts of heavy rime fell from the conductors. The conductors bounced in a completely normal manner and the system vibrations died away in a minute or two.

Acknowledgments

The Saguenay-Kitimat Company, a subsidiary of the Aluminum Company of Canada, were the general contractors, Mr. F. T. Matthias, General Manager and Mr. W. Richards, Field Superintendent.

The erection of the cross suspension ropes was contracted to the Dominion Bridge Company, Limited and carried out by their erection department at Vancouver, Mr. H. Minshall, Erection Manager and Mr. R. Harris, Erection Engineer.

Dr. D. B. Steinman, Consulting Engineer of New York City, N.Y., was consultant on the design of the suspension system and supervised the construction and test programme of the model.

Engineering and construction were under the direction of Mr. J. S. Kendrick and the writer was responsible for the project design.

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1. B. Cooper and D. G. Dunbar: The Nechako-Kitimat Development—Design and Construction of the Transmission Line; The Engineering Journal, 1954 November.

2. Dr. K. Sutter, F. L. Lawton, and A. Soosar: The Nechako-Kitimat Development—Aluminum Towers on the Transmission Line; ibid.

Geothermal Energy

(coninued from page 922)

cause all surface thermal activity to cease, as it has at Larderello.

These estimates are based on obtaining maximum yields from the surface layer of permeable volcanics. The possibility still remains that if drier steam could be obtained from beneath a cap rock structure, if such can be located, or from deeper sources beneath the ignimbrite sheet, then the above estimates might be substantially increased, though to what degree must remain a matter of speculation until test wells have been drilled.

On the basis of experience at Wairakei a careful estimate has been made of the present natural heat escape from other thermal areas. Including flash recovery from the hot water these could run to an estimated 475,000 kw.

However, unless production greatly exceeds current estimates, geothermal energy cannot provide sufficient power to satisfy the long-term requirements of the North Island. Eventually they must look to steam generating stations, nuclear power or other sources to meet the rapidly rising demand for electricity, a demand which on past experience doubles in less than ten years. This is not to belittle the contribution which geothermal power can make. Its full utilization, as an alternative to coal-fired generating stations may well mean a saving of £5 million per annum. It represents a resource of high potential value. Its possibilities should be explored resolutely and boldly.

DISCUSSION

The editor invites discussion of papers appearing in the Journal.

Readers may contribute to this section by sending appropriate comments to the editorial office.

Canadian Developments

NEWS OF MAJOR ENGINEERING DEVELOPMENTS IN CANADA

St. Lawrence Seaway and Power Project

Progress By Ontario Hydro

Construction work on Ontario Hydro's half of the St. Lawrence Power Project geared up during May for peak summer operations. In the month, activity had been hampered somewhat by extensive rains and frost coming out of the ground. However, in this period, contractors started moving more equipment on to various sections of the development, ready for speeding up of construction activity. Work on the power-house section proceeded with scarcely any interruptions, despite the unfavourable weather conditions during the month.

A total of 100,000 cubic yards of concrete had been placed by the month end in the north sector of the power-house area in the "U" abutment, wing wall, and No. 1 ice sluice sections. The structure was 35 per cent completed. Rock foundation had been prepared for No. 2 ice sluice and for No. 1 generating unit. Excavation of earth had been carried out in the top lift right to the international boundary.

During the month, work was resumed on Cornwall dike, No. 2 highway, and on channel dredging operations, after the winter shutdown. Meanwhile, scrapers commenced work on the west end of the diversion canal, beginning full-scale excavations in that area. In the main part of Cornwall dike, now 12 per cent complete, the contractor had pumped out last season's excavations which were dried sufficiently to permit work over them.

Several houses had been moved from the north end of the dike area to give free access to the contractor for extending the dike structure. The entire fleet of scrapers was completing the stripping and resuming dike building between the present Canadian National Railway line, now 66 per cent complete, and old No. 2 highway. Concrete placing had started in the dike closure structure. Stripping also had commenced in the power-house sector of the dike.

Work commenced in May on the second section of No. 2 highway from Moulinette area west to the vicinity of Dickinson's Landing. This consisted mainly of fencing the right-of-way and in grubbing, in preparation for grading. In the third sector of the new highway from Dickinson's Landing west to the county road north of Aultsville, clearing had begun.

At the beginning of the month, two dredges were back for channel improvement work in the vicinity of Spencer Island and a third was in position. On Galop Island, excavation work continued and the contractor was concentrating on rock removal in the northwest section of the island. Building of the upstream rock dikes also was in progress in that section.

House moving operations in Iroquois were suspended for part of May because of soft ground conditions. Progress was made however on sidewalk building and construction of permanent roads. Erection of the new community's water tank proceeded favourably.

Sewer and water main installations in new towns No. 1 and 2 progressed well during May. In town No. 2, installation of the power distribution system was completed. During the month, in Mille Roches and in Moulinette, preparations advanced for the early moving of houses to new town No. 2 site.

Throughout the month, construction progress was affected considerably over the entire project because of the wet conditions. The work force during May was increased to a total of 3,400 employees.

Progress by NYSPA

May progress was keyed to concrete placement operations as four major structures rose from solid rock

Barnhart power plant. This general view of the power-house construction shows the curving draft tube forms being assembled.

foundations reached after months of excavation below river level. Concrete in place at end of May exceeded a quarter of a million cubic yards. Some sixteen and one-half million cubic yards of material had been removed and excavation operations began tapering off in structure areas. With expanding construction operations demands for manpower had increased employment to 4,700.

Final stage excavation at Barnhart power-house and clean up of rock for the eight units at its south end moved toward completion. Form work, placement of reinforcement and concreting operations continued in the intake structure and ice sluice. Draft tube base slabs had been poured for 8 of the 16 units.

At Long Sault dam, with structure 27 per cent completed, the rising structure of the 275-ton permanent gantry crane and placing of concrete in piers give a preview of the completed structure's impressive size. Concrete in place exceeded 100,000 cubic yards, and compacted backfill was being placed behind abutment and wingwall. Excavation at Cut "F" was more than two-thirds complete as four million cubic yards had been removed.

Piers were increasing in number at Iroquois dam as forms were transferred to new locations and placing of concrete continued; the structure was 39 per cent completed. Consolidation foundation grouting for Stage 1 was completed. Excavation equipment was creating a new channel for the river with removal of two and one-half million cubic yards of material through May.

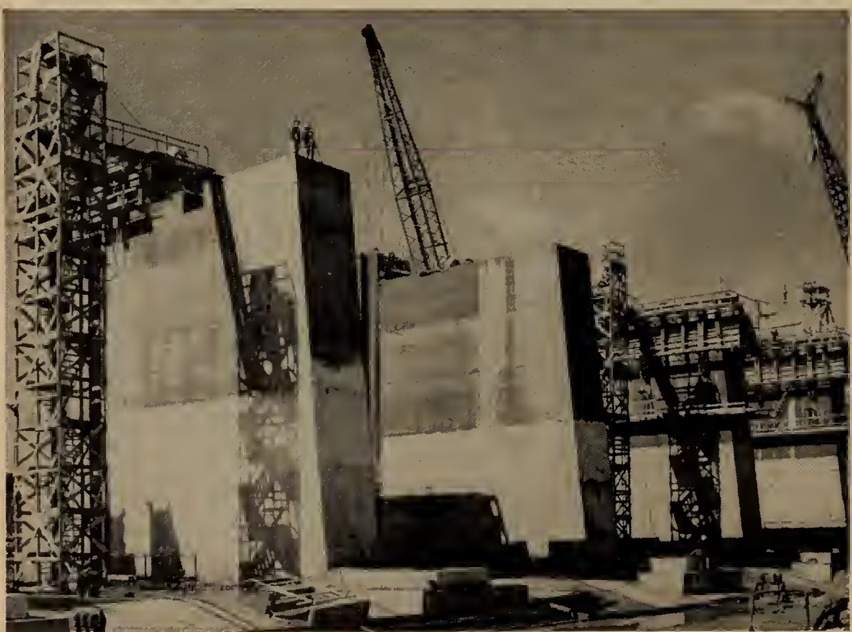
Concrete placement at Massena intake continued as the structure took shape in what was formerly a muddy excavation far below the river. To the end of May, 25,000 cubic yards of concrete had been placed. Water facilities for Alcoa and Massena progressed as grading of the right of way moved forward and large sections of pipe were distributed along the bank of the canal. With concrete deck and sidewalks in place, the Grass River bridge was opened for traffic.

With excavation approximately 20 per cent completed, work continued on five channel improvement contracts requiring the moving of 35 million cubic yards of material. Work was started on the Waddington sewage disposal system as required by one of the major channel improvement contracts.

Surveys for the Barnhart- Plattsburgh transmission line were progressing. The Massena town beach and recreation area near Louisville Landing was reconditioned and extended during the month.

The design work continued on schedule. Specifications were issued for the trash racks, stop logs and lifting beams and the contract for the electrical work at Barnhart Island was awarded. Bids were received May 29 for the main switchboards.

Iroquois dam. Sluiceway blocks are reaching their full height.



Progress By S.L.S.A.

Tenders were called on May 16 for two of the most important contracts in the building of the seaway. These are for the two locks which will enable ships to be raised or lowered the 85 feet between Lake St. Louis and the Beauharnois power canal. Tenders were called for the supply and erection of two rolling lift type bridges, one at Cote Ste. Catherine and the other at Iroquois lock, near Iroquois, Ontario.

Features will be the temporary diversion of the New York Central Railroad during construction, the building of a four-lane highway diversion tunnel to carry Quebec highway No. 3 under the lower Beauharnois lock, the construction of a cofferdam in Lake St. Louis and dredging in the Beauharnois canal. The highway diversion is to receive priority in the progress of the work.

Excavation over the two-mile extent of the two lock contracts will require the removal of some 1,110,000 cubic yards of overburden and 2,621,000 cubic yards of rock. For construction there will be required some 9,000 tons of iron and steel and some 3,200,000 bags of cement. Work for the upper Beauharnois lock must be completed by November 30, 1958, and for the lower Beauharnois lock, by October 31, 1958.

The bridges for which tenders are called are to be completed, respectively, at Iroquois lock, March 31, 1957, and at Cote Ste. Catherine lock, December 31, 1957.

Controversy Over Dredging

The United States has declined to meet Canada's wishes for deep sea dredging on the north side of Cornwall Island, apparently fearing it may lead to an all-Canadian seaway and American-Canadian competition for seaway traffic. The U.S. wants to dredge a 27-foot channel on the south side of Cornwall Island, but further dredging will be needed on the north side so river levels and flow will not be unduly disturbed.

Canada has reserved the right to build all the seaway channel on her side of the river if future traffic or friction with the United States should warrant it. Both countries agree some dredging must be done on the north side, but the U.S. maintains it need not be done to a depth of 27 feet, while Canada insists that it should.

Under the Boundary Waters Treaty of 1909 neither country can undertake construction in international waters without the other's consent if it will result in changing flows or water levels. Canada feels it would be best to obtain consent to 27-foot dredging now rather than to have to open negotiations later.

However, authorities state the problem is getting high priority from both governments. Further discussions will be held at an early date. They are convinced it will not delay completion of the power and seaway project scheduled for the opening of the navigation season in 1959.

SLSA President Addresses Queen's Graduates

President Lionel Chevrier of Canada's Seaway Authority, addressing the graduates of the faculty of science of Queen's University, at Kingston on May 18, told them that they should "retain the clarity and open mindedness on which your scientific knowledge is based; but retain also with that a lively awareness of the social consequences of your work". He then underlined the importance of engineering in civilized society, stressing particularly the marked effect this profession has had upon the destinies of Canada.

Mr. Chevrier pointed to the seaway as one of the greatest achievements in the heart of Canada, and as one where the engineer finds the opportunity to put into action all the resources of his skill. In the mind of the speaker, however, the aspect to be stressed on the occasion was that graduates are to leave the university "with a balanced view of their society".

Progress by SLSDC

Dedication ceremonies took place on June 3 at Massena, New York, for the Dwight D. Eisenhower lock, one of the two United States locks on the seaway now under construction, formerly referred to as the Robinson Bay lock. Assistant Army Secretary George H. Roderick gave the opening address in the community sponsored ceremony and a new lock site marker was unveiled. Lewis G. Castle, SLSDC administrator was also present. The ceremonies formed part of a 1½-hour TV program entitled "The St. Lawrence Story".

Tenders have been called for the supply of trash racks, stoplogs, lifting beams and gate suspension metalwork for the U.S. half of the Barnhard Island power plant, Long Sault dam and Massena intake, amounting to some 1200 tons of fabricated steel metalwork. Bids closed on June 15 and were not restricted to American manufacturers.

Seaway Ports
Facilities or Traffic First?

Professor John L. Hazard of the University of Texas, who served as economic consultant to the SLSDC, places the probable total traffic potential of the seaway at 36½ million tons by 1959. He believes if Great Lakes port cities provide adequate facilities and don't hamstring their port authorities with local restrictions, a traffic total of 52 million tons by 1965 is possible.

About half the seaway supporters believe direct overseas commerce will expand steadily after 1959, he states. The remainder think there will be startling surges in 1959, with some levelling off thereafter. Various estimates of non-bulk overseas seaway commerce average up to 1.8 million tons for 1959 and about six million tons by 1965. The general expectation is for a cumulative average growth of 15 per cent yearly to 1959, 40 per cent a year for 1960-61 and then a slow tapering-off.

Since last summer, local ardour for the project has cooled somewhat. In some Ohio and Michigan communities there is a strong tendency to wait and see before providing new and enlarged waterfront facilities, reports Prof. Hazard. Some leaders in these areas question the wisdom of installing large new facilities for general cargo handling. Nor are they keen to give their port authorities control over their waterfronts.

The opposite school, bankers, utility managements and the like, who see vast economic benefits for general foreign commerce, contend facilities must be provided before overseas trade will come. Port authorities must co-ordinate the entire waterfronts, so that industry which does not make a direct contribution to port activity cannot stymie building plans.

American Lake Ports are Preparing

Chicago, Milwaukee, Detroit, Cleveland and Toledo expect seaway benefits to be substantial, according to a recent Seaway Supplement in the *New York Journal of Commerce* dated April 25. These cities have long been leaders in interlake tonnage. The New York Port Authority predicted last year that the seaway would divert three to four million tons of cargo yearly from New York to Great Lakes ports. New Orleans thinks it may lose six million tons of its commerce to lake cities.

Chicago is generally conceded to have geographic and economic advantages which should make it the number one ocean port on the Great Lakes. Milwaukee too has been alive to the possibilities of a seaway for twenty years. It is far and away the best prepared community in the lakes from standpoints of business and understanding of what the seaway will mean to it. Milwaukee's modern port facilities and machinery can handle lifts up to 90 tons. Its port authority estimates it will develop at least a million tons of new highgrade cargo within 10 to 20 years following 1959. Between now and 1959 the city will spend some $4.7 million to deepen harbour slips, build a new pier and terminal and access highways and expand its harbour railroad system.

Milwaukee has confidence in its future as a lake port. But it recognizes many seaway problems cannot be solved by mere building of additional berths and shed capacity. It is the first lake port to have succeeded in establishing export rates as an inducement to use of the port by inland shippers.

Duluth, already one of the world's two busiest ports, is in excellent condition to tap the commerce and industry of the upper tier of midwest states. Seventy-five million tons of bulk cargo, including 80 per cent of the iron ore used in United States passes yearly through Duluth-Superior. Over a million tons of taconite ore were shipped from Minnesota ports last year. By 1971 mining engineers estimate 35 million tons yearly will be shipped. Though most of it will load at nearby Two Harbors, Duluth, which will also benefit, looks forward to a slow and steady growth of direct foreign commerce, though it does not expect an overnight boom.

Detroit and Cleveland, while not overlooking the possibilities of increased overseas commerce, point out that the deeper harbours and expanded port facilities would have strong appeal for chemical manufacturers, and for producers and consumers of bulk cargoes in search of cheaper transportation within the lakes areas. Detroit authorities foresee a yearly import-export commerce of some millions of tons after 1959. The port of Detroit, which handled 23 million tons of cargo last year, will remain Michigan's No. 1 port. Detroit does not claim to be ready for the seaway yet, but hopes private enterprise will provide the needed waterfront development. If not, the Port Commission will step in. The commission is now seriously considering a $20 million port development, to accommodate 30 to 40 ocean going vessels including slum clearance action on some 140 acres of sub-standard housing.

Cleveland also believes the greatest foreseeable benefit will be the development of commerce and industry in Ohio and other lake states. It has no port authority. Cleveland's port plans are progressing slowly. An independent engineering report last year estimated 1959 overseas traffic potential at over 2½ million tons. By 1970 more than 4½ million tons were predicted, of which a million tons would be general cargo. But the most ardent seaway boosters foresee not more than 200,000 tons of overseas cargo by 1959. Cleveland's total port traffic amounted to 15½ million tons in 1954, including 41,300 tons of general export-import cargo. Construction is proceeding on a new waterfront terminal and additional improvements are expected later.

Other upper-lake ports deserving of mention include Muskegon, with its large well-equipped terminal which handles nearly a million tons bulk cargo yearly; Escanaba with its natural harbour and 5 million tons of iron ore shipments per year; Manistique with a proposed harbour deepening project; and Bay City, Saginaw and Port Huron, all of which have plans for benefiting from the seaway.

Along the 1700 square mile area sitting along the southern shore of Lake Erie are other ports which will be regular ports of call for the heavier draft vessels, such as Erie, Ashtabula, Fairport, Conneaut, Toledo, Oswego and Buffalo.

Erie, Pennsylvania, like its larger competitors Cleveland and Buffalo, is looking forward to becoming a deep water port. During the decade up to 1953, Erie handled some 7 million tons of cargo yearly, all of it bulk, chiefly iron ore, coal and pulpwood. Port interests believe the city could generate a quarter of a million tons of traffic yearly and double that in 25 years.

Toledo expects nearly 60 million tons of traffic through its port by 1980, including 1½ million tons of general cargo. It is presently Ohio's largest port from the standpoint of tonnage, having handled more than 34 million tons in 1955.

Oswego has a good natural harbour and a nucleus of terminal and pier facilities adaptable to deep water shipping at modest expense. It has functioned as a port for more than 200 years. Its waterborne commerce amounted to over three million tons in 1953, of which two million tons of various commodities such as coal, grain, pig iron, cement, pulp and petroleum. It is formulating an active port development program and setting up an Oswego Port Authority.

Buffalo, long the seat of determined opposition to the seaway, has undergone a change of heart. It now visualizes the whole Niagara frontier as one of the chief beneficiaries of the deep waterway. Seaway traffic in exports of general cargo is expected to reach more than 667,000 tons by 1960. The port is expected to have a potential of 800,000 tons of coal in 1960 and a million tons a decade later, for shipment to Canada.

Canadian Pipeline Projects

With construction of Westcoast Transmission's pipeline from the Peace River and Northern B.C. areas well under way, as reported in our last issue, favourable weather conditions are permitting excellent progress on all sections of the project.

The British Columbia Public Utilities Commission has authorized Inland Natural Gas Company to distribute gas in 25 communities of the Cariboo, Okanagan Valley and West Kootenay areas. Authorization was also given this company to sell gas to the Prince George Gas Co., which will distribute the gas when approval is given by the municipality. Some $22 million will be spent by Inland Natural Gas between now and the fall of 1957. Orders have already been placed for some of the pipe.

Meantime, attention was focussed during the month of May on Parliament at Ottawa and the debates on the proposed legislation respecting the trans Canada pipeline. Here, observers saw history reversing itself. Arguments between government and opposition resembled those in the fight over the Canadian Pacific seventy five years ago.

But this time the parties were in different "corners" of the ring. Conservative opposition leader George Drew now assumed the role of liberal opposition leader in the "Eighties", Sir Richard Cartwright, who had predicted the C.P.R. 'would not earn enough to pay for axle grease'. If history should repeat, they predicted, Canadians some years hence would be indeed thankful for the pipeline.

Legislation authorizing an $80 million 5-per cent loan to Trans Canada, repayable by April 2, 1957, to enable it to build the 575-mile western leg of the line to Winnipeg during the coming summer, and for setting up a Crown company—The Northern Ontario Pipeline Co., to build from Winnipeg to North Bay, was finally passed by Parliament and Senate and received Royal Assent early in June. The company must complete the line to Winnipeg by December 1, 1955. Default on the loan would give the government the option of expropriating the company's assets.

In the course of the debates at Ottawa, the Hon. C. D. Howe expressed the hope that Trans Canada would be able to complete the 2200-mile pipeline in two construction seasons. It was necessary to get things moving, he observed, and so assure prospective customers they would have the Alberta gas they wanted. Contracts were coming along well, he reported, and already some 75 per cent of the sales contracts needed to enable Trans Canada to survive its debt were in sight. In other words the question of whether the line could be fully financed without export of gas to the United States was pretty well answered.

But this legislation, and the granting by the Board of Transport Commissioners of a permit on May 25, make it appear that Trans Canada Pipelines is not required to show capacity to finance any portion of the line beyond Winnipeg. However, it is evident the western leg alone cannot stand on its own feet unless joined with markets either in Canada's central provinces or in the United States.

Vast Construction Program will Result

An early start on the pipeline from Alberta to Winnipeg may touch off an expenditure of about $150 million this year in addition to Western Canada's estimated investment of some $680 million for exploration and development, land purchase, refineries, new construction and expansion of pipelines for oil and gas, along with scrubbing plants and other facilities which are definitely earmarked for 1956.

The start of Trans Canada's western leg will call for expenditures of some $118 million on the pipeline, gathering and distribution systems. The major portion will be the $80 million for the main line itself. Opinions vary as to the possible 1956 outlay for a drilling program, an expenditure of some $20 million being predicted in some quarters, while elsewhere the view is held that gas wells already drilled and capped are adequate for production during the early stages of the project.

Another king size project in Alberta to be commenced soon after a start on the western leg will be the Alberta Trunk Line Company's system, designed to gather and deliver gas to Trans Canada at the inlet 'gate' near the Alberta-Saskatchewan boundary. The estimated cost of this project alone is $47 million to be spent over three years, with some $23 million being required the first year.

Pipe Purchased Total $116 Million

Trans Canada announced the award in May of a $32 million contract with the South Durham Steel and Iron Co. Ltd., for 636 miles of 30-inch-diameter pipe for the northern Ontario section of the national gas line between Winnipeg and North Bay, Ontario. This is the British firm which is already supplying 30-inch pipe for the West Coast Transmission project. First deliveries will be made in a year's time with completion of the contract by July, 1959.

A further $45-million order for 878 miles of 30-inch pipe for this northern Ontario section to Toronto was placed at the end of May with the Welland Tube Company. This company, formed by Steel Co. of Canada and Page-Hersey Tubes, Ltd., is now building a new mill at Welland, Ontario, for the manufacture of seamless pipe in sizes up to 34 inches in diameter. The contract calls for delivery during 1957 and 1958. This is said to be the largest order for pipe ever placed with one supplier at one time.

These orders, which complete pipe requirements for the main pipeline from Alberta to Toronto, are in addition to the order placed last October by Trans Canada with the United States Steel Corporation for more than 200,000 tons of 34-inch pipe at a cost of $30 million for the western leg to Winnipeg. They are also in addition to the $9-million order placed last fall for 24-inch and 20-inch pipe for the extension of the Niagara Toronto line to carry a further 90 million cubic feet of gas daily to the Montreal and Ottawa-Hull market areas and cities and towns along the route.

Most of the pipe needed for gathering and distribution systems are of sizes that can be rolled in Canada. Already several pipe mill groups are preparing for filling these requirements. Alberta Phoenix Tube and Pipe Co. Ltd., recently completed a $6-million mill near Vancouver and another mill at Edmonton is being built by the company to produce 150,000 tons yearly in sizes from 3½ to 12¾ inch diameters. Hoesche Werke Aktiengesellschuft is putting up a $3 million mill at Regina for 3-inch to 20-inch pipe. Mannesmann Tube Co. is building a $20-million seamless pipe plant at Sault Ste. Marie to make smaller diameter pipe for feeder lines.

Bigger Market in Northern Ontario

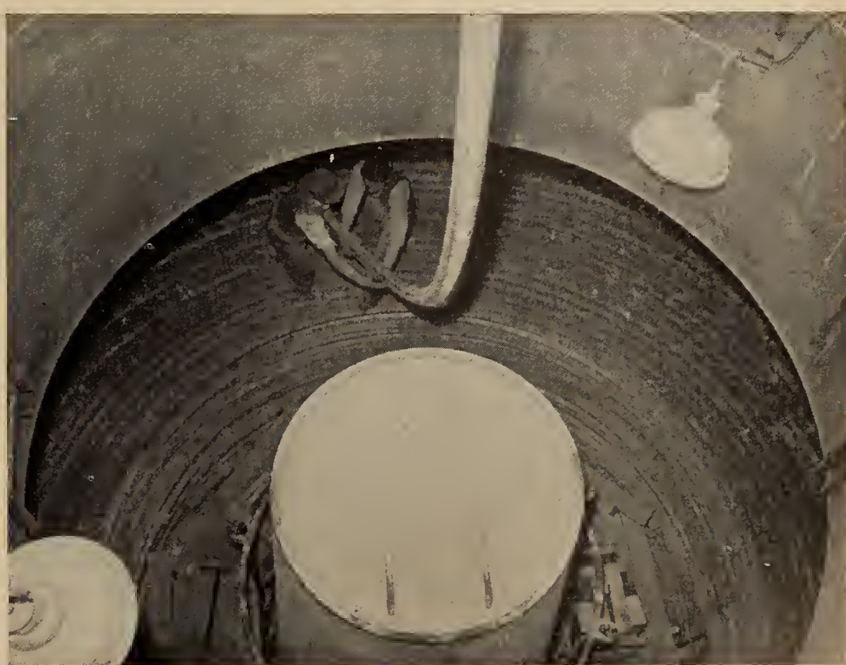
Meantime, the gas marketing outlook in northern Ontario is reported to be proving better than pipeline officials previously estimated. This is the area to be served by the 675-mile line from the Manitoba border to North Bay, the gap to be constructed by a federal-provincial Crown company.

Between Kenora and North Bay the outlook is for sales of 100 million cubic feet of gas daily in the third year of pipeline operation. Long term gas sales contracts have recently been concluded by Twin City Gas Co. with Fort William, Port Arthur and Sudbury. In May the Ontario Fuel Board will consider company applications to serve these areas.

Long term sales contracts are signed by Northern Natural Gas Company, with 21 municipalities between Hearst and North Bay, and Fuel Board "Letters of Convenience and Necessity" are granted to construct the facilities for service. Northern Natural Gas is also negotiating with Orillia, while Northern Ontario Gas and Consumers Gas are competing for the right to serve Barrie. Northern Ontario is also negotiating with Bracebridge, Gravenhurst and Huntsville.

Submarine Power Cable

This cable will link the high voltage supply system of the British Columbia Electric Company in Vancouver Island with the hydro electric resources on the mainland. Ninety miles of 138,000-volt gas-pressure type cable was manufactured at British Insulated Callender's Cables Limited, England, during the past two years. Loading started early in May on the cable ship "Ocean Layer" by means of a purpose-designed power operated gantry system.



Month to Month

News of the Institute and the Profession

COMMENT AND CORRESPONDENCE ELECTIONS AND TRANSFERS

Progress Report on Confederation

The Institute's Committee on Confederation presented an interesting progress report at the annual meeting in Montreal. First it was presented to the meeting of Council held on Tuesday, May 22, then in the afternoon of the same day, to the Branch Officers' Conference. On the following day it was brought before the annual business meeting of the Institute and on the day following that it was discussed at the first meeting of the new Council. On all these occasions the report was approved unanimously.

The chairman of the committee, Dr. Irving R. Tait, in response to the invitation from Dominion Council, was requested by Council to attend the annual meeting of that body to be held in Saskatoon, so there could be free and full discussion of the report and Confederation. This Dr. Tait agreed to do.

Dr. Tait reports that the discussion at Saskatoon brought out many expressions of opinion, but that no decision was made as to the report itself. It was agreed however that it should be submitted to each provincial association with the request that they study it and report back to Dominion Council.

There the matter rests for now. It is understood that the associations will give the report their early attention so that the minimum of delay will result.

It is of interest to note that the report is a joint one submitted by the special committee of the Dominion Council and the special committee of the Institute. Under these circumstances there is a reasonable prospect that it will be as well received by the councils of the associations as it was by the Council and members of the Institute.

There are twenty-three pages in the report, and as it is only an interim or progress report and as it has not yet had the approval of the associations, it is not proposed to print it in full in the *Journal.* However in view of the wide interest in the subject shown by members right across Canada, and at the suggestion of the chairman of the committee, an attempt will be made to summarize it.

Members are reminded that these proposals in many instances are compromises between the two committees, and are not final or as yet binding on anyone. It may well be that further study and further discussions will bring about changes in the present recommendations.

Also it should be kept in mind, that no undertaking on Confederation can be agreed to by the Council of the Institute until a final proposal has been submitted by ballot to every member of the Institute and has been received favourably.

Herewith is the summary.

It is recommended jointly by the committees that the functions of the national body be described as follows—

1—Perform the present work of Dominion Council.

2—Perform the present work of The Engineering Institute of Canada.

3—Provide a recognized voice for all professional engineers in Canada.

4—Promote and effect relations and activities with non-Canadian engineering bodies.

Membership

1. Engineers will be members of the national body by reason of their provincial registration.

2. All members of the national body will be eligible for membership in the branches of the national body for which there will be a separate fee. It is contemplated that branch membership may be voluntary unless the provincial body decides that in the best interests of that province it should be compulsory.

3. Provision will be made to take care of students, juniors, affiliates, etc.

Fees

In the report there are seven pages of figures compiled by the Institute's committee, which show that with a confederated set up and greatly increased membership substantial reductions can be made. It is expected that under the same circumstances, reductions can be made, at least by some of the provincial bodies. Therefore with these varying conditions no attempt can be made now to set down a specific fee for joint membership. It is safe to say however, that in the minds of the two committees, there should be really worthwhile reductions under Confederation. It is possible that the reduction in the Institute fee may be even greater than that now applying in those provinces where there is a co-operative agreement between the Institute and the Association.

Cover Picture

The cover picture is related to the paper "Cross Suspension System, Kemano-Kitimat Transmission Line" on page 901 of this issue.

It is a view, during the construction, from the northeast anchorage during pull to final closure. Towers on Twin Peaks are visible to right and Kemano Valley is in the centre.

Organization

The national body would be managed by a National Council made up of one member elected by each provincial body (10), one elected by members of the national body in each province (10), plus the immediate past-president, the president, the vice-president, a representative of affiliated technical societies and a treasurer.

The Council would meet three times a year and have their expenses paid.

There would be an Executive Committee made up of the president, vice-president, chairman of finance committee and three other members of the Council. They would meet not less than four times a year and their expenses would be paid.

Committees

There would be the following additional committees—

1. Affiliated Technical Societies.
2. Uniform Standards for Professional Registration.
3. Public Relations
4. Publications
5. Professional Status
6. Engineering Problems
7. House and Library
8. Honours and Awards
9. Ethical Review
10. The Engineer in Industry
11. Legislation
12. The Young Engineer
13. Finance
14. Nominations

It is hoped that this summary will put each and every member "in the picture". As details become settled the membership will be informed. It is expected that the president Vern A. McKillop will discuss the subject with the executive committees and the members of all the branches he visits during his term of office. The members may be assured that no decisions will be made without their support.

A Great Loss

The profession and the Engineering Institute lost a distinguished member in the recent death in Montreal of Roger DeLand French. He was known to engineers both old and young from coast to coast, and was held in high regard by them all. For forty years he was on the teaching staff of the engineering faculty of McGill University.

Professor French was never one to compromise with principles. He had an unusually alert mind, and usually was well informed not only on the things related to his teaching, but on the practical things of the world as well. This background made him a wonderful person to consult on a great variety of subjects. There was never any doubt as to where he stood on any question, and he did not hesitate to give expression to his convictions when it was useful to do so.

He was a strong character with fear of no one. His alert mind was served with a quick and clever tongue. On committee work he was a tower of strength to his associates. He never spoke unless he was informed on the subject, but he seemed always informed, and in a few short words he could sum up and dispose quickly of a discussion, to everyone's relief and satisfaction.

These qualifications made him unusually valuable to the Institute. Not many members know it, but for about fifteen years there has not been an issue of *The Engineering Journal* that has not been influenced in one way or another by Roger French. For that period of time he has been vice-chairman of the Publication Committee and has done a great variety of editorial work. He has written original articles, edited papers, and handled almost wholly by himself two of the best departments of the *Journal*.

It was he who month in and month out did the articles about *The Engineering Journal* titled "Thirty - Five Years Ago". It was he who read dozens of periodicals and books every month to produce the material for the "Abstracts" section.

It was characteristic of the man that he would have ready at the time of his death a whole series of twelve articles for "Thirty-Five Years Ago". These will be published over his initials throughout the next twelve months. It was part of this same characteristic that permitted him to have on hand at the Institute, enough Abstracts to carry on for several months.

In his latter years Professor French was seriously crippled with arthritis so much so that he could walk only with a cane and crutch, and yet this man almost never missed a meeting of the Publication Committee and never stopped using his typewriter. His conquest over his handicap, his resourcefulness and his will to work, made him outstanding in any company and endeared him to his many friends and associates.

The *Journal* will miss him terribly, not only will his copy never be available again, but his advice, his comments and his counsel are gone forever. The profession has lost a great man, the *Journal* a great contributor and those on the staff who knew him well, a great friend.

"I shall not look upon his like again."

An obituary of Professor French will be found on Page 942 of this issue.

Early Engineering

In some way not known to the present generation, the Engineering Institute of Canada some time ago came into possession of two original letters that are of considerable interest to engineers and historians. One is dated February 26, 1841, signed by George Stephenson, and is addressed to T. Gooch, Esq. The other is dated September 18, 1841, and is signed by Robert Stephenson. It is addressed to T. L. Gooch.

Here we have interesting and early communications from the man who invented the steam locomotive and from his son. From the context of the letters it would appear that Mr. Gooch had charge of the operations of the trains and their crews. Our research in the Institute library has indicated that at the time in question Mr. Gooch was joint principal engineer for the construction and operation of the Manchester and Leeds Railway.

It is interesting to note that in 1841 speeds of 26 to 28 miles an hour were not considered excessive. It seems hard to realize that they could have been running as high as 50 miles an hour, as complained of by Mr. George Stephenson.

These valuable documents have been in the Institute's possession for some time, but unfortunately the Institute has never developed any museum for such things or other means of taking proper care of them and for making them available to interested parties. Hence it was agreed at a recent meeting of Council that in appreciation of the hospitality extended by the Institution of Mechanical Engineers to the president of the Institute when he visited there in October of last year, these two letters be presented to the Institution.

Recently word has been received that the Council of the Institution of Mechanical Engineers will be happy to receive the letters which will be added to their outstanding collection of documents of all kinds relating to the two Stephensons, both pioneers in the field of mechanical engineering.

The letters read as follows:

Tapton House
February 26, 1841

My Dear Sir:—

I have drawn up a few observations about the Tunnel. Look it over and see if it will do to be attached to your report. Let Mr. Gile see it and if he can put in any better words about you let him interline it. I should advise you to cause the Locomotive Engineer to go slower, certainly not exceeding 26 or 28 miles per hour until the road gets consolidated. At the speed you are now running you will destroy both rails and engines. I believe I came along the other day at the rate of 50 miles per hour.

I am, my dear sir,
Yours truly,
(Signed—G. W. STEPHENSON)

T. GOOCH, Esq.

Westminster
18 September 1841

Dear Sir:

You will oblige me by permitting the Bearer, Mr. England, to inspect the Locomotive depot of the Manchester and Leeds Railway.

Yours sincerely,
(Signed—ROBT. STEPHENSON)

T. L. GOOCH, Esq.

The Institution of Mechanical Engineers has, since receiving and studying the original letters, referred the following information to Headquarters, which will be of further interest:

"Both these letters are, undoubtedly, addressed to T. L. Gooch, who was a contemporary of the Stephensons and is well known to us. Thomas Gooch, as he was known then, was appointed chief draughtsman under George Stephenson during the construction of the Liverpool and Manchester Railway. He became engineer to the Bolton and Leigh, and later to the Manchester and Leeds Railway. He was brother to Sir Daniel Gooch who became locomotive superintendent of the Great Western Railway, when he was only twenty-one, at the commencement of that line. Thomas Gooch made most of the drawings during the construction of the Liverpool and Manchester Railway, and was secretary to Stephenson.

"The address at the top of George's letter is Tapton House, which was a brick built mansion just outside Chesterfield where George Stephenson resided from 1837 until his death.

"You may possibly be aware that we have an excellent collection of original letters of George Stephenson housed in the Institution, most of which were presented by one of our past presidents, the late Colonel S. John Thompson, and we are indeed very happy to have these further additions which you have so kindly sent to us."

What Do You Expect Now?

This issue of the *Journal* has been prepared by a new and different printer, as some of you are now aware if you noticed the announcement in April "Month to Month". The different format for some of the section headings will also arouse suspicion that something queer has happened.

The change-over of printing establishment from Montreal to Toronto will obviously seem like a capital idea to many Ontario readers, but we hasten to assure you that neither geography nor politics had anything to do with it. Improved service and a better price were the objectives of the new contract.

It seems to some of us here in the editorial department that it should be a time for wiping clean of slates, and rededication of purposes, with maybe a search for some fresh ideas. But we must confess that with the arrival of summer our thoughts are liable to veer sharply toward golf, fishing, and the washing of new automobiles. This will never do.

On the serious side, we can hope that our new printing facilities will give us scope to produce a still better *Journal.* It should never remain static for very long—except in purpose. We will do our best, and members can help. Another readership survey will be launched in October. If one of the cards comes to you—please complete it and mail it back. But no one needs to wait for a survey card. Send us your suggestions now, and complaints too if you wish. These are life blood to a successful publication, and the Institute would never be satisfied with anything less.

Invitation to Banff

These Westerners came to Montreal for the annual meeting — the new councillor for the Calgary Branch W. A. Smith (left), and the Calgary past-councillor J. J. Hanna. They lost no opportunity to boost the 1957 annual meeting at Banff, June 12, 13, 14. Here they are shown at the Wednesday luncheon promising a Western welcome.

THIRTY-FIVE YEARS AGO

Comment on the Journal of July, 1921

During World War I Canada went into the production of ships in a relatively large way for a country so small in population and inexperienced in ship building. Its success was a little intoxicating and led a good many Canadians to think that their country was well on the way to regaining the place among the maritime nations of the world that it had held in the 50's, 60s and 70's of the last century.

It was only natural, then, that the two principal papers of the July, 1921, issue of the *Journal* should be concerned with ship building. One, by H. R. McClelland, A.M.E.I.C., dealt with the general design of ships, the other, by T. C. Phillips, M.E.I.C., with their propelling gear. Either paper would bring home to a 1956 reader how far we have come in only thirty-five years and how unsafe it is to venture on prophecy.

Mr. McClelland thought there would be no more luxury liners, like the *Aquitania* and the *Imperator*, for one reason, because "the use of aircraft may have developed to such an extent that the thoughts of transportation . . . then will be . . . (of) hangars rather than . . . of wharves and freight sheds." His speculation as to transocean air travel came true, but he did not foresee that there would still be a good many travellers who would prefer the comparative stability of a ship's deck to the more skittery aircraft.

Mr. Phillips' paper traced the development of marine propelling machinery from the slow speed, single cylinder steam engine, operating at 3 or 4 p.s.i., and driving a pair of clumsy paddle wheels, to the modern steam turbine with geared or electric drive. Incidentally, he noted that John Molson's *Accommodation* that made the trip between Montreal and Quebec in thirty-six hours, was the second steam driven vessel to be built in America; she had a 6 hp. engine.

The author's opinion of the diesel engine was to the point. He thought it would become a strong contender of the steam turbine, because of the small space it occupied and because of its high efficiency. Even in 1921 there were upwards of sixty vessels powered with diesels, one of which had been operating successfully for eight years.

Salaries Considered

The matter of salary scales for engineers was very much alive in 1921; it will never die. Not much had been heard of it in the *Journal* for some months, but this number published a report by a committee of the Halifax Branch which felt that its report ought to receive careful consideration by Council. It was a sensible document. In essence it said that no schedules, United States or Canadian, so far suggested were good enough to be adopted as official by the Institute.

The branch committee thought that there was too much variation in the classifications; that most of the schedules appeared to have been made up to suit local conditions; that there was not enough differentiation between positions bearing the same titles, but involving quite different duties and responsibilities; that there was generally little or no recognition of executive ability; and that intangible qualifications, like good judgment, personality and leadership were often not considered at all.

These were all important points, but trying to include every one of them in a schedule might well have led to the use of a sort of rating system like that so dear to some personnel people—a hundred points for ideal experience, another hundred for perfect personality and so on—rank and salary to be determined by the applicant's score on this basis. This scheme never works too well, except for preliminary purposes; the final choice of any employee, certainly in the "top brass", is usually based on reputation and all-around fitness for the job, generally determined mostly from personal interviews.

The first annual meeting of the new Cape Breton Branch, seven months old, was held in Sydney on May 26, 1921. The Institute's general secretary made a special trip from Montreal to attend and to talk to the branch about Institute affairs in general. He received a courteous and attentive hearing, but the real event of the day was the address of the branch's own retiring chairman.

He bore an Irish name, which probably accounted for some of the wit of his remarks, but some must also have come from his Nova Scotia environment — the dry, somewhat dour, matter of fact, inclined to be skeptical atmosphere we have learned to associate with the Maritimer. We need traits like these to keep our national character in balance, to stir the self-contented people of the central provinces out of their complacency and to offset the ebullience of the westerner.

Professional Recognition

The chairman's subject was the perennial one, professional recognition for the engineer and why he deserved it. His views were not so different from those which had already been expressed by many others, but his language was more positive and direct.

"Up to a few years ago there were only three professions . . . the doctor, the preacher and the lawyer. The doctor officiates at our entrance into this . . . world, the parson (tries to) to ensure our safe passage into the next and the lawyer, having read of the difficulties which a rich man encounters in his efforts to attain the celestial kingdom, does his best to remove any surplus wealth which we are in danger of accumulating . . .

"If the doctor mixes up the wrong decoction . . . and your widow has to cash in your life policy, the M.D. is always there with . . . (an) excuse . . . When the jury decides against you in a case you 'can't lose' . . . the lawyer is there with his story of miscarriage of justice . . . and a bill . . . which would make a plumber green with envy. If . . . you find that your road across . . . the mapless land leads in a direction opposite to that which you intended . . . you can't come back to argue the case, (but) you may rest assured that your spiritual adviser will not accept any of the blame for your misdirection.

"The fact is that the only certain profession is that of the engineer. If you build a bridge it must carry its load, if you lay a pipe line it must carry the water; . . . there is no getting by—your work is there to answer for itself. In the language of the day you must 'deliver the goods'

. . . The world today is . . . looking to the engineering profession to drag it out of the chaos with which it is threatened . . . A devotion of our best talents to the betterment of living conditions alone will obviate this and it is to the engineering profession that we must look for the solution of the questions which daily present themselves."

Thoughts of this kind were no doubt running in the minds of many in 1921 and still are in 1956—but it is seldom that anybody states them so frankly and in such positive language. Most of us keep them under our hats for fear of stirring up a row, something each succeeding generation seems more and more reluctant to do. R. DeL.F.

A.W.A. Meets Again

The Aviation Writers Association held their eighteenth annual meeting at San Francisco from May 27 to June 3. There were about three hundred including about twenty from Canada. The locale was the Mark Hopkins Hotel.

It is always surprising to find so many women writers at these meetings, and what is even more surprising is that there are about nine thousand women who have been licensed as pilots in the United States. Practically all the ladies attending this conference were licensed fliers, including some from Canada. It was an education to hear them discussing a plane or a flight, with the assurance and the vocabulary of the expert, which of course they are.

The new deadline for *Journal* copy made necessary by the arrangement with the new printer makes it impossible to get a complete report ready for the July issue. This then is just an introduction with more to follow in the August issue. It was a most noteworthy meeting and it is hoped that a more detailed account will interest many readers.

When it comes to packing a program, in all probability the first prize should go to the Aviation Writers' Association. They surely set themselves a task that none but the hardy, the enthusiastic and the dedicated could follow. Starting with a reception on Sunday night, the program plugged its way through a solid week of papers, speeches, plant visits, fly pasts, demonstrations, breakfasts, lunches and dinners, sufficient to make a full agenda for at least three conferences for any other organization.

In looking back over those seven hectic days it is difficult to straighten out one's thinking, and to know where and when certain newsworthy events took place, in addition to which it is difficult to determine which items should be included in a general statement and which should be featured later. Perhaps some pattern will emerge as we plough through the releases and photographs that were issued in gigantic quantities, and the notes made in the enthusiasm of the moment which at this later date seems to have lost some of their meaning and significance.

The Aviation Writers' Association annual meeting has many features not found in other meetings. One of the most noteworthy is that, in this instance at least, members were flown "for free" all the way to San Francisco and back, seven planeloads of them. Another helpful feature is that all meals—three a day for six days—are "sponsored" by various industries in the aviation field. As if this were not enough, other industries provide refreshments before every lunch and every dinner reminiscent of "Muriel's Room" hospitality at its best.

The program placed great emphasis on the armed services in the air. Trips were taken to distant air fields to see what the army could do, and the navy, and of course the air force. Top officers addressed the group to tell them not so much of their achievements but of their hopes and their problems (frequently political) that faced them in the achievement of these hopes.

It was surprising to the Canadians to hear so much about the troubles, the failures of top people at government level to see what should be done for and between the services. The comment was made frequently by Canadians and Americans, too, that if the administrative officials at Washington were as sensitive as the Minister of National Defence at Ottawa proved to be at last year's A.W.A. meeting in Toronto, all three services would be losing their senior officers. Nothing has happened yet so apparently the Secretary of Defense can take it better than can the Canadian minister.

The theme adopted by the U.S. Air Force seems to be "Peace through strength". Over and over again A.W.A. members had it impressed on them, that the great bases they were visiting, the great fleets they were seeing were there to deter other nations from going to war, and not to make war. One air base had over the door to the main building "A decade of security thru global air power 1946-1956".

Such a meeting surely brings home to Canadians the extent of the aviation and associated industries in the United States—with dozens of companies manufacturing all or parts of a plane, with three services requiring planes and with each service requiring a great variety of planes, the scene is quite confusing. Add to this, the constant change in basic requirement, the never-ending series of improvements and the increasing demand for more and better planes, and it is quickly evident that "confusing" is a modest word for it.

Impressive Organization

The organization of the United States forces was most impressive. They are surely not playing with the issues. They are well organized and equipped, and operate from permanent bases that should be efficient in their work and thoroughly acceptable to the men who work there. If Canadian service men could see these working conditions they would indeed be envious.

To a neighbor and an ally, it was a comfort and satisfaction to see the fine calibre of persons occupying the senior posts in all three services. From generals down they were an intelligent-looking lot of men, with uniforms of fine material and excellent fit, and pressed up to the n'th degree. It would seem that the Canadian forces could improve their appearance a great deal by observing what has been done to the south of us. What is more these U.S. officers not only looked like leaders but they acted like them, and their smart appearance was no small aid in bringing this to pass.

It was disappointing to a writer from a technical publication, to find so much of the program given over to the activities of the services. However, there were some technical papers given at breakfast, lunch or dinner and there was the visit to the Ames Aeronautical Laboratory of the National Aeronautical Research Establishment at Moffett Field. These all merit some mention in later issues of the *Journal.*

ATLANTIC PROVINCES MEETING OF PROFESSIONAL ENGINEERS

Sponsored by the Atlantic Provinces branches of the Engineering Institute of Canada and the Associations of Professional Engineers of Nova Scotia, Prince Edward Island, Newfoundland and New Brunswick.

SEPTEMBER 5, 6, 7, 1956

The Algonquin Hotel, St. Andrews-By-The-Sea, New Brunswick

THE PROGRAM

WEDNESDAY, SEPTEMBER 5

2.00 P.M. Meeting of Council

5.00 P.M. Informal dinner

THURSDAY, SEPTEMBER 6

10.00 A.M. Professional Sessions:

"High Voltage D-C Transmission"

E. V. Leipoldt, Vice-President, Shawinigan Engineering Limited.

"Sub-surface Foundation Exploration by the Seismic Method"

Emery Holzl, Chief Engineer, S.E.M. Prospecting Limited.

12.30 P.M. Opening Luncheon

2.00 P.M. Cruise on M.V. "Grand Manan" through proposed Passamaquoddy power project area.

7.30 P.M. Banquet

Speaker: Brian M. Colquhoun, Engineering Adviser to the International Bank for Reconstruction and Development.

FRIDAY, SEPTEMBER 7

10.00 A.M. Professional Sessions:

"Recently Developed Metallurgical Techniques as Applied to New Brunswick Minerals"

Dr. Marvin Udy, Consulting Engineer.

"Utilization of Nuclear Fuels for Power Production"

Dr. A. J. Mooradian, Superintendent of Engineering and Development, Atomic Energy of Canada.

1.00 P. M. Luncheon

Speakers: Mrs. T. P. Lusby, "The Role of the Engineers Wife".

2.30 P.M. Golf Tournament

7.30 P.M. Banquet

Speaker: Rt. Hon. C. D. Howe, Minister of Trade and Commerce of Canada. "The Professional Engineer and Expanding Economy".

10.30 P.M. Grand Ball.

SATURDAY, SEPTEMBER 8

9.30 A.M. Breakfast

TRANSPORTATION

Special 21-day return tickets are available from local agents. Delegates are encouraged to inquire at local C.P. agencies about the S.S. "Princess Helene".

HOTEL

The entire hotel is reserved, at rates of $12.00 and $14.00.

Reservations should be requested from:
J. B. Eldridge, M.E.I.C.,
P.O. Box 38, Saint John, N.B.

Mass Transportation in Cities

On 25th May the annual meeting proceedings included a panel discussion on traffic problems. A similar panel had proved highly successful the previous year; this year's discussion was a further development of the theme, and a most interesting one.

Chairman of the panel was George S. Mooney, director of the St. Lawrence Municipal Bureau, Montreal, and the panel members were: Col. H. S. Bingham, M.E.I.C., (retd.) late administrator, Board of Transportation, New York City; C. E. Campeau, M.E.I.C., City Planning Director, Montreal; W. E. P. Duncan, M.E.I.C., general manager, Toronto Transportation Commission; Arthur Duperron, M.E.I.C., chairman and general manager, Montreal Transportation Commission.

Mr. Duperron opened the discussion by stating City transportation generally had more than doubled over the last decade. He pointed out that Montreal's street traffic was almost paralyzed today, with speeds no better than fifty years ago. Montreal's population, he predicted, would double by 1981, while the number of vehicles using city streets would quadruple. The only solution lay in utilization of high speed mass transit, with free car parks at City approaches. Many more would use public transportation if faster service could be provided. Meantime buses would entirely replace trams within the next 5 years.

Mr. Campeau, explaining modern trends in City Transportation, said 60 per cent or more of those going to work daily rely on public transit, and this would be the case for the foreseeable future. Every device had to be used, he said, in order to save the centre areas of our cities. Only community planners had the means to co-ordinate the use of highways, expressways and city transit services. It was only common sense to make fullest use of the investment in transit services already provided.

Mr. Duncan emphasized that modern cities need every means of transportation, used at the right time and place. Buses occupy only a tenth of street space per passenger as do

(Continued on page 991)

The Junior Panel Discussion

Those who attended the junior panel discussion (some sixty members and visitors) obviously took a considerable interest in the subject "What can a young engineer do in developing professionally?", to judge from the lively open discussion and the many questions asked from the floor.

Co-chairmen of the panel were N. J. Viehmann, A.M. ASME, Jones and Lamson Machine Company, Springfield, Vt., and G. L. MacLean, Jr. E.I.C., Geocon Limited, Montreal. The members of the panel were: R. W. Honebrink, General Electric Company, Schenectady, N.Y.; W. R. Thompson, A.M. ASME, United Engineers and Constructors, Inc., Philadelphia; J. F. Harris, M.E.I.C., consulting engineer, Toronto; and Guy Savard, M.E.I.C., Canadian Liquid Air Company, Montreal.

Each of the panel members spoke of his experience in the field of professional development, and enlarged on the subject during subsequent discussion. Many contributions to the proceedings were made by members of the audience, who expressed their views and particular interest. Notably, Colonel L. F. Grant, the E.I.C. field secretary, outlined the professional development courses carried out by the various Branches.

Altogether this was a stimulating and valuable evening session, and a more detailed account of the proceedings will be published in a later issue of the Journal.

Seen during the junior panel discussion are (from left): Guy Savard, M.E.I.C.; J. F. Harris, M.E.I.C.; G. L. MacLean, Jr. E.I.C., co-chairman; N. J. Viehmann, A.M. ASME, co-chairman; W. R. Thompson. A. M. ASME; and H. W. Honebrink.

Events at the Annual Meeting

On these pages are further reports and scenes from the Annual Meeting.

The Annual Banquet

Top picture, from left: C. G. Kingsmill, M.E.I.C., chairman, Annual Meeting Committee; E. D. Brown, M.E.I.C., president, Mining Society of Nova Scotia; J. Hoogstraten, M.E.I.C., president, Association of Professional Engineers of Manitoba; Mrs. Olive S. Morrison; Georges Demers, M.E.I.C., president, Dominion Council of Professional Engineers; Mrs. H. G. Burchell; Colonel E. H. Webb, Canadian Army; Madame Leo Roy; A. J. C. Paine, M.E.I.C., president, Royal Architectural Institute of Canada; Mrs. E. D. Gray-Donald; Wing-Commander R. R. Hilton, Royal Canadian Air Force; Mrs. A. Turner Bone; J. G. Chenevert, M.E.I.C., president, Association of Consulting Engineers of Canada.

Mrs. O. B. Thornton; V. A. McKillop, M.E.I.C., president-elect, the Engineering Institute of Canada; Mrs. G. Ross Lord; J. A. McCrory, Hon. Member and past-vice-president, E.I.C.; Mrs. H. W. McKiel; Francis W. Gray, Hon. Member and past councillor, E.I.C.; Mrs. Thorndike Saville; M. D. Hooven, president, American Institute of Electrical Engineers, Mem. ASME; Msgr. I. Lussier, rector, University of Montreal; Lady Nelson; Joseph W. Barker, president, American Society of Mechanical Engineers; Dr. David L. Thomson, vice-principal, McGill University; R. E. Heartz, M.E.I.C., Hon. Mem. ASME, the President.

Sir George H. Nelson, president, Institution of Electrical Engineers; Mrs. R. E. Heartz; Dr. F. Cyril James, principal and vice-chancellor, McGill University; Mrs. V. A. McKillop; Dr. Thorndike Saville, president, Engineer's Council for Professional Development; H. Dolisie, Société des Ingénieurs Civils de France; A. R. Decary, past-president and HON. M.E.I.C.; Madame Georges Demers; H. W. McKiel, past-president and HON. M.E.I.C.; Mrs. J. Hoogstraten; C. E. Davies, HON. M.E.I.C., secretary, ASME; Mrs. Joseph W. Barker; R. Gaudry, president, Chemical Institute of Canada; Mrs. A. J. C. Paine.

Bottom picture, from left: O. B. Thornton, chairman, Executive Council, Canadian Chamber of Commerce; Mrs. E. D. Brown; J. S. Cameron, M.E.I.C., president, Canadian Standards Association; Madame J. G. Chenevert; A. Turner Bone, M.E.I.C., president, Canadian Construction Association; Capt. H. G. Burchell, M.E.I.C., Royal Canadian Navy; Mrs. C. G. Kingsmill; G. Ross Lord, M.E.I.C., chairman, Ontario Section ASME, past-president, Association of Professional Engineers of Ontario; Mrs. R. Gaudry; Leo Roy, M.E.I.C., president, Corporation of Professional Engineers of Quebec; Mrs. E. H. Webb; E. D. Gray-Donald, M.E.I.C., chairman, Montreal Branch, E.I.C.

The ASME Luncheon

At a luncheon held during the Annual Meeting under the auspices of the American Society of Mechanical Engineers, many members heard a vigorous address by ASME president Dr. J. W. Barker. Seen here are the guests at the head table.

Above, from upper left: G. M. Dick, vice-president-elect, E.I.C., Mem. ASME; M. A. Montgomery, vice-president, E.I.C.; C. W. Parsons, M.E.I.C., Mem. ASME; J. O. Martineau, vice-president, E.I.C.; R. L. Dunsmore, vice-president, E.I.C.; W. H. Byrne, vice-president, ASME; General the Hon. A. G. L. McNaughton, M.E.I.C., Hon. Mem. ASME; V. A. McKillop, president-elect, E.I.C.; Dean Thorndike Saville, president, Engineer's Council for Professional Development; Sir George Nelson; J. W. Barker, president, ASME.

Below, from upper left: R. E. Heartz, president, E.I.C., Hon. Mem. ASME; M. D. Hooven, president, American Institute of Electrical Engineers, Mem. ASME; Dr. Lillian M. Gilbreth, Hon. M.E.I.C., Hon. Mem. ASME; Professor A. G. Christie, M.E.I.C., Hon. Mem. ASME; Dr. D. F. Galloway; Dr. W. G. Van Note, Mem. ASME; T. H. Wickenden, Mem. ASME; H. R. Sills, vice-president-elect, E.I.C.; B. G. Ballard, vice-pres., E.I.C.; W. K. Brasher, secretary, Institution of Electrical Engineers.

In the chair at the luncheon was G. Ross Lord, M.E.I.C., chairman of the Ontario Section, ASME.

NEWS OF THE

Associations and Corporation

Information received through co-operation of the provincial organizations.

DOMINION COUNCIL

National Office for Dominion Council

A national office is to be established in Ottawa by the 30,000-member Dominion Council of Professional Engineers, it was announced at the annual meeting of the Council held at Saskatoon last week.

Durnin Elected President

The new president of the Council, which represents the 11 provincial engineering associations, including the Yukon, is *E. J. Durnin,* of Regina. He succeeds Georges P. Demers, of Quebec City. Other members of the Council's executive are: C. N. Murray, Sydney, N.S., vice president; Prof. W. O. Richmond, Vancouver, executive member; and J. Murray Muir, Toronto, secretary-treasurer.

Confederation Discussed

The meeting saw the circulation of a brief to all councils on the plan for unity which would provide a confederation of all engineering bodies in Canada. After consideration by them, the brief will be studied by the Dominion Council's special committee on unity for further action.

Other matters discussed at the three-day meeting included; consideration by each of the provincial associations of changes in their respective legislation; and the existing federal legislation governing the free entry into Canada of engineering plans from other countries.

E. J. Durnin, M.E.I.C.

Yukon Joins Council

Newest member of the Dominion Council is the Association of Professional Engineers of the Yukon Territory which was represented at the meeting by Lieut.-Col. M. C. Sutherland-Brown, Whitehorse, provisional vice-president.

Also attending as observers were officials of the two U.S. engineering bodies; L. R. Durkee, Seattle, Wash., vice-pres., National Society of Professional Engineers, and Bruce Williams, Joplin, Missouri, president of the National Council of State Boards of Engineering Examiners. Representatives of other technical societies in Canada were in attendance, including G. A. Blackburn, of Ottawa, who represented the Civil Service Commission.

It was announced that the 1957 meeting of the Dominion Council would be held in Nova Scotia. Actual meeting place will be announced at a later date.

QUEBEC

Pierre Bournival, M.E.I.C.

Sécretary-general of the Corporation of Professional Engineers of Quebec is Pierre Bournival, a Laval University graduate in geological engineering, class of 1948. The appointment was made early this year.

He joined the Quebec Roads Department shortly after graduation, working first as a soils engineer. In 1949 he headed a land surveying party on the mapping of rivers and lakes for the department.

Later in 1949 he accepted the appointment of assistant registrar of the Corporation of Professional Engineers of Quebec. He has since served as registrar and assistant general secretary.

He is a native of Shawinigan Falls, Que.

Results of the December, 1955 Salary Survey

In accordance with a practice established some years back, at the Corporation, a salary questionnaire was sent out to the membership in early January. Survey forms were forwarded to approximately 5,700 members and of this number 2,230 completed and returned their forms, thus providing the Remuneration Committee with a fair cross-section of the salary conditions prevailing as of December 1, 1955. The response indicated above represents 39% of the membership which is somewhat better than the 29% return achieved in 1953 but still below the 50% high recorded the year before.

Pierre Bournival, M.E.I.C.

The three charts which were printed in the March 1955 issue of the Bulletin have been reconstructed using the new salary survey figures; the results are presented herewith.

Although the curves are self-explanatory, some of their features are worth commenting upon:

1) Generally, engineers' salaries have been subjected to an upward pressure. It can be seen, for instance, that 50% of the members who responded were earning more than $6,700 per year as compared with $6,400 in 1954. As to the current year's graduates, their median income was $4,100 which compares with $3,900 in 1954.

2) This year again, the survey shows that administrative positions top the salary scale with supervisory functions and non-supervisory work following behind.

A complete tabulation of the results of the December 1955 survey will be made available upon request.

Abstracted from the Bulletin *of the Corporation, June 1956.*

ONTARIO

Russia's Bid

Much has been written regarding the educational program now being carried out in Russia to train engineers, scientists and technical workers. Some arresting facts and impressions of a well known Canadian industrialist, James S. Duncan, C.M.G., are presented in this issue. They are based on a recent and extensive tour of Russia and provide food for serious thought by the peoples of the Western World.

Western Appraisal

Western appraisal of Russian engineers and scientists of some twenty years ago was not very high. Today's reports suggest that the older ideas must be revised for it is evident that by 1955 the progress of technical education has left the entire Western world lagging behind. Mr. Duncan has emphasized the possible Western error of regarding the lower standards of living of the Russian people as signs of backwardness, and of the proneness to underestimate the power, drive and vitality of the U.S.S.R. He also underlines the real danger in cold war which springs not only from Russian Communism but from the ambitious, relentless, uncompromising and expansional policy of Russia's State Capitalism and a totalitarian government.

Discipline in Education

With the Russian education system we must remember that several generations have been brought up to accept the doctrine that the Russian leaders know best and that such is their sense of discipline that the policies of the leaders are accepted without question.

Little Ivan's dream to become a second Shostakovitch has nothing to do with his future. The powers that be will tell him what he has to do and, depending on his abilities he may become an engineer, a scientist, a technician or one of the many skilled laborers. Starting at the age of seven he goes to school, six days a week, and many more weeks in the year than his Canadian fellow being. He'll study mathematics, physics and chemistry whether he likes or not and when and if he is allowed to complete his higher education he will go to work where he is told.

Expansionist Dreams of Progress

We have had a number of years to consider the expansionist dreams of the U.S.S.R. and to witness the progress. We are becoming alarmingly aware of the part education is playing in this plan and are able to compare the Russian education system with others. We are fairly well convinced that we must not let down our own guard and must continue to match Russia's growing industrial and military strength with our own. We realize that much of our own well-being is dependant upon markets abroad and that the shadow of a determined competition is not imaginary. With all this before us it also might be wise to remember that it is much later than we thought.

Abstracted from The Professional Engineer, *May, 1956.*

OBITUARIES

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Roger DeLand French, M.E.I.C., retired professor of engineering at McGill University, died in Montreal on May 23, 1956.

Born at North Brookfield, Mass., on August 20, 1885, he was educated at Worcester Polytechnic Institute, earning a B.Sc. degree in 1905, and three years later the degree of civil engineer. After graduation he was for a time located in Louisville, Kentucky, where he was employed by the Commissioners of Sewerage, and later by the National Concrete Construction Company of that city.

Established in Canada in 1911, he became the principal assistant engineer with R. S. and W. S. Lea, consulting engineers of Montreal, and did work on water supply, sewage disposal, and various municipal projects for Montreal, Ottawa, Quebec, and other large cities. In 1917 he transferred his services to the consulting engineering firm of Arthur Surveyer and Company of Montreal, and continued this association for three years. Since his arrival in Canada he had carried on, with his other duties, as a lecturer on highway and municipal engineering at McGill. He was made professor in 1920. At that time he was also awarded the Gzowski Medal by the Engineering Institute for a paper on the design and construction of reinforced concrete covered reservoirs. He was awarded the King's Jubilee Medal in 1935.

Serving on the Lignite Board created by the Dominion government, Professor French was instrumental in devising methods of increasing the availability of Saskatchewan's low-grade coals as a domestic fuel. For three years he was a member of the Committee on the Fire Resistance of Roofing Materials of the Dominion Fire Prevention Association. For some time he was a member of the Metropolitan Town Planning Board of Montreal, and during World War II became a member of the Advisory Board Wartime Bureau of Technical Personnel.

At McGill University he held the duties of chairman of the engineering faculty's highway and municipal engineering section, and was secretary of the faculty for over twenty years. He was one of the eight members of the university's placement board. He retired from the university in 1951.

In addition to his many accomplishments Professor French was the author of numerous technical articles, and his facility with the written language was regularly called upon to provide some of the best material for the pages of this Journal.

A member of the American Society of Civil Engineers, he also belonged to the Canadian Institute on Sewage and Sanitation.

His greatest hobby was stamps — postage and revenue. It is stated that his collection of Canadian revenue stamps is the finest in existence. Not only was he among the foremost collectors of stamps but he was an expert consulted frequently by other collectors, estates and universities.

Professor French joined the Institute in 1913, as an Associate Member, became a Member in 1918, and was elected to Life Membership in 1948.

R. DeL. French, M.E.I.C.

Major James Henry Brace, M.E.I.C., president of Fraser-Brace Engineering Company Limited, Montreal, died on April 10, 1956, in Westmount, Que.

He was born in 1870 at Sheridan, N.Y., near Buffalo, but the family later settled in Lone Rock, near Madison, Wisconsin. He attended the University of Wisconsin and graduated in civil engineering, in 1892.

Major James H Brace, M.E.I.C.

For eleven years after graduation, Major Brace was mainly engaged in work on waterways and power schemes in the Great Lakes and upper St. Lawrence River areas. This work included projects for the Chicago Drainage Canal Authority; Chicago Park Commission; United States Board of Engineers on Deep Waterway; New York State Barge Canal Authority; and Michigan-Lake Superior Power Company, Sault Ste. Marie, Michigan. During these years, he worked on surveys, estimates, designs and construction projects for water supply and other municipal services, hydro-electric power developments and a deep waterway canal from the Great Lakes to the Atlantic Ocean.

Proceeding to New York City in 1903, he became assistant to Mr. Alfred Noble, who was the consulting engineer on the construction of the Pennsylvania railroad tunnels under the East River into Pennsylvania Station. On this project he was associated with Mr. Charles E. Fraser, and in 1908 they formed a partnership founding the construction firm of Fraser, Brace and Company. Three years later a third associate, Mr. George C. Clarke, joined as a partner in the company.

This was the commencement of a half-century of activity during which Major Brace, as vice-president, directed the construction activities of Fraser-Brace companies in both Canada and the United States. In this capacity, he was responsible for the construction of many important hydro-electric power developments and extensive industrial projects.

The hydro-electric developments constructed by Fraser-Brace under Major Brace's direction have a total installed capacity of over 2,000,000 h.p., which is approximately one-eighth of the total hydro-electric power developed in Canada up to 1954.

In addition to these electric projects Major Brace directed the construction of some of the largest chemical and metallurgical plants built in Canada. Some of these are as follows: more than fifty projects for the International Nickel Company of Canada Limited, in the Sudbury area of Ontario, numerous chemical and explosive plants for Canadian Industries Limited and the Du Pont Company of Canada Limited, for the manufacture of diversified chemicals and chemical products.

During the first and second world wars, Major Brace contributed all his time and energy to wartime projects. He supervised the construction of the Cedar Rapids power development for the Montreal Light, Heat and Power Company, from 1913 to 1917, and was instrumental in pushing through to completion this pioneer of Quebec's hydro-electric power industry in time to furnish the required power for a substantial portion of Quebec's industrial contribution to World War I.

In 1917 he joined the United States Army as a Major in the U.S. Engineers Corps. 4th Batt., 22nd Engineers, and served with them in France.

In World War II, at the age of seventy-five, Major Brace came out of semi-retirement and contributed unsparingly of his time and energy to supervise in both Canada and the United States many large construction projects having a total value of more than a half-billion dollars.

In the United States the projects supervised at this time by Major Brace, comprised many large ordnance works for the U.S. Government.

In Canada, during the same war period, Major Brace further extended himself to supervise the construction of some of Canada's largest ordnance plants for Defence Industries Limited—a wartime subsidiary of Canadian Industries Limited, including T-N-T cordite plant at Nobel, Ontario; a Cordite plant at Transcona, Man.; Hexachlorethane and P.D.X. plants at Shawinigan Falls, Que., and the first Canadian Atomic Energy plant at Chalk River, Ont.

In addition, under his general supervision, Fraser-Brace constructed several aluminum pot lines for the Aluminum Company of Canada at Shawinigan Falls, La Tuque and Arvida, Quebec, at a time when the production of aluminum had top priority on the allied wartime production program.

Another World War II project of considerable magnitude was United Shipyards Limited, where, in association with the late W. F. Angus, then president of Dominion Bridge Company Limited, Major Brace, as vice-president of United Shipyards Limited, headed up a wartime joint venture which constructed and operated at Montreal, one of the largest shipyards in Canada.

Following the retirement of Mr. Fraser, Major Brace was elected to the presidency of Fraser-Brace in 1946 and guided the affairs of the company during the following eight years.

He was a member of the Corporation of Professional Engineers of the Province of Quebec; A Life Member of the American Society of Civil Engineers of New York, and of the Western Society of Civil Engineers of Chicago.

Major Brace joined the Institute in 1916 as a member, and was elected to Life Membership in 1947.

Robert Wilson, M.E.I.C., general manager of the telephone contract division of the Northern Electric Company Limited, Montreal, since 1953, died on April 12, 1956.

Mr. Wilson was born in Clydebank, Scotland, on September 12, 1897. He attended Clydebank High School and Technical School and on graduation from the latter in 1915, joined the British Army, serving in France and Belgium. He was awarded the Distinguished Conduct Medal. After the war, in 1919, he enrolled at the Royal Technical College, Glasgow, as a student of engineering.

At the conclusion of his studies, in 1922, he moved to Canada. The following year he was taken on the staff of the Northern Electric Company Limited in the capacity of equipment draughtsman. Other positions held, over the years, were dial equipment engineer and supervisor, manual and toll equipment engineer, assistant chief equipment engineer, telephone engineer, chief engineer, installation superintendent, manager of engineering and installation, and acting sales manager of the company's communications equipment division. In 1952 he was named to the post of assistant manager of the telephone contract division.

Robert Wilson, M.E.I.C.

Mr. Wilson was a member of the Corporation of Professional Engineers of the Province of Quebec. He joined the Institute in 1943 as a Member.

George Skiffington Grimmer, M.E.I.C., of Chamcook, N.B., died in St. Stephen, N.B., on April 30, 1956.

Mr. Grimmer was born in St. Andrews, N.B., on Sept. 17, 1887. He attended St. Andrews Grammar School, and then studied at the University of New Brunswick, gaining degrees in 1910 and 1911, in both forestry and civil engineering. He won the City of Fredericton Gold Medal in these subjects.

Following a varied career in engineering, his first professional appointment was that of resident engineer in charge of construction, in 1911, with the Canadian Sardine Company in Chamcook. He was engaged in survey work between New Brunswick and Quebec in 1912. Later, in 1914 he decided to go into private practice as a land surveyor. Within the next few years he was concerned with the development of two large eastern plants. In 1918 he moved to the United States and until 1926, was responsible for a great deal of construction work in the city of New York. Appointed president of the Bachman-Veghte Company, fuel and building materials suppliers, the Fuel Oil and Supply Company and the Elizabeth, New Jersey coal exchange, he remained in the United States until 1953.

It was at this time that he returned to Canada to take up residence at Chamcook, for many years his summer home.

Mr. Grimmer was elected a Member of the Institute in February of this year.

Institute Honours and Awards

Presented at the Seventieth Annual General Meeting


President R. E. Heartz makes awards to J. A. McCrory and A. R. Deca

HONORARY MEMBERSHIPS

Five honorary memberships were awarded this year to distinguished members of the profession: Clarence Ebenezer Davies, M.E., D.ENG., secretary, The American Society of Mechanical Engineers, New York; Albert R. Decary, M.B.E., D.SC., formerly superintending engineer, Province of Quebec, Department of Public Works, Quebec; Francis William Gray, LL.D., formerly assistant general manager, Dominion Steel and Coal Corporation, Victoria; James Alexander McCrory, B.SC. (mechanical engineering), D.SC., engineering consultant, Shawinigan Engineering Company, Montreal; Harold Wilson McKiel, B.Sc., LL.D., vice-president, Mount Allison University, Sackville. Citations accompanying the awards were as follows.

Clarence Ebenezer Davies, HON.M.E.I.C.

Clarence Ebenezer Davies was born in Utica, N.Y., and graduated from the Rensselaer Polytechnic Institute with the degree of Mechanical Engineer in 1914.

Following graduation he entered the production department of the Smith Premier Works of the Remington Typewriter Company in Syracuse, N.Y. In 1917 he became an assistant production superintendent at the Frankford Arsenal of the United States Army and a year later was promoted to superintendent of its fuse shop. At the conclusion of the first world war Dr. Davies returned to the Remington Typewriter Company and shortly after became production superintendent at their Syracuse Works.

In 1920 he joined the staff of the American Society of Mechanical Engineers as associate editor. He has remained with that great organization ever since and has been its executive officer since 1931.

When the United States entered the second World War, he was called to the post of chief of the Control Division in the office of the Chief of Ordnance of the War Department in Washington, with a rank of colonel. For these services he was awarded the United States Legion of Merit.

Colonel Davies was one of the organizers and the first secretary of the Engineers' Council for Professional Development, of which our own Colonel L. F. Grant has been president for the past three years. For two years he was president of the Newcomen Society of England, the first and only person outside of England to hold this office.

He joined the Engineering Institute of Canada as a member in 1937, and is, as well, a fellow of his own society and of the American Association for the Advancement of Science, a member of the Institution of Mechanical Engineers, of the Society of Automotive Engineers, of the American Management Association, and a number if other organizations.

Colonel Davies was awarded honorary doctor of engineering degrees by Clarkson Institute of Technology in 1948 and by Drexel Institute of Technology in 1950.

Probably no other American engineer in our generation has done more to promote mutual understanding and practical working relationships among the engineering societies of the Western World, and particularly between The Engineering Institute of Canada and The American Society of Mechanical Engineers.

The characteristics that have made Clarence Davies a great secretary and a great servant of our profession are imagination, vision, perception, dynamic and persuasive leadership and the ability to plan and carry out great projects. He is a great secretary, a great friend and a great man.

Albert R. Decary, HON.M.E.I.C.

Albert R. Decary was born in Montreal, in eighteen hundred and seventy-five. He received his education at St. Mary's College in Montreal and at the Ecole Polytechnique in Montreal. He was with the Department of Public Works of Canada on hydrographic work on the St. Lawrence River, between Kingston and Quebec, from 1900 to 1905. At that date, he was appointed district engineer at Quebec, which office he held until 1913, when he became superintending engineer, having jurisdiction over the Province of Quebec.

He was intimately connected with all the important river and harbour works made by the Dominion Government since 1900, including the Champlain dry dock at Quebec, and the new Esquimalt dry dock in British Columbia; in connection with this latter undertaking, he was chairman of the board of engineers specially entrusted with the design and preparation of plans.

Dr. Decary joined The Engineering Institute of Canada in 1900. He was a councillor from 1914 to 1924, when he became vice-president. In 1925 he was elected president of the Institute.

When the Quebec Branch of the Institute was formed in 1907, Dr. Decary was among its principal promoters; he was a charter member and a member of the first executive committee, an officer of which he has remained ever since. He was chairman of the branch for eight years; in 1913 and from 1919 to 1925. Upon retiring from the chairmanship, the Quebec members made him their honorary chairman for life.

He was largely responsible for the establishing of the Corporation of Professional Engineers of Quebec. He was elected the first president in 1920, which office he held until 1938.

Dr. Decary is also a member of the Province of Quebec Association of Architects, a fellow of the Royal Architectural Institute of Canada, and holds membership in the Quebec Board of Trade, the Permanent International Association of Navigation Congresses, the Canadian Institute, the Quebec Geographic Society, the Canadian Forestry Association, the Canadian Club, the Quebec Garrison Club, the Engineers' Club of Montreal, the Quebec Golf Club, the Royal St. Lawrence Yacht Club of Montreal, the Quebec Yacht Club, the Cercle Universitaire Laval and the Cercle Universitaire Montreal.

In 1927 he was given the honorary degree of doctor of applied science by the University of Montreal and in 1949 the same degree from Laval University.

He was made a Member of the Order of the British Empire in 1943.

Francis William Gray, HON.M.E.I.C.

Francis William Gray was born in Yorkshire, England, and graduated from Sheffield University in 1899. He came to Canada in 1904, to work with our own past president, George Herrick Duggan. His professional and business life was spent entirely in the Cape Breton area with the Dominion Steel and Coal Company and its various affiliated enterprises. In 1928 he became assistant general manager of Dosco, a position which he held until his retirement in 1945. In some way or other during these busy years he managed to fill the posts of editor of the *Canadian Mining Journal* and *Iron and Steel of Canada* from 1919 to 1921. Like so many other wise men from the east, after retirement he moved to Canada's garden spot of Victoria, British Columbia.

Dr. Gray was an outstanding authority on mining coal under the sea. He introduced oxygen breathing apparatus for fire fighting in coal mines in Canada, and has served as consultant in both technical and labour boards in the West.

Dr. Gray has been active in several engineering organizations including the Engineering Institute of Canada. He has been president of the Canadian Institute of Mining and Metallurgy, and the Mining Society of Nova Scotia, and is an honorary member of the Association of Professional Engineers of Nova Scotia. He has been a member of the Institution of Mining Engineers of Great Britain for fifty-two years.

His character and achievements have been recognized formally by several organizations. Dalhousie University awarded him the honorary degree of doctor of laws, the Canadian Institute of Mining and Metallurgy their Barlow Medal and the Engineering Institute of Canada their Leonard Medal in 1923, and their Julian C. Smith Medal in 1940.

He joined the Engineering Institute of Canada in 1921 and served as councillor in 1942.

Dr. Gray is one of those rarer types, who successfully and respectfully live a double life. All through his workaday life he has been a patron and a producer in the field of the arts. He is distinguished as a painter, a sculptor and an author in both prose and verse.

He is the sort of fully developed man who so many people bemoan does not exist. He gives the lie to those uninformed and prejudiced persons who say the engineer has no culture.

We are grateful to him for this service to our profession. He is an ornament to our calling.


F. W. Gray


H. W. McKiel


C. E. Davies

James Alexander McCrory, HON.M.E.I.C.

James Alexander McCrory was born in Pittsburgh, Pa., and graduated from Pennsylvania State College in 1907 with a B.Sc. degree in mechanical engineering.

He came to Canada in 1910, joining the staff of the Shawinigan Water and Power Company as an assistant engineer. When the Shawinigan Engineering Company was formed in 1918, he was appointed office engineer, in which capacity he served until 1935, when he was made vice-president and chief engineer. He became president of the company in 1949 and chairman of the board of directors in 1951, continuing in the latter post until 1953, after which he served as engineering consultant until 1955, when he retired.

Mr. McCrory is probably best known for his contribution to the development of the great power resources of the St. Maurice River. In recognition of these services he was awarded the Julian C. Smith Medal of the Institute in 1950 and the honorary degree of doctor of science by McGill University.

Joining the Engineering Institute of Canada in 1921, Doctor McCrory served it for many years. He was chairman of the Montreal Branch in 1929 and a member of Council from 1930 to 1935. In 1937-1938 he was vice-president and chairman of the finance committee.

Doctor McCrory was president of the Corporation of Professional Engineers of the Province of Quebec in 1942.

Dr. McCrory is a conspicuous example of the all too few instances where Canada benefits greatly by the immigration of highly educated, intelligent men from our great neighbour. This is the sort of invasion which we like to encourage.

Harold Wilson McKiel, HON.M.E.I.C.

Harold Wilson McKiel was born in Gananoque, Ontario, and graduated from Queen's University, Kingston, with a B.A. degree in chemistry in 1908, after which he continued his studies to obtain a B.Sc. with honours in chemical engineering in 1912. In 1913 he was appointed professor of mechanical engineering at Mount Allison University. He held this position for seven years and served at the same time for most of the period as secretary and registrar of the faculty. In 1920 he was made Brookfield professor of engineering, becoming dean of the faculty in 1934. In 1949 he was appointed vice-president of the university.

Dean McKiel served in a consulting capacity with a number of prominent maritime industries for many years and also devoted considerable time to professional development and engineering education. He was given the honorary degree of doctor of laws by Mount Allison in 1943.

Doctor McKiel joined The Engineering Institute in 1919. He was made a Life Member in 1955. He served as a councillor in 1927, becoming vice-president in 1936-1937. In 1939 he was elected to the presidency of the Institute—the first to be chosen from the Maritime Provinces.

Doctor McKiel is a fellow of The Canadian Institute of Chemistry, having served as a councillor, chairman and vice-president of the Maritime Section. He is a past president of the Association of Professional Engineers of New Brunswick. For almost twenty years he was a member of the board of governors of the Nova Scotia Technical College at Halifax. He has been an active Rotarian throughout his life, and successively held the positions of district governor, Canadian director and vice-president of Rotary International.

It is fitting, Sir, that his betters and his equals in his calling here assembled should recognize his contributions to the profession by making him an honorary member of the Institute.

JULIAN C. SMITH MEDALS

Two awards were made this year: to Howard Kennedy, C.B.E., M.C., B.SC. (civil engineering), consulting engineer, Ottawa; and Adrien Pouliot, B.A.SC., C.E., M.SC., L.SC., LL.D., dean of the faculty of science, Laval University, Quebec. The citations are as follows:

Howard Kennedy, M.E.I.C.

Howard Kennedy was born in Dunrobin, Ontario. He was graduated in civil engineering from McGill in 1914; immediately he immersed himself in military affairs, a field in which he acquired great distinction, rising through two wars to the rank of major general, and being awarded the Military Cross, and in 1944 a C.B.E.

His professional career in civil life has been spent almost wholly with the forests and their products. He has been associated in a senior capacity with the E. B. Eddy Company, Quebec Forest Industries Association, Ontario Paper Company and the Quebec North Shore Paper Company. In 1946 he was appointed a one-man commission on forestry in Ontario, and in 1954 chairman of a Royal Commission on Forestry in Newfoundland. Also he was chairman of the Eastern Rockies Conservation Board.

General Kennedy has been a staunch supporter of institutions associated with his profession, such as The Engineering Institute of Canada, the Canadian Pulp and Paper Association, the Quebec-Ontario Industries Association, the Association of Forest Engineers, the Forest Insect Control Board, and the Canadian Forestry Association.

In military circles he has been active in the Military Engineers Association. He was made honorary colonel of the Fourth District Royal Canadian Engineers in 1945 and the Tenth Field Engineers Regiment in 1953.

His military record is a notable one. Starting in the first World War with the Canadian Engineers he went overseas with the rank of captain. In 1917 he received the Military Cross. At the outbreak of the second World War he went overseas again, this time with the rank of major in command of the Third Field Company of the Royal Canadian Engineers.

In 1941 he returned to Canada to take charge of training schedules, and methods of officer selection for the Royal Canadian Engineers. He occupied successively the posts of general staff officer in charge of trades training, adjutant general, and quartermaster general.

In 1953 he was recalled to the army to serve as chairman of a board of enquiry into conditions in the reserve army.

He joined The Engineering Institute in 1921, and in 1956 attained life membership. In 1946 he served as chairman of the Institute's Rehabilitation Committee for Armed Forces Personnel.

Howard Kennedy

Adrien Pouliot

Morris Katz

Adrien Pouliot, M.E.I.C.

Adrien Pouliot was born at Saint-Jean, Island of Orleans, Que. He received his B.A. degree from Laval University in 1915, and his B.A.Sc. degree from Ecole Polytechnique in 1919. In 1928 he obtained both his M.A. degree from Laval and his L.sc. from Sorbonne in Paris; the following year undertaking postgraduate study at the University of Chicago. Dr. Pouliot also holds an LL.D. of the University of Ottawa, an honorary D.Sc. of the University of Montreal, doctorates d'honneurs of the University of Poitiers and Rennes, France, honorary doctorate in philosophy of Milan, Italy, and a doctorate in letters of St. Joseph's University, Moncton.

In 1919 Dr. Pouliot was employed on the engineering staff of the Department of Public Works in Quebec, and at the same time lectured in mathematics at Laval, becoming professor of mathematics in 1928. Ten years later he was appointed secretary of the faculty of science. In 1940 he was named dean of the faculty of science, serving as director of the department of mathematics until 1950, and since then as director of the department of civil engineering.

He was appointed vice-chairman of the board of governors of the Canadian Broadcasting Corporation in 1955, having served as a member of the board since 1939. He is a past-president of the French-Canadian Association for the Advancement of Sciences, of the National Congress of Mathematicians, the Quebec Society of Mathematicians, and the Corporation of Professional Engineers of Quebec, of the Graduates of Ecole Polytechnique, of the Conseil de la Vie Francaise en Amerique and of the Societe du Parler Francais au Canada. He served as vice-president of the Canadian Committee on the Council of Reconstruction, through UNESCO, in 1948. He is an honorary and life member of the Engineer Doctors of France, and a member of the Scientific Research of Quebec; the Mathematicians Society of France, member of the Societe des Ingenieurs Civils de France, the American Mathematical Society, the American Association for the Advancement of Science, the Mathematicians Association of America, and the Canadian Institute of Mining and Metallurgy.

He is a Knight of the Legion of Honour, a Commander of Saint Gregory the Great, a Knight of the Latin Order, Officer of the Academy and Laureate of the Academie Francaise. He has also received the Medal of Honour from the Universities of Turin, Brussels and Liege and from the City of Dieppe and the Medal Archambeau for 1955 from the ACFAS.

He joined the Engineering Institute of Canada as a Member in 1942.

DUGGAN MEDAL AND PRIZE

The Duggan Medal and Prize, awarded for papers dealing with the use of metals for structural or mechanical purposes, was awarded to three authors of the paper "Fatigue Life of Steel I-Beams at Normal and Sub-zero Temperatures". They are Julien Dubuc, B.A.SC., C.E., M.A.SC., JR.E.I.C., associate professor, Ecole Polytechnique, Montreal; Thomas A. Monti, B.SC.A., D.SC.A., M.E.I.C., consulting engineer, Montreal; and Georges A. Welter, B.A.S.C., D.ENG., M.E.I.C., professor of applied mechanics, Ecole Polytechnique, Montreal. This paper was published in *The Engineering Journal May, 1955 issue.*

Julien Dubuc, JR.E.I.C.

Professor Julien Dubuc was born in Quebec, Canada, and received his engineering degree in 1947 from Ecole Polytechnique of Montreal, where he became assistant in the strength of materials laboratory.

He received his master of science degree in 1949, and for the next two years he carried on postgraduate studies at the Federal Polytechnic Institute in Zurich, Switzerland.

He is now associate professor at Ecole Polytechnique in Montreal.

Mr. Dubuc joined The Engineering Institute as a Student in 1944, transferring to Junior in 1949.

T. A. Monti, M.E.I.C.

Dr. T. A. Monti is a past chairman of the Junior Section of the Montreal Branch of the Engineering Institute, and a former member of the executive of the Branch. He has also been a vice-president of the Corporation of Professional Engineers of Quebec.

His engineering degrees were gained from Ecole Polytechnique, Montreal — B.A.Sc. in civil engineering in 1941, and D.A.Sc., in 1947 with specialization in strength of materials. He has earlier been awarded Institute prizes—the Ernest Marceau Prize in 1941 and the Keefer Medal in 1951.

Dr. Monti was employed by the Dominion Bridge Company, Lachine, from 1941 to 1943, as a steel structures and bridge engineer. During his doctorate studies, 1943 to 1947, he worked as a consulting engineer. Completing his studies, he joined the National Research Council staff as a regional representative, and in 1949 became district engineer for the Canadian Institute of Steel Construction for Quebec and the Maritimes. Since 1952 he has practised as a consulting engineer in Montreal, in the firm Letendre, Monti and Associates.

Dr. Monti joined the Engineering Institute in 1938 as a Student, transferring to Junior in 1946, and to Member in 1949.

Georges Welter, M.E.I.C.

Dr. Georges Welter studied engineering at the University of Charlottenburg, Berlin, Germany, receiving a B.A.Sc. degree in mechanical engineering and metallurgy in 1914, and that of D.Eng. in 1916. He was born in Luxembourg.

From 1918 to 1931 Dr. Welter performed research work on Light, Ultra-Light and Antifriction-Alloys at the research laboratories of the Metallgesellschaft at Francfort on Main. He was chief of the mechanical and technological departments of these laboratories.

He became a professor at the faculty of chemistry and metallurgy, in the Polytechnical Institute of Warsaw, Poland, working there from 1931 until 1939. During this time he also organized a new governmental institute for metallurgy and scientific research work at Warsaw. He was made a vice-director of the Institute of Metallurgy and Metallography.

In 1941 he joined the staff of Ecole Polytechnique, Montreal as professor of strength of materials and head of the metallographical and mechanical testing laboratories. Here much research work was done for the National Research Council and at the request of such agencies as the Carnegie Corporation, the British Air Ministry, the Department of Mines of Quebec, the Defence Research Board, the Welding Research Council and others. Results of this research have been compiled and in many cases published.

Altogether since 1920, over a hundred scientific publications have been contributed by Dr. Welter to English, French and American technical periodicals.

THE LEONARD MEDAL —

The Leonard Medal, awarded for papers on mining subjects submitted either to the Canadian Institute of Mining and Metallurgy or to The Engineering Institute of Canada, was presented to Franc R. Joubin, B.A.SC., M.A., M.C.I.M, for his paper "Uranium Deposits of the Algoma District".

Franc R. Joubin, M.C.I.M.

Francis (Franc) R. Joubin was born in San Francisco, California, in 1911 and was brought to Canada in 1912. He became a naturalized Canadian in 1918.

Receiving his early education in Victoria, he studied also at the University of British Columbia, obtaining a B.A. degree, majoring in chemistry (1936) and an M.A., majoring in geology (1942).

He has worked in the field of geological exploration throughout Canada and in several Central American countries. He has written and lectured widely on Canadian exploration methods for technical journals and societies in Canada and abroad. Among his better known works is the paper entitled "Modern Methods of Mineral Exploration in Canada" prepared by him at the request of the Canadian Institute of Mining and Metallurgy for presentation to the Fourth Empire Geological Congress (Oxford, 1949), his contributions to the "Structural Symposium on Canadian Ore Deposits"; and his several recent papers including that on "Uranium Deposits of the Algoma District, Ontario", presented through the American Geological Institute to the Nuclear Engineering and Science Congress in Cleveland in December, 1955.

It was in 1948 that Mr. Joubin turned his attention to exploration for uranium deposits. Under his leadership a small group of geologists, engineers and metallurgists have discovered, developed and have readied for production at least eight uranium mines in the Beaverlodge district of Saskatchewan, in British Columbia and in the Algoma District of Ontario. The developments in the Algoma field directed by Mr. Joubin will establish Canada as a world leader in the production of uranium.

Mr. Joubin has been generous with his service to professional societies of which he is a member, acting on committees and presenting technical papers. The associations to which he gives his support are the Canadian Institute of Mining and Metallurgy (member of the committee on applied field geology and member of the executive of the Toronto Branch); the American Institute of Mining and Metallurgical Engineers, the Geological Society of Canada, and the Associations

Franc R. Joubin

of Professional Engineers of British Columbia and Ontario.

He has served until recently as managing director of Pronto Uranium Mines, Rix Athabasca Uranium Mines, Rexspar Uranium Mines, Lake Nordic Uranium Mines, Spanish American Uranium Mines; as a director of Preston East Dome Mines and as president and managing director of Algoma Uranium Mines.

PLUMMER MEDAL

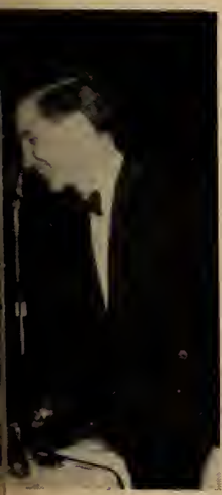
The Plummer Medal, for papers on chemical and metallurgical subjects, is awarded this year to Morris Katz, B.SC., M.SC., PH.D., M.E.I.C., consultant on Atmospheric Pollution; chairman, Technical Advisory Board on Air Pollution, Department of Health and Welfare, Ottawa. His paper "The Nature, Distribution and Dispersion of Contaminants in the Urban Environment" was published in the April, 1955 issue of *The Engineering Journal*.

Morris Katz, M.E.I.C.

Dr. Morris Katz is a graduate of McGill University with the degrees of B.Sc. in chemical engineering, 1926, M.Sc. in 1927 and Ph.D. in 1929; with early specialization in organic and biological chemistry and later in physical chemistry. While at McGill he also served as a demonstrator in various branches of chemistry.

Late in 1929, he was called in to investigate the international problem of smelter fumes at Trail, B.C.; in 1931 he returned to Ottawa as a member of the research staff, Chemistry Division, National Research Council. In 1934, there was another flare-up of the fume problem at Trail, and he was appointed officer-in-charge of field and experimental work on the effects of sulphur dioxide on vegetation, soil and water supplies and other aspects of the problem. This research was completed in 1937.

Julien Dubuc



Thomas Monti

Georges Welter

In 1939, the National Research Council published a book entitled, "Effects of Sulphur Dioxide on Vegetation", based on the experimental and scientific investigations of Dr. Katz and his co-workers at Trail and Summerland. This book is considered a classic in its field and is still widely used.

During World War II, as consultant to the Directorate of Chemical Warfare, he undertook the development of more effective catalysts for the oxidation of carbon monoxide, in addition to respirator and personnel protection problems. When the chemical warfare studies were transferred to the Defence Research Board in 1947, Dr. Katz was taken on staff of the Board as a research scientist and occupied this position until joining the Department of National Health and Welfare in January 1956, as consultant on atmospheric pollution. He holds world patent rights on a new type of oxidation catalyst and has perfected an improved type of carbon monoxide indicator.

Since 1949, Dr. Katz has been chairman of the Canadian Section of the Technical Advisory Board on Air Pollution, International Joint Commission, and in this connection he has been in charge of all field and experimental work relating to the Canadian part of the International Detroit-Windsor air pollution problem.

Dr. Katz is the author of about seventy-five scientific papers in the fields of high polymers, kinetics of heterogeneous reactions, catalysis, toxic gases and their effects on plants, measurement, identification and control of atmospheric pollution.

ROSS MEDAL

The Ross Medal is awarded for papers on electrical engineering subjects. George William Holbrook, B.SC., M.SC., M.E.I.C., head of the department of electrical engineering, Royal Military College of Canada, Kingston, won this award for his paper "Design of a Wide Audio Band", which was published in the November, 1955 issue of *The Engineering Journal.*

George William Holbrook, M.E.I.C.

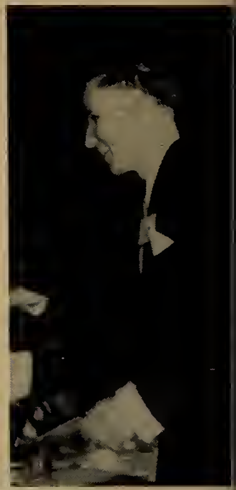
Prof. Holbrook is originally from Asquith, Saskatchewan. He studied at the University School in Hastings, Sussex, England, and at London University (Woolwich Polytechnic), receiving the Woolwich engineering diploma, and a B.Sc. degree in electrical engineering in 1938. In 1948 and 1949 he studied at Queen's University, Kingston, after which he obtained the degree of M.Sc. in electrical engineering.

His professional training and experience began in London, England, with four years as an accredited engineering student with Standard Telephones and Cables, and one as a laboratory engineer in the transmission laboratory of the company.

He became a signals officer in the Armoured and Airborne formations, for the British Army (Royal Signals) in 1939, retiring in 1946 with the rank of major. He transferred to the Canadian Army in 1946, and serving in the Royal Canadian Signals, was chief instructor at the Royal Canadian School of Signals, and head of the department of electrical engineering, Royal Military College of Canada. He retired with the rank of lieutenant colonel in 1951.

H. J. Saaltink

G. W. Holbrook



R. R. Real

Since 1951 he has been a Civil Service professor and head of the department of electrical engineering, R.M.C.

Prof. Holbrook has completed many research and development projects during this time, as well as the one on which his prize-winning paper was based. Some of the subjects were resistance capacitance oscillators, speech scrambling system, harmonic measuring set.

He is an associate member of the Institution of Electrical Engineers, and a member of the Association of Professional Engineers of Ontario. Among his present publications are papers on "Variable Gain Amplifier", published in *Electronics;* and "High Frequency R.C. Oscillator", *Electronic Engineering,* Vol. 25.

JOHN GALBRAITH PRIZE

The John Galbraith Prize is awarded for the best paper by a Junior in the Province of Ontario. It was won by Hendrik Jan Saaltink, JR.E.I.C., engineer, hydraulic Department, H. G. Acres and Company, Niagara Falls, Ont., for his paper "In the Wake of Hurricane Hazel" written in collaboration with R. L. Clinch and published in the August, 1955 issue of *The Engineering Journal.*

Hendrik Jan Saaltink, JR.E.I.C.

H. J. Saaltink was born in Semarang in the Dutch East Indies in 1923, and received his early schooling and secondary education alternately in the Netherlands and in the Dutch East Indies.

From 1941 to 1950, he served in the Engineering Corps of the Royal Dutch East Indies Army in the Pacific, lastly with the rank of first lieutenant. In 1952 he received his degree in civil engineering from the Technological University in Delft, The Netherlands.

Upon his arrival in Canada in May 1952, he joined the staff of H. G. Acres and Company Limited, consulting engineers, and has since been engaged in various phases of engineering, mainly in connection with hydro-electric developments.

He is a member of the Association of Professional engineers of Ontario.

PHELPS JOHNSON PRIZE

The Phelps Johnson Prize is awarded for the best paper by an English Junior in the Province of Quebec. Roderick Roy Real, B.ENG., JR.E.I.C., is awarded this prize for a paper "Over the Hill and Line of Sight", which is a treatise on the propagation of electromagnetic waves from radio to microwave frequencies.

Roderick Roy Real, JR.E.I.C.

Mr. Real is an electrical engineering graduate of the University of Saskatchewan, class of 1953, with the degree of B.Sc. in electrical engineering. At present he is one of seven engaged in graduate studies in communications, leading to the degree of M.E., electrical engineering, at McGill University.

He was earlier for two and one-half years in the power cable testing and design division of Northern Electric Co. Ltd., Lachine, Que.

His graduate studies will extend to May, 1957. He has been on the electrical engineering staff of McGill as a laboratory demonstrator for the 1955-1956 session, and this will be repeated in the next session. He is also the recipient of a National Research Council grant for his research project. This is one of a series of noise and acoustics problems, of concern to industry, being conducted by Dr. F. S. Howes, professor of electrical engineering at McGill.

In addition to his association with The Engineering Institute, Mr. Real is a student member of the Institute of Radio Engineers, and is associated with the Society of Sigma Xi, for the promotion of research in the sciences in North America.

Personals

News of the Personal Activities of Members of the Institute.

T. Ingledow, M.E.I.C., president of the B.C. Engineering Company Limited, in Vancouver, has been awarded an honorary degree from the University of British Columbia.

A native of Cumberland, England, and a graduate of the University of Glasgow, he was named president of B.C. Engineering Company Limited in 1954, at the same time holding the appointment of vice-president and executive engineer with B.C. Electric Company Limited.

B. G. Ballard, O.B.E., M.E.I.C., vice-president (scientific) of the National Research Council of Canada and director of its division of radio and electrical engineering, recently received the degree of doctor of science from Queen's University, Kingston, Ont.

Dr. Ballard was born in 1902 at Fort Stewart, Ontario, and graduated from Queen's University in 1924. Following a Westinghouse graduate course in electrical engineering in 1924-25, he joined the staff of the Westinghouse Electric and Manufacturing Company, East Pittsburg, Pa.

In 1930 he was appointed to the National Research Council of Physics, and

B. G. Ballard, M.E.I.C.

throughout the following ten years built up the electrical engineering section of that Division.

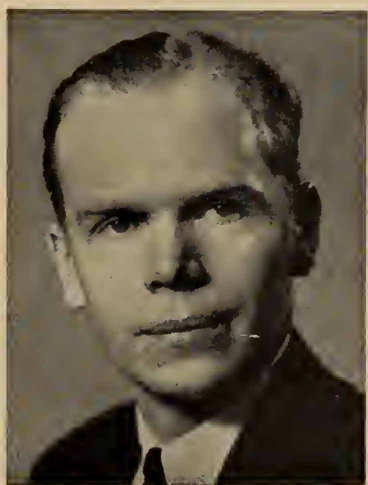
For his wartime efforts, which included the development of mine sweepers and other means of protecting ships against enemy magnetic mines, Dr. Ballard was awarded the Order of the British Empire.

In 1946 he was named assistant director of the division of physics and electrical engineering, and in 1948, a full division of radio and electrical engineering was established, with Dr. Ballard as director. He was named vice-president in 1954.

R. A. Emerson, M.E.I.C., vice-president of operations and maintenance with Canadian Pacific Railways, has been elected treasurer of The Engineering Institute.

From Manitoba originally, Mr. Emerson received his schooling at Morden and then went on to engineering studies at the University of Manitoba from which he graduated in 1930. Three years later he was honoured in being chosen a Strathcona Memorial Fellow and in the term 1933-34, carried on further work at Yale University.

Mr. Emerson's association with Canadian Pacific Railway dates back to 1935. His first appointment with the company was at Revelstoke, B.C. He spent the next nine years in various railway positions across the Prairie Provinces, and in 1944, then a division engineer, he received an appointment to Vancouver as assistant district engineer. Within a short



R. A. Emerson, M.E.I.C.

time he was district engineer for British Columbia.

In 1948, named to take over the system office of the engineer of track in Montreal, he left Western Canada and has remained in the eastern city to the present time, rising in three years to the position of chief engineer of the company. He received his most recent appointment in 1955.

Mr. Emerson is a member of the Corporation of Professional Engineers of Quebec and the American Railway Engineering Association.

C. K. McLeod, M.E.I.C. Following the annual meeting of Walter Kidde and Company of Canada Limited, it was announced that C. K. McLeod had been elected president. Mr. John F. Kidde remains as a director. Mr. McLeod has

C. K. McLeod, M.E.I.C.

been associated with the company for thirty years, and has been the managing director for the last sixteen.

Karl Ewart Whitman, M.E.I.C., consulting engineer of Halifax, N.S., was awarded an honorary degree of doctor of engineering at the annual convocation of the Nova Scotia Technical College held recently.

Mr. Whitman is a native of Advocate Harbor, N.S., and a graduate in civil engineering from the Nova Scotia Technical College, class of 1914.

He returned to Nova Scotia in 1923, having worked in other parts of Canada, and it is in this province that most of his engineering work has been done. He was, at first, associated with the Avon River Power Company, and later, in 1925 and 1926, was assistant professor of civil engineering at the Nova Scotia Technical College. In the succeeding twenty years, he did a great deal of work with the Department of Highways of Nova Scotia, the Avon River Power Company, and the Nova Scotia Power Commission. Since 1947 he has been in private practice. Over a period of thirty years Mr. Whitman has been concerned with the structural or hydraulic design of most of the hydro-electric developments.

K. E. Whitman, M.E.I.C.

A member of the Association of Professional Engineers of Nova Scotia, he is also a member of the American Society of Civil Engineers, the American Concrete Institute and the Association of Consulting Engineers of Canada.

T. M. Parr, AFFIL. E.I.C., of Canadian Ingersoll-Rand Company Limited, Toronto, has been appointed manager of the firm's central region, responsible for the operation of branches at Toronto, Kirkland Lake, Timmins, Sudbury and Winnipeg. Geographically the central region covers Manitoba, Northern and Western Ontario, the mining area of North Western Quebec and Southern and Central Ontario as far east as Kingston.

Born in Morden, Manitoba, Mr. Parr was educated at St. John's College Winnipeg, and the University of Manitoba. After a few years service with the Canadian National Railways in Western Canada, he joined Canadian Ingersoll-Rand Company Limited in 1927 and on completion of a training course at Sherbrooke, Que., was transferred to head office in Montreal, working in the compressor, pulp and paper and general sales divisions. In 1928 he joined the sales force at Toronto, specializing in industrial and construction sales work. During the next three years Mr. Parr handled mining, construction, railway and industrial sales at Kirkland Lake, Winnipeg and Calgary.

In 1931, Mr. Parr returned to Toronto and, after gaining broad experience in mining, construction, petroleum and various industrial fields, he succeeded the late G. R. Southee as branch manager in 1940. In 1951 he was appointed regional manager, Toronto.

Mr. Parr is a member of the Canadian Gas Association, Canadian Institute of Sewage and Sanitation, American Water Works Association, Canadian Section, and a past chairman of the Toronto Branch of the Canadian Institute of Mining and Metallurgy.

For information about appointment of three regional managers of the company see "Business and Industrial Briefs."

Dr. Harold W. McKiel, M.E.I.C. Among those receiving an honorary degree in 1956 convocation exercises in Canada this spring was Dr. Harold W. McKiel, vice-president of Mount Allison University, Sackville, N.B. He was awarded the degree of honorary doctor of engineering at graduation exercises held recently at Nova Scotia Technical College, Halifax, N.S.

Dr. Charles A. Robb, M.E.I.C., Montreal consulting engineer and retired professor of mechanical engineering at McGill University was recently awarded an honorary degree from Mount Allison University, Sackville, N.B.

A graduate of McGill University, the Massachussetts Institute of Technology, and John Hopkins University, he was

Dr. Charles A. Robb, M.E.I.C.

professor of mechanical engineering and resident engineer at the University of Alberta for twenty years. He has also taught engineering at the M.I.T.

During the early days of World War II he was engaged by the Canadian government as power consultant to the Department of Munitions and Supply. From 1942 to 1945 he was with the Aluminum Company of Canada as a power expert and was concerned with steam and hydro power costs and with power resources.

At the end of the war Dr. Robb took office as chairman of the department of mechanical engineering at McGill University. He taught thermal power plant design. It was in 1953, on leaving the university staff that he became established as a consulting engineer.

Dr. Robb joined the Institute in 1908, as a Student, transferred to Associate Member in 1913, and to Member in 1923. He attained life membership in 1948.

L. C. Sentance, M.E.I.C., has been named manager of the new defence apparatus division of the Canadian Westinghouse Company Limited.

Mr. Sentance joined Canadian Westinghouse in 1937 following his graduation as a mechanical engineer from the University of Saskatchewan and two years spent as a lecturer at that University. After serving his engineering apprentice course he joined the apparatus division as a design engineer, and in 1951 was appointed manager, manufacturing department, apparatus division. In 1952 he was made manager, manufacturing department, electronics division.

Mr. Sentance was this year elected to serve as councillor representing the Hamilton Branch of the Engineering Institute.

W. L. Hutchison, M.E.I.C., has returned to Canada after several years' service in Great Britain with Remington Rand Limited. He has accepted the appointment as general works manager of Moffats Limited, a division of Avco Manufacturing Corporation, in Weston, Ont.

Mr. Hutchison was responsible for setting up the manufacturing facilities for the noiseless typewriter in Scotland, and later became supervisor of production in the company's United Kingdom operations. In New York, in 1953, he held the position of assistant director of European production in the International division of Remington Rand Inc.

He had, in 1946, while still in Canada, been working as plant manager for the company in Hamilton, Ont.

Prior to that he held the position of general superintendent of the Hamilton Bridge Company Limited, in that city.

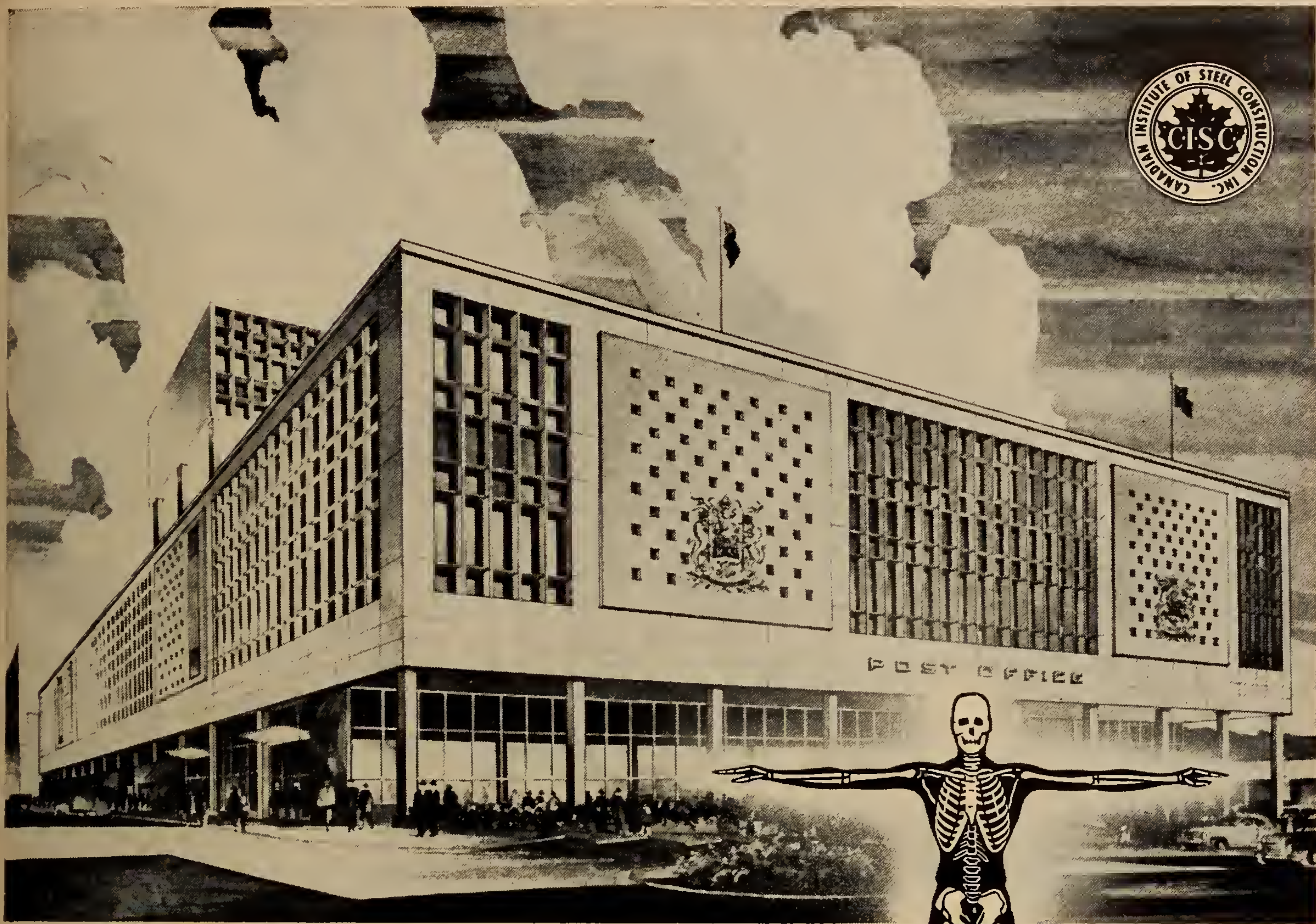
Mr. Hutchison is a McGill University graduate.

Percy L. Climo, M.E.I.C., plant engineer with the Ontario Paper Company in Thorold, Ont., has been elected chairman of the Niagara Peninsula Branch of the Institute. Known in engineering circles in Temiskaming, Ont., where he

Percy L. Climo, M.E.I.C.

worked prior to 1952, Mr. Climo was active in organizing the Nipissing and Upper Ottawa Branch.

A native of Cobourg, Ontario, he attended schools in that community, studied engineering at Queen's University,


CANADIAN INSTITUTE OF STEEL CONSTRUCTION INC.
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POST OFFICE

and obtained a bachelor of science degree in 1932. Shortly after graduation he became municipal engineer on sewer construction for the Town of Cobourg, and remained in this position until 1934. Moving to Timmins, Ont., he was six years with the Hollinger Consolidated Gold Mines Limited.

In the next ten years he was associated successively with the Gaspesia Company Limited at Chandler, Que., which firm he joined in 1940; with Armstrong Wood and Company in Toronto, and with the Canadian International Paper Company at Temiskaming, Que. He joined the latter firm in 1947 and remained with them until he accepted his present appointment in 1952.

Mr. Climo has, for two years occupied a seat on the Grantham Township Council, a municipality close to the City of St. Catharines, Ont.

Mr. Climo joined the Institute in 1928 as a Student, was transferred to Junior in 1934, and became a Member in 1940.

F. A. Bain, M.E.I.C., recently named superintendent of the Sun Oil Company refinery at Sarnia, Ont., has been chief refiner at the company's Canadian installation since 1953.

His previous professional experience has been gained with Imperial Oil, Polymer Corporation and Canadian Industries Limited.

He is a McGill University graduate.

Col. W. G. Swan, M.E.I.C., 1955 winner of the Engineering Institute's Julian C. Smith award, has been conferred an honorary degree by the University of British Columbia.

Col. W. G. Swan, M.E.I.C.

A long-time resident of British Columbia, Colonel Swan was born at Kincardine, Ont., and studied engineering in that province, being graduated from the University of Toronto in 1906. In 1911 he won the degree, C.E.

Col. Swan served overseas during World War I, was awarded the D.S.O., the Croix de Guerre, and earned the rank of Colonel.

He has been for many years a consulting engineer in Vancouver.

With the onset of another war Colonel Swan was director of construction for the War Supply Board; then served as chief engineer with the Pacific Command of the R.C.E. He was, in 1945 awarded an O.B.E. Two years later he was recipient of the Alumni Medal of the University of Toronto.

L. A. Dokken, M.E.I.C., has accepted a position at Concord, California, as chief engineer with Martin Brothers Incorporated.

With Piggott Construction, Edmonton, as general manager and director in 1951, he was earlier associated with Industrial Maintenance Limited, in Montreal as president and general manager, and was for a time in 1949 president of the Dokken Pipe Line Construction Limited in Edmonton. Prior to that he worked with Edmonton Cottons Limited and Imperial Oil Limited in Regina and the Montreal East refinery.

Mr. Dokken is a 1942 graduate of the Univesrity of Saskatchewan.

S. Charles Moseley, M.E.I.C. Representing his firm overseas is S. Charles Moseley, senior plant engineer with Rolland Paper Company at St. Antoine des Laurentides, Que. While in Great Britain he will oversee the plans and specifications in the manufacture of the new 160-inch fine paper machine being installed by his company, as well as visit some of the important paper mills in England and on the continent.

He is a member of the Corporation of Professional Engineers of Quebec, and the Association of Professional Engineers of Ontario.

S. Charles Moseley, M.E.I.C.

Mr. Moseley is a McGill University graduate.

W. G. Seline, M.E.I.C. An award has been made to W. G. Seline, electrical engineer with the Shawinigan Water and Power Company repair department in Three Rivers, Que., for a paper submitted to the American Institute of Electrical Engineers, St. Maurice Valley Section. The paper dealt with the rewinding of alternating current generators.

He is a graduate in electrical engineering from the University of Manitoba, class of 1945.

William P. Kerr, M.E.I.C., has been appointed assistant chief engineer with the Department of Highways, Province of Nova Scotia.

A graduate of Mount Allison University, 1946, he also holds a bachelor of science degree in civil engineering, obtained from the Nova Scotia Technical College two years later.

Mr. Kerr joined the staff of the Department of Highways at that time and from 1948 to 1950 was a resident engineer on highway construction. From 1950 to 1952 he was assistant division engineer for Halifax and Hants Counties, and since 1952 has held the position of division engineer for Lunenburg County.

Jack C. Dale, M.E.I.C., general manager of Canadian Utilities Limited, has been named president and general manager of the company.

Mr. Dale started his career in the utility field in 1933, joining Northwestern Utilities Limited, in Edmonton, on graduation from the University of Alberta. Two years later he joined his present firm, working on design, drafting and estimates. In 1940 he left the company for service overseas, as a major with the 13th Field Regiment, R.C.A. He returned in 1945 to the Calgary office and became assistant to the superintendent and responsible for construction of electric transmission lines and distribution systems in towns. In 1951 he received the appointment of general manager of the company.

He has been active in the work of the Association of Professional Engineers of Alberta.

E. Gordon Tallman, M.E.I.C., has been appointed senior projects engineer with British Columbia Power Commission. His headquarters will be in Victoria.

With the Hydro Electric Power Commission of Ontario since 1937, Mr. Tallman has, among other appointments within the firm held those of project engineer of the hydraulic generation branch, and hydrometric and topographic survey engineer.

Mr. Tallman was for some time Canadian representative of the International Association of Hydrology.

Secretary - treasurer of the Toronto Branch of the Institute, 1946 and 1947, he also served on the executive, in the succeeding years 1948 to 1950.

He is a graduate of the University of Saskatchewan.

S. P. Slinn, M.E.I.C., of Vancouver is in private practice as a consulting mechanical engineer. He is at present engaged in the designing of mechanical services, for the Oakridge Shopping Centre of Woodward stores, Vancouver.

A mechanical engineering graduate of the University of British Columbia, class

of 1949, Mr. Slinn was in 1954 associated with H. F. Clarke and Company, Calgary, as manager.

R. E. Davey, M.E.I.C., holds the position of senior engineer, roads and bridges department, with the Township of North York, Willowdale, Ontario.

Experienced in this field, Mr. Davey has served as town engineer for the Town of Trenton and the Corporation of Brockville, both in Ontario. He accepted the Trenton appointment in 1948, the latter in 1951.

At an earlier period in his career he was with the Toronto Transportation Commission, rapid transit department, and in 1946 was divisional manager of Canadian Oil Companies Limited, in Montreal.

Stanley S. Copp, M.E.I.C., sanitary engineer with the Department of National Health and Welfare in Edmonton, since 1950, has been transferred to Vancouver.

A 1943 graduate of the University of British Columbia, he worked with Imperial Oil Limited in Calgary and spent three years in geological and geophysical oil exploration in Alberta and Colombia, South America. He spent nine months with the engineering department of the City of Vancouver, before taking up work with the Public Health Engineering Division of the Department of National Health and Welfare, as district engineer in the Edmonton Office.

Stanley S. Copp, M.E.I.C.

A few years ago Mr. Copp took time out from active engineering practice to prepare for a master's degree in sanitary engineering at John Hopkins University, which award was made in 1951.

D. E. Peatfield, M.E.I.C., has accepted employment as civil engineer with Noranda Mines Limited. He was formerly associated with C. J. McCulloch and Company, consulting engineers at Point Edward, Sydney, N.S. He held the position of resident engineer in the construction of Seaward Defence Base.

Earlier, after receiving a civil engineering diploma from Loughborough Engineering College in 1950, he was on the staff of H. K. Ferguson Company Ltd., in Midhaven, Ont., as area engineer.

M. J. Hassell, JR.E.I.C., is on the staff of Dominion Tar and Chemical Company in Montreal.

A B.Sc. graduate in electrical engineering, two years ago, from the University of New Brunswick, he has also worked in Montreal with the Montreal Engineering Company.

Martial Quesnel, JR.E.I.C., has accepted employment at Eastman, Que., with the Quebec Copper Corporation Limited.

Mr. Quesnel is an Ecole Polytechnique graduate in mining and geology, class of 1954, and has gained experience with the Iron Ore Company of Canada at Knob Lake, Que., since that time.

F. H. M. Ridley, JR.E.I.C., has been named manager of the installation field engineering section of the Canadian General Electric Company Limited's electronic equipment and tube department in Toronto.

On receiving a B.A.Sc. degree in mechanical engineering from the University of Toronto, he joined the Canadian General Electric Company Limited as methods engineer in 1949.

Oliver Y. Barde JR.E.I.C., has left C. D. Howe Company in Montreal to join the

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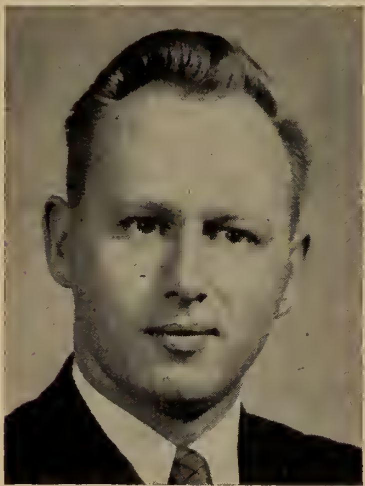
ST. JOHN'S • SYDNEY • FREDERICTON • MONTREAL • KIRKLAND LAKE • TORONTO • SUDBURY • WINNIPEG • CALGARY • VANCOUVER staff of Key Construction Limited in that city. In 1955 he held the position of resident engineer with the former concern.

He is a 1948 graduate of the Swiss Federal Institute of Technology.

Jon G. Mydral, JR.E.I.C., a University of Manitoba graduate, class of 1951, is now at work in Vernon, California. He holds a position with the power division of Bechtel Corporation, engineers and constructors, as electrical engineer in charge of the electrical design of hydroelectric power plants.



Jon G. Mydral, Jr. E.I.C.

On graduation Mr. Myrdal joined the firm of E. G. Eggertson Inc., consultants, of New York and Winnipeg. He was employed in the design of two hydro-electric power plants in Iceland, and immediately following the completion of these projects joined International Engineering Company, designers, of San Francisco, California. Shortly thereafter, he was transferred to the parent company of Morrison-Knudsen Company, as an electrical engineer on construction of the underground powerhouse for the Aluminum Company of Canada, at Kemano, B.C. Later, on completion of this work, he returned to International Engineering Company, becoming a part of their hydro-electric design department.

Michel Gendron, JR.E.I.C., a 1954 graduate of Laval University, in Great Britain recently on an Athlone Fellowship, has returned to Canada and is with Eastern Mining and Smelting Corporation Limited, in Chicoutimi, Que., where he serves as assistant to the works manager.

Under the Athlone Fellowship scheme, Mr. Gendron spent one year at the Imperial College of Science and Technology. From September 1954 to June 1955 he did post-graduate work in structures, and, under Dr. J. Sutton Pippard, studied structural analysis, obtaining the D.I.C. degree on presentation of a thesis entitled, "Domes Analysis".

M. Gendron, Jr. E.I.C.

Later, through the Federation of British Industries, he was given the opportunity, in the summer of 1955, to visit many of the country's industrial works.

Mr. Gendron then concluded his stay in Great Britain by spending a few months in association with a firm of consulting engineers.

J. W. Johnson, JR.E.I.C., who was last year in Edmonton with the Joint Services

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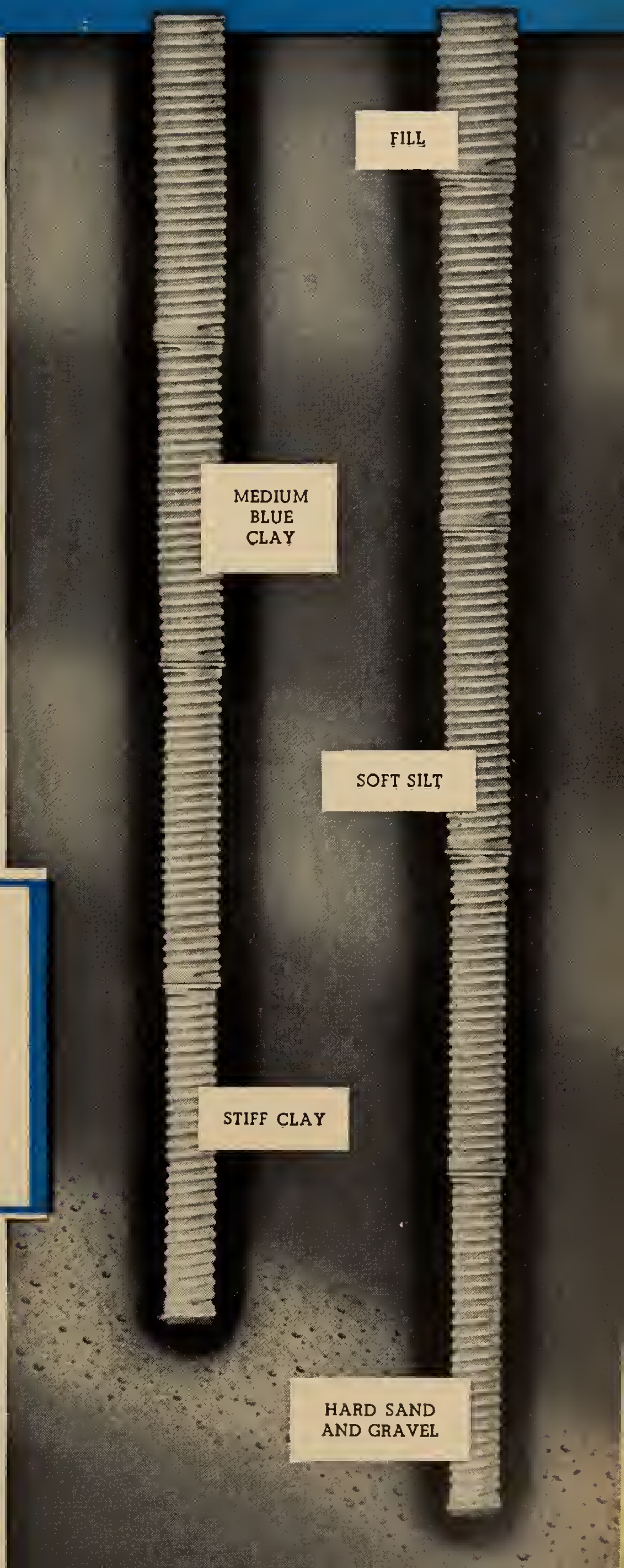

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• PERSONALS

Operational Research Team, serving as a Defence Research Technical Officer, has received a posting to Ottawa. He is now employed in the capacity of Defence Scientific Service Officer, and is instead, attached to the Canadian Army Operational Research Establishment.

He is a University of Alberta graduate in civil engineering, class of 1954.

P. Van Vliet, JR.E.I.C., of Regina, formerly employed as a machinist with the White Motor Company of Canada Limited now holds the position of switchman on the automatic exchange in connection with the Government Telephones in that city.

H. F. Pragnell, JR.E.I.C., was recently appointed project engineer with the Eddy Match Company Limited, Pembroke, Ontario.

Mr. Pragnell graduated from the Royal Military College in 1942 and is a civil engineering graduate of McGill University. Since graduation in 1949 Mr. Pragnell has been employed in construction and design work with the Foundation Company of Canada Limited in Montreal and Chalk River, Ontario.

Camille Cauchon, JR.E.I.C. Recently transferred from Montreal to Quebec City is Camille Cauchon, of the sales engineering division of Minneapolis-Honeywell Regulator Company Limited.

He is a native of Quebec City and

Camille Cauchon, Jr. E.I.C.

a graduate in electrical engineering from Laval University, class of 1951.

Lorne Rispler, JR.E.I.C., has been transferred to Ottawa from Montreal by the Minneapolis-Honeywell Regulator Company Limited. He is responsible for sales in the commercial division of the Ottawa office of the company.

Lorne Rispler, Jr. E.I.C.

He is a graduate of the University of Alberta, class of 1951.

G. A. C. Eby, JR.E.I.C., is now chief engineer, of the reinforced plastics division of the Brunswick Balke Collender Company in Toronto.

First a laboratory supervisor with Dominion Alkali and Chemical Company in 1949 and then associated with E. B. Magee Limited in Port Colborne, Ont., in 1951, he has also worked with Dominion Rubber Company, in Kitchener,

Ont. Concluding his studies at McGill University in 1949, he was awarded a B.Eng. degree in chemical engineering.

F/O H. R. Hyslop, JR.E.I.C., combining his profession with an air force career is at present stationed at Air Force Headquarters, Ottawa, in the procedures section of the Directorate of Construction Engineering.

F/O Hyslop graduated from the University of Saskatchewan in 1953. He was awarded a B.Eng. degree in civil engineering.

D. M. Murray, JR.E.I.C., is with the operational research section of the Defence Research Board, Ottawa, following a period of work with the division of radio and electrical engineering, National Research Council of Canada.

A 1951 graduate of the University of Manitoba, Mr. Murray has held positions with the Dominion Rubber Company of Canada shortly after his graduation, with Poole Construction in Edmonton, in 1953, and the engineering department with the City of Edmonton a year later.

Albert Rodney Sandall, JR.E.I.C., has accepted a position with the Ste. Anne Paper Company at Beaupre, Que., following a term of service with the National Street Car Corporation, in Hamilton, Ont. With this firm since 1954, he has also been employed in the same general field as materials inspector, with the Ontario Northland Railway, at North Bay, Ont., in the mechanical department.

Mr. Sandall completed his engineering studies at the Nova Scotia Technical College. In 1950 he was awarded a B.Eng. degree in mechanical engineering.

In 1953 he held the position of design engineer with the Bathurst Power and Paper Company Limited, Bathurst, N.B.

R. S. Jermyn, JR.E.I.C., has taken up employment with Dominion Electrohome Industries Limited in Kitchener, Ont., as mechanical engineer.

Most recently he has been working in the capacity of sales engineer with Magna Metals Limited, in Toronto, and has also had employment with the Canadian Westinghouse Company Limited in Hamilton, Ont.

He studied engineering at the Nova Scotia Technical College and gained a B.Eng. degree in mechanical engineering in 1952.

James R. Young, JR.E.I.C., with Canadian Westinghouse Company since 1950, has received a transfer from Hamilton, Ont., to Edmonton. Serving in the company's apparatus sales office, he will be largely concerned with the oil and mining companies of the area.

Mr. Young has spent the whole of his engineering career to date with the Canadian Westinghouse Company, beginning with a two-year engineering training at the company plant in Hamilton, following his graduation from the University of Alberta. On conclusion of the course he was moved to Montreal where he was employed in the apparatus division, dealing with shipbuilding and suppliers of marine and naval equipment.

James R. Young, Jr. E.I.C.

C. G. Forberg, JR.E.I.C., has received the appointment of London, Ont., township engineer, following three years' work of a similar nature as municipal engineer at Wallaceburg, Ont.

A veteran of the second world war,

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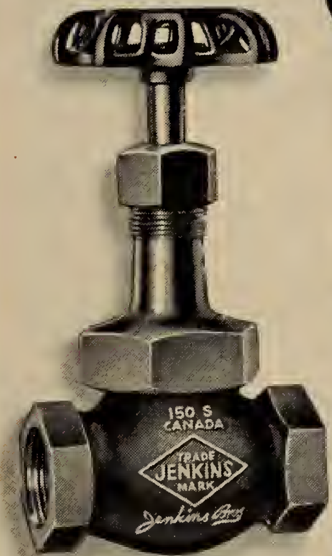

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LOOK FOR THE DIAMOND MARK
VALVES

• PERSONALS

he served overseas with the R.C.A.F. After the war, returning to his home in Ontario, he studied at Queen's University and there obtained a civil engineering degree in 1949.

Mr. Forberg's graduate engineering career began with an appointment as assistant city engineer at St. Thomas, Ont., where he remained until his Wallaceburg appointment in 1953.

Jacques Lapointe, JR.E.I.C., is field engineer on the construction of an electro-metallurgical pilot plant being built by Fraser-Brace Engineering Company Limited, Montreal, at Niagara Falls, Ont.

Mr. Lapointe graduated from McGill University in 1950, and immediately joined the Canadian General Electric Company Limited for a one-year test course in Peterborough, Ont., and later spent six months with the company's transformer design section in Toronto.

In 1951 he accepted a position with Fraser-Brace Engineering Company Limited as assistant electrical superintendent on the construction of the Dupont Nylon plant at Maitland, Ont. He remained with the firm, at that time, until 1954, rejoining in November, 1955.

In the interim Mr. Lapointe was service engineer with Thompson Electrical Works Limited, in Montreal.

MacKenzie Dickson, JR.E.I.C., has become vice-president and sales engineer with Separator Engineering Limited, in Montreal.

Earlier in his career, after a 1950 graduation from McGill University with a B.Eng. degree in chemical engineering, he was in 1952 employed with Merck and Company Limited at Valleyfield, Que.

He has also worked as sales engineer with the Delaval Company Limited in Peterborough, in 1953.

G. W. Morgan, JR.E.I.C. The position of chief engineer with Coast Steel Fabricators Limited, in Vancouver, is held by G. W. Morgan, the former chief design engineer of Standard Iron and Steel Works Limited plant in Toronto.

Shortly after graduating from the University of British Columbia in 1950 his address was Lambton Mills, Toronto.

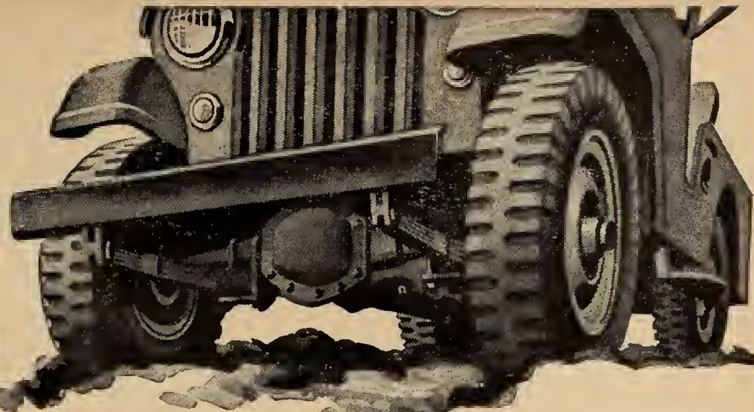
J. Hode Keyser, S.E.I.C., a 1955 graduate of the Ecole Polytechnique has been accepted for the position of soil engineer with the City of Montreal.

Mr. Keyser obtained a B.A.Sc. degree in civil engineering.

Jean Morin, S.E.I.C., has joined the staff of Canadian Fairbanks-Morse Company Limited as an estimating engineer in the firm's pump and electrical department.

He is a 1955 graduate of the Ecole Polytechnique, where he studied mechanical engineering. While an undergraduate he won one of the student prize memberships, awarded by the Institute in 1954.

Traction



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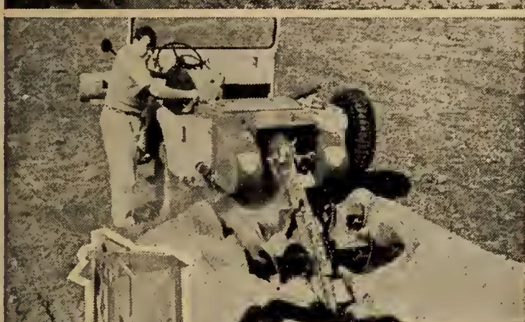

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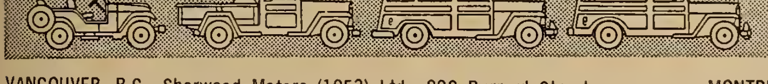

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WINNIPEG, Man., Leonard & McLaughlin Motors Ltd. Portage and Maryland
LONDON, Ont., Middlesex Farm Equipment Ltd., 287 Adelaide Street
TORONTO, Ont., Cooke-Willys Ltd., 676 Bay Street

MONTREAL, Que., Cooke Toledo Motors Ltd., 2134 St. Catherine Street W.
QUEBEC, Que., Auto Moderne Ltee., 498 Rue de la Couronne

FREDERICTON, N.B., Capital Garage Ltd.,355 Campbell Street
HALIFAX, N.S., Provincial Motors Ltd., 35 Grafton Street
ST. JOHN'S, NFLD., Baird Motors Ltd., Merrymeeting Road

NEWS OF THE BRANCHES

Activities of the Forty-Seven Branches of the Institute and abstracts of the papers presented at their meetings

BELLEVILLE

E. T. HILBIG, JR.E.I.C.,
Secretary-treasurer.

General Meeting

The final meeting for the 1955-56 season of the Belleville Branch of the Engineering Institute took the form of a conducted tour of the Marmoraton Mine, located near Marmora.

All phases of the iron mining operation as it occurs at Marmora were seen. The magnetite type of ore is obtained from an open pit, being hauled by huge 22-ton Euclids, to the north end of the pit where it is dumped into skips. A balanced arrangement of inclined hoists raises the loaded skip, while simultaneously lowering the empty skip.

The ore is subjected to the usual crushing processes, emerging from the ball mill as fine powder. Of considerable interest is the separation of the magnetite from the tailings by means of revolving magnetic drums, under which the emulsion of ore and water is conveyed. The final operation consists of "pelletizing" the beneficiated ore. In this form, the ore is suitable for refining in the blast furnaces at Buffalo, to where it is shipped by rail and boat.

The Belleville Branch are greatly indebted to Mr. H. O. Olson, the mine manager, and his assistant, who personally conducted the tour.

VANCOUVER

A. D. CRONK, JR.E.I.C.,
Secretary

T. F. HADWIN, M.E.I.C.,
Branch News Editor

International Invasion

At the invitation of the Seattle Section of the American Society of Civil Engineers and their Ladies' Auxiliary, a group of members of the Vancouver Branch of the Engineering Institute of Canada and their wives were royally entertained in Seattle on May 26, 1956. The invading party headed by the Branch chairman, S. S. Lefeaux and ably supported by the organizing Secretary, A. D. Cronk, made their headquarters at the Vance Hotel on May 25 and were greeted by their hosts led by Hanford Thayer, chairman of the Seattle Section, Mrs. Elmer Ginnute, chairman of the Ladies' Auxiliary and Mr. and Mrs. Edward Greathouse in charge of arrangements. The hosts then distributed copies of a carefully prepared program for the following day.

Inspection Trip

On May 26, while the ladies shopped, the men were taken on a bus tour which included many points of interest, but placed prime emphasis on two unusual construction projects. The first was the new First Avenue bridge which will span the Duwamish Waterway. This bridge of the bascule type is constructed on a silt bottom too deep for piles and the idea was conceived of precasting a concrete base long enough to support both leaves of the bascule, floating it into position and sinking it on a prepared bed. This was successfully accomplished, and at the time of the inspection, both leaves of the bascule were almost complete. Frank Culp, project engineer, illustrated and described the engineering features.

The second unusual engineering project was the supersonic wind tunnel at the Boeing plant in south Seattle. Here Gordon Cheney, supervisor of wind tunnel design, conducted the group to the two 38 foot diameter spheres which will supply the air blast, giving supersonic speeds of Mach Number 4. The centrifugal compressors with air dryers and the exhaust towers with sound supressing baffles posed many problems of engineering interest.

Lunch and Dinner Dance

Lunch for the engineers and their wives followed the tour at a waterfront seafood grill and the afternoon was spent at private homes of Seattle engineers. The climax of the trip was a smorgasbord and dance at a private club. There, the host and visiting chairmen expressed the hope of all concerned that the alternation of annual visits to Vancouver and Seattle would continue indefinitely and foster the interchange of ideas and professional fellowship across the border.

VANCOUVER ISLAND

Engineers Wives Association

Organizing to form an association, the wives of the professional engineers of Lower Vancouver Island met recently to elect a president and executive.

Mrs. T. A. J. Leach became president by acclamation, Mrs. A. B. Sanderson and Mrs. R. C. Thurber were elected first and second vice-president and the duties of corresponding and recording secretary went to Mrs. W. G. McIntosh and Mrs. A. F. Paget. Other officers elected were Mrs. C. Errington, treasurer, Mrs. J. Bowering, social convenor, Mrs. F. Slaney, program convenor, and Mrs. J. B. Hicks, membership convenor.

ATTENTION PLEASE!
E.I.C. BRANCH EXECUTIVES

Several months ago you were written to by headquarters' staff on the subject of new developments in your area of Canada, and the desirability—almost the necessity—of getting Journal papers to describe them. There is so much going on now, in so many places, that ordinary methods of keeping abreast of the engineering news may fail us. We hope not, but you can help us to be sure. Please organize your branch this year so as to cover these two things:—

1. When you hear about a new development in your vicinity, in engineering or technology, get a few facts together, plus the names of some of the principals, and send this information to the editor. We will take it up from there, if you wish.
2. When you have a paper delivered before your branch, if it is a reasonably worthwhile effort TRY to get a manuscript of it and send it to the editor. Some of our finest technical presentations are lost forever because of this lack, and no record exists beyond the memories of the comparative few who heard the speaker.

HELP THE EDITORS TO KEEP IMPROVING OUR JOURNAL

News of Other Societies

International Society of Aviation Writers

The International Society of Aviation Writers, a new worldwide body to encourage high standards of aviation writing for peaceful ends throughout the globe, was formed in San Francisco. The organization was formed as the result of the expressed interest in and need for wider exchange of aviation information and with the aim of increasing goodwill among the nations of the world.

The permanent headquarters of the new organization is Montreal, Canada, the site of the International Civil Aviaion Organization, U.N. Agency. I.C.A.O. Council Chambers will be used as a meeting place.

Leading writers and information people are behind the organization from the following countries: United States, United Kingdom, Canada, France, Italy, Denmark, Norway, Sweden, Belgium, Netherlands, Spain, Portugal, Switzerland, Greece, Argentine, Brazil, Mexico, India, Burma, Hawaii and Australia.

Officers of the new organization are announced as follows: President, Arthur Riley, the Boston Globe; Vice-Presidents, Sydney Cooper, The International Civil Aviation Organization; Erik Bergaust, American Aviation, Washington, D.C.; Peter King, The Bristol Aeroplane Co., United Kingdom. The Secretary-General is Ross Willmot, Hunting Associates, Toronto. Other directors include: Verne Haugland, Associated Press; Boyd Ferris, Air Industries and Transport Association, Ottawa; Neal MacDougall, The Aeroplane; Niels Beck, Union of Burma Applied Research Institute, Rangoon; Stanley Brogden, Royal Australian Air Force, Victoria, Australia; Maximillian Garavito, Revisto Aerea Latinoamericana; Gunnar Kristiannson, Stockholms-Tidningen.

The first general meeting of the International Society of Aviation Writers is planned to take place in the Montreal Headquarters later this year. Another meeting is to be held at the same time as the Society of British Aircraft Constructors' Show, at Farnborough, England in early September.

Canadian Chemical Institute Meets at Montreal

The thirty-ninth annual conference and exhibition of the Chemical Institute of Canada was held in Montreal, May 28 to 30, 1956, with some 1500 delegates in attendance. His Worship Mayor Jean Drapeau opened the exhibition and welcomed delegates to the city. Dr. Raymond V. Lemieux of the University of Ottawa presented the Merck Lecture on the subject "The Significance of the Half Chain Conformation in Carbohydrate Chemistry".

Dr. Clifford B. Purves, chief of the wood chemistry division, Pulp and Paper Research Institute, Montreal, was elected president of the Chemical Institute for 1956-57, with Dr. Osman J. Walker of the University of Alberta as vice-president. E. A. Crockett, chief chemist, Polymer Corporation, Ltd., Sarnia, was elected chairman of the board of directors, together with 12 new councillors.

The Chemical Institute of Canada Medal, awarded yearly for outstanding contributions to Canadian chemistry, was awarded to Dr. Leo Marion, F.C.I.C., of the National Research Council, in recognition of his great contribution in the field of alkaloids.

The opening luncheon meeting on Monday was addressed by F. C. Pace, of the special weapons section, Civil Defence Services, Ottawa, who spoke on "Medical Planning in Civil Defence". Describing the effects of nuclear explosions and radiation therefrom, and the three main devices for detection, he stated the Canadian plan for civil defence was really a huge effort in preventive medicine.

A symposium on "Problems Confronting University Educators" was held in the afternoon. Dr. C. A. McDowell of U.B.C. drew attention to the increased employment and lack of teachers and equipment. F. A. Demarco of Assumption College, Windsor, urged courses in social sciences and liberal arts be included in curricula. Louis A. Madonna of the University of Ottawa pointed out that the theory required from the students was continually in a state of change in our fast developing world. Only by mutual cooperation can Universities know what is actually desired in industry and alter courses accordingly.

The second luncheon meeting on Tuesday was addressed by L. G. Cook, director of the chemical and metallurgical division, Atomic Energy of Canada, Ltd., Deep River, Ont., whose subject was "Our Relation to the Technicians". He told of the need for more technicians to give professionals more time to think.

The Montreal Medal of the C.I.C., established earlier this year for award to the Canadian showing the most significant leadership or making the outstanding contribution to the profession of chemistry or chemical engineering, was awarded during the luncheon meeting to R. R. McLaughlin of the University of Toronto by President Roger Gaudry.

Earlier in the conference, T. H. C. Raikes of Howard and Sons (Canada) Ltd., stated that the chemical industry, employed 60,000 workers and had a gross product exceeding $1 billion. It was as inventive and progressive as any in the world. The only drawback was a shortage of chemists and chemical engineers.

Tuesday afternoon was devoted to a symposium of the division of chemical engineering on "The Financing of the Chemical Industry in Canada", with P. W. Blaylock, president, Shawinigan Chemicals, Ltd., Dudley Dawson, president, Dawson Hannaford, Ltd., H. B. Fewkes, associate treasurer, Sun Life Assurance Co. Ltd., and Selwyn Irwin, president, McArthur Irwin, Ltd., as panel members.

Conclusions reached were that the Canadian public can expect increasing opportunities to invest in Canada's chemical industry because of its current rapid expansion, and because with the publicity now being given to the high rate of foreign investment in Canada, foreign companies may give Canadians a larger opportunity to participate in their subsidiaries. So far most of the industry has financed its expansion internally, but due to expansion, outside capital is becoming necessary. Expected capital investment needed this year is $80 million.

Dr. Louis Frederick Feiser of Harvard University delivered the Leroy Egerton Westman Memorial Lecture, his subject being "Hooker Oxidation". This was followed by the conferring of an honorary degree on Dr. E. W. R. Steacie, president of the National Research Council, by the Université de Montréal, and a reception by the Société de Chimie de Montréal.

Plastic Design of Steel Structures

Some sixty structural engineers from across Canada attended a five-day course in Plastic Design of Steel Structures during the week of May 28. The course was arranged by the Royal Military College and Queen's University of Kingston, Ontario, with the support of the Canadian Institute of Steel Construction, Inc.

(Continued on page 970)

• NEWS OF OTHER SOCIETIES

Professor J. W. Dolphin, head of the civil engineering Department at R.M.C., Professor H. M. Nelson, assistant professor of civil engineering at R.M.C. and Doctor D. T. Wright, M.E.I.C. assistant professor of civil engineering at Queen's University were the lecturers.

The course was geared to meet the needs of the practising structural engineer rather than a group interested in pure research only. For this reason considerable emphasis was placed on practical problems, such as joint details that will be encountered when plastic design methods are used. The results of research in this field seem to indicate that structural joints will be simpler and more functional in appearance but that fabrication and erection procedures will have to be changed somewhat from present day practice in order to achieve full economy.

The course began by developing the simple plastic theory of flexure and applying it to the design of structures. Modifications to the basic theory were introduced in order to cope with such familiar problems as shear, axial load and local and lateral instability. Laboratory tests on full-sized structures demonstrated the accuracy of the procedures advocated.

Dr. Bruno Thurlimann of Lehigh University was guest speaker at a luncheon.

Dr. Thurlimann pointed out that the current practice of designing continuous structures by the stress theory was somewhat of a fallacy, as in nearly all structures of this kind stresses exist that are not taken into account in design. Such practices as welding, cambering, crimping and aligning of members, and even cutting and shearing, create residual stresses that may be extremely high, so that the yield stress may be reached in some parts of the material before any design load is put on the structure. The question arises as to just what is keeping such a structure from collapsing. Plastic behaviour appears to be the only answer. Elastic analysis is only a beginning in the actual problem of steel design. We are now ready to consider the more logical method of taking plastic behaviour into account and making full use of its desirable characteristics.

In effect, plasticity is that property of a continuous structural member which permits it to transfer moment by the formation of plastic hinges at points of maximum moment. This ability allows the member to carry considerably more load than has been previously thought possible. The whole basis of plastic theory is based on the ductility of structural steel (i.e. the ability to strain without increase of stress). In order for a designer to correctly understand this method of design, it is necessary for him to forget the stress concept and to concentrate on actual load carrying capacity. Of course there are still several problems involved in plastic design. One of these problems which is extremely important is lateral stability of the structure and another is column design in high buildings, where a high axial load occurs; but the outlook is very bright and Dr. Thurlimann believes that a solution is imminent.

Dr. Thurlimann strongly believes that the factor of safety, as we know it today, should be re-appraised. A safety factor of 4 was originally devised in France in 1820 and was based on actual ultimate load tests measured in existing buildings in Paris. From that time until now the factor of safety has been reduced to a figure of 3.25 on ultimate load. Under the new theory a designer will be able to predict accurately the exact load at which real structural failure will occur. These predictions have been verified by actual tests of full-scale models. He suggests, therefore, that a more realistic factor of safety be determined.

As far as practical considerations are concerned, plastic design will provide a marked tendency to more continuous structures, and the present waste of material involved in simple span framing will be largely eliminated. Since rigid connections are an absolute necessity, welding will be used far more, and new techniques will have to be evolved. It is quite clear that just by using less structural material the actual economy of structures may not be immediately reduced because shop fabricating costs for the type of connections required will be higher until the necessary experience is gained. The trend will likely be to more shop welding with splice connections being made in the field by use of high-tensile bolts.

Presently in England the British Standard for the design of steel building frameworks incorporates a clause on fully rigid design that enables the designer to use the plastic design method. Upwards of two hundred building frames embodying this principle have been erected.

In the United States a committee of the A.S.C.E. has been established which will publish simple design procedures and test results for the use of practising engineers. The American Institute of Steel Construction is presently preparing a design manual for the plastic design of low buildings. Because research is still engaged in the design of columns with high axial loads, only one- or two-storey buildings will be included in the scope of this manual. It is generally felt that in a matter of one or two years plastic designs throughout the range of buildings will be made in the United States.

In Canada the theory of plastic design has been in the curriculum of at least six Canadian universities during the past year and it is expected that additional courses either for graduates or under-graduates will become available for the coming semester.

Mining Congress

The Canadian Institute of Mining and Metallurgy, and the Canadian committee of the Sixth Commonwealth Mining and Metallurgical Congress in 1957, have announced that the president of the congress will be R. W. Diamond, M.E.I.C., of Trail, B.C.

Mr. Diamond will direct a nation-wide organization appointed from the Canadian mineral industries to plan and prepare for this major mining event in the fall of 1957. The congress plans call for a cross-country inspection tour of important Canadian mining operations by 500 delegates from all parts of the Commonwealth. Three special trains and six chartered aircraft will take the delegates on their tours from Vancouver to Halifax and through the north country. Major meetings of the Congress will be held in eight Canadian cities, commencing in Vancouver on September 8-9-10, 1957.

The Congress General Committee is headed by Robert A. Bryce of Toronto. Co-chairmen are H. L. Roscoe, for Eastern Canada, and H. R. Banks for Western Canada. John S. Proctor of the Imperial Bank of Canada is honorary treasurer. Committee members are Dr. John Convey, F. V. C. Hewett, and C. C Huston. C. H. Mitchell is excutive secretary for the general committee of the Congress, with headquarters at 507 Metropolitan Building, Vancouver 1, B.C.

Forestry Conference

A national forestry conference will be held in Winnipeg, September 17-19, 1956, under the sponsorship of the Engineering Institute of Canada, the Canadian Chamber of Commerce, the Canadian Institute of Forestry and the Canadian Forestry Association.

Secretary of the program committee is J. L. Van Camp, of the Canadian Forestry Association (4795 St. Catherine Street West, Montreal 6).

Library Notes

Additions to the Institute library
Reviews, Book Notes
Abstracts

BOOK REVIEW

Rideau waterway

Robert Legget. Toronto, University Press; 1955. 249 p., $5.00.

When an author is in love with his subject, a better than ordinary book is pretty sure to result. One needs to read only a few pages of "Rideau waterway" to realize that Mr. Legget is indeed an enthusiast on the waterway and that he must have spent many hours not only in digging into the data on which much of this book is based, but also a good deal of his spare time in travelling up and down the waterway itself.

The first six of the even dozen chapters are historical. They tell why, how and by whom the waterway was built and are necessarily a biography of Lt. Col. John By, R.E., the genius behind the project. Perhaps Lt. Col. By was our earliest distinguished engineer. As such, he has lately attracted increasing notice from today's members of his profession, to the extent that a memorial to him was recently unveiled in Ottawa, thanks largely to the efforts of our Ottawa branch.

But Mr. Legget also pays tribute to the work of By's associates—his principal assistant, John MacTaggart; the junior engineers, e.g., Lieuts. Pooley and Denison; the contractors, among whom we find names still familiar to us—Drummond, McKay, Phillips, White and Redpath, for example. Parsons and politicians, lawyers and merchants pop in and out of these chapters, making them veritably a brief history of the Rideau area from its early days to the present.

These chapters will be of more direct interest to the engineer than to the general reader, written as they are with the touches necessary for technical clarity yet they should be quite intelligible to anybody. They bear witness of By's ability and good judgment in the face of conditions inherent in the time and place, which would have discouraged a less talented and determined engineer.

Having got the waterway built and in operation, Mr. Legget follows its fortunes from its official opening in 1832 to the present. Never used for military purposes under stress of war, it contributed much to the development of the area which it served, until driven out of the commercial picture by the competition of rail and road. Given over today almost exclusively to tourist traffic, the waterway justifies its continued operation by bringing into Canada many more dollars than it takes from the taxpayer's pocket.

The last five chapters of "Rideau waterway" are a log of a trip through it from Kingston to Ottawa and a short account of the founding and development of Ottawa. There is much gossipy comment on and anecdotes of people and places, past and present, along the way. If the general reader has even only a partly developed sense of history, he cannot fail to be intrigued by these chapters.

There are sixteen pages of excellent illustrations, mostly from the author's own photographs, a few line cuts in the text and adequate maps. The book ends with a list of references; a list of superintending engineers — By himself served from 1826 to 1832; information on maps, charts and fishing; a table of mileages, lifts and clearances; and a good index.

This writer thoroughly enjoyed "Rideau waterway". It should give any Canadian pride in his national heritage and ought to convince any engineer that there is an historical tradition behind him. It is pleasant to feel that Mr. Legget, director of the division of building research of the National Research Council and an active member of the Engineering Institute of Canada thought it well worth while to devote some of his time to this kind of writing, though it will probably add little to his professional reputation. Would that others able might follow his example! We need biographies of other Canadian engineers—the Shanlys, Sir Casimir Gzowski, T. C. Keefer and Sir John Kennedy, to mention only four.

R.DeL.F.

BOOK NOTES

Prepared by the Library
The Engineering Institute of Canada

* Review provided through the courtesy of the Engineering Societies Library in New York.

Alternating-current circuit theory, 2nd ed.

M. B. Reed. New York, Harper, 1956. 589 p. illus., $6.50 (U.S.)

The advent of television and computers has created more complex systems in the electrical engineering field, and these in turn demand greater precision in the mathematics and physics needed. The second edition of this textbook takes into account these developments by revision of some of the material, or by the presentation of new approaches to problems e.g. the *m*-derived approach to filter design has been replaced by the time-tested method based on the symmetric lattice.

The first section of the book covers such basic principles as sine wave and vector representation of an alternating current, the algebra of complex numbers, the parallel and series-parallel electric circuit, Fourier series, and transients. The remainder of the book deals with specialized topics, among them three-phase wye- and delta-connected power distribution systems, symmetrical components, steady state operation of a transmission line, and electric filters.

***Analyse dimensionnelle et théorie des maquettes.**

H. L. Langhaar. Montreal, Fomac, 1956. 230 p.

This work is a translation of the author's "Dimensional analysis and theory of models" and is devoted to the principles of dimensional analysis which treats the general form of equations that describe natural phenomena. The first four chapters deal with basic principles and develop them mathematically. Chapter five covers the theories of similarity and model testing. The remaining five chapters treat specific applications of dimensional analysis. A knowledge of the principles of physics and engineering

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9 TO 5, MONDAY TO FRIDAY

usually presented in the first three years of an engineering curriculum is assumed.

Analysis of electric circuits.
W. H. Middendorf. New York, Wiley, 1956. 306 p., diagrs., $6.00.

The author has attempted in this book to present in detail the basic principles and problems of circuit analysis. A variety of numerical examples is used to assist the student in understanding the subject matter.

The first section of the book is entitled "Basic circuit analysis" and includes chapters on basic laws, types of voltage and current variations, notation, the algebra of complex numbers, impedance and admittance, circuit parameters, equivalent series, locus diagrams, resonance phenomena, and magnetic field coupling.

The second part is more advanced and considers such matters as nonsinusoidal waves, and network simplifications and theorems. The last section of the book deals with polyphase and communication circuits.

***Annual report on the progress of rubber technology, volume 19, 1955.**
London, Institution of the rubber industry, 1955. 15B p., 21/–.

A critical review of the literature covering advances in cable and electrical insulation, synthetic rubber, testing and equipment, machinery and appliances, processes and materials, and in the manufacture of various types of rubber goods. One section deals with the use of rubber as a road surfacing material.

Les applications de l'explosion thermonucléaire.
Camille Rougeron. Paris, Berger-Levrault, 1956. 307 p., 600 fr.

In this work the author discusses the possibilities of harnessing thermonuclear power, and expresses his belief that the solution to the problem lies in underground explosions.

The author believes thermonuclear power could be used in excavations for large dams, for electric power, and in the chemical industry. He also suggests that by using this type of power it would be relatively easy to keep navigation in the St. Lawrence-Great Lakes open all winter.

There are also chapters on naval, air and land warfare.

Applied electricity, 3rd ed.
A. W. Hirst. Glasgow, Blackie, 1956. 39B p., diagrs., 25/–.

The M.K.S. system of units has been used in this revised edition. Other new material is included in the sections on parallel operation of transformers, double cage rotors, strain gauges, transducers, closed loop control systems, and photoelectric cells.

The boik contains material on direct current machines, alternating current circuits, transformers, alternators, induction motors, the conversion of a-c to d-c, illumination, instruments and measurements, and the elements of thermionics.

Architectural construction, 2nd ed.
Theodore Crane. New York, Wiley, 1956. 433 p., illus., $10.00

The new edition of this valuable reference work will be welcomed by students in architecture and engineering, and by those practicing in these professions. It is an up-to-date resume of the better types of construction in use in the United States, with recommendations concerning their specific applications. The reader is given a procedure for determining the type of building frame, foundation, floor, roof and wall construction most suitable to meet the requirements of a special structure. The book also discusses the choice of the best type of building materials.

The first chapter deals with building codes and design standards. Included in the new material in this edition are descriptions of modern coliseums, hangars and parking garages, and contemporary fireproofing details for steel assemblies.

Beton-Kalender; Taschenbuch für den Beton-und Stahlbetonbau.
Berlin, Ernst, 1956. 2 vols., 16 DM the set.

In this forty-fifth edition of the handbook all aspects of concrete construction are dealt with, as well as all types of cement and concrete. Each chapter has been written by a specialist, and topics covered include the analysis of structures and parts, foundations, rigid roofs, machinery etc.

There are many graphs, tables and diagrams, and throughout the handbook reference is made to the German standards for steel and other construction materials.

The Canadian petrochemical industry.
Shell Oil Company of Canada. Chemical division. Toronto, Ryerson, 1956. 154 p., illus.

The petrochemical industry in Canada is only about fifteen years old but a great deal of progress has been made in this short span. The Shell Oil company has attempted to define the term "petrochemical" and has devoted a chapter to each of the major products in this class. Within each chapter the work of the most important developing company has been described.

The ten chapters include synthetic rubber; glycols, polystyrene and other chemicals; carbon black; ammonia; sulphur; petrochemicals and cellulose acetate; polyethylene; isopropyl alcohol, acetone and phenol; glycols; and formaldehyde and pentaerythritol.

Circular cylindrical shells.
Dieter Rudiger and Joachim Urban. Leipzig, Teubner, 1955. 270 p., tables, 24 D.M.

In the last decades many types of structures have been used for enclosing large spaces economically without supports, and of these cylindrical shells have become important, both because they are relatively simple to calculate and construct and because they can be used for roofing rectangles.

The main body of the book is devoted to tables for the calculation of cylindrical shells, and solutions are given for 48 parameter-values, from 0.03 to 0.90.

There is also a short introduction giving the theory of circular cylindrical shells, and the basic equations used. Several pages of worked examples are given. The text is arranged with German and English in parallel columns.

The control of quality in the production of wrought non-ferrous metals and alloys. Part III—The control of quality in heat-treatment and final operations.
London, Institute of metals, 1955. 104 p., $2.50. (Monograph and report series no. 17).

The papers published here were presented at a symposium held in London in March, 1955. The six papers are followed by a general discussion of the reports.

The subjects covered range from an assessment of quality of wrought products; the production of rolled, extruded, and drawn aluminium and its alloys, of copper and aluminium rod and wire, and of copper and copper-base alloys; to the production of light-alloy drop-forgings, and the heat-treatment, inspection, and testing of wrought nickel and nickel alloys.

***Engineering in history.**
R. S. Kirby and others. Toronto, McGraw-Hill, 1956. 530 p., illus., $10.20.

This is a general introduction to the subject, devoted to recording the most significant achievements in certain branches of civil, mechanical, electrical, and metallurgical engineering. Engineering history is integrated into general history with the intent of showing how social conditions influenced engineering advances and how these in turn influenced the development of Western civilization. Selected references are listed after each chapter, and a general bibliography is given at the end of the book.

50 years' boundary layer research.
H. Gortler and W. Tollmien, eds. Braunschweig, Vieweg, London, Maxwell, 1955. 499 p., diagrs., $13.50.

It was in 1904 that Ludwig Prandtl gave a lecture at Heidelberg which established the theory of boundary layers. This volume, containing forty-four papers written by leading scientists from all over the world, has been published in commemoration if that event.

However, the book is not an historical survey, but rather the authors have presented the findings of the latest research on the subject. It should therefore, be of interest to all those connected with fluid dynamics, aeronautics, shipbuilding, etc.

Among the topics considered are turbulence, the boundary layer in the electron stream, the laminar boundary layer on a rotating sphere, the growth of the boundary layer behind a shock wave, the profile drag of biconvex wing sections at supersonic speeds, etc. With one exception the papers are all in English or German.

The Financial post survey of oils, 1956, vol. 14.
Toronto, Financial Post, 1956. 372 p., $3.00.

This is the most comprehensive survey of its kind, covering 600 oil producing, refining, pipeline and drilling companies in Canada. Its reports on individual companies give data on production, reserves, earnings, dividends, acreage interests and management.

A special section contains up-to-date maps of important oil fields, including some 1956 information.

The volume also provides a five-year price range of oil stock movements, among other statistical material, and lists inactive and defunct companies.

Germanium diodes.
S. D. Boon. Eindhoven, Philips, Houston, Elsevier, 1956. 85 p., illus., $1.95 (U.S.)

The germanium diode is one of the new "semi-conductors" and this small book describes its properties and uses. Sufficient theory is given to enable the reader to analyze the most common diode problems and to design diode circuits, but the book is mainly practical. There is a detailed treatment of the electrical properties of germanium diodes, and various examples of practical applications of this device are provided.

***Heating ventilating air conditioning guide, volume 34, 1956.**
New York, American society of heating and air-conditioning engineers, 1956. 1696 p., $12.00 (U.S.)

The new edition of this standard guide to current practice in the field has been brought up to date by additions or changes in sections devoted to heat transmission of building materials, cooling load, chimneys, estimating fuel consumption, central systems for air conditioning, automatic control, automobile air conditioning, and a number of other subjects. As in past years, the contents are presented in seven main sections dealing with fundamentals, human reactions, heating and cooling loads, combustion and consumption of fuels, systems and equipment, special systems, and instruments and codes. A manufacturers' catalog data section is again included.

High-speed combustion engines, 16th ed.
P. M. Heldt. Philadelphia, Chilton, 1956. 805 p., illus., $12.00 (U.S.)

This new edition of the classic text book on combustion engines covers design, production and tests.

New developments since the previous edition was published in 1951 have made it necessary to include material on the properties of liquefied petroleum gases used as motor fuels. There is a new chapter on the thermodynamics of the combustion engine, and the chapter on engine tests has been enlarged.

The general plan of the book remains the same. Each component of the combustion engine is discussed separately: engine cylinders, crank case, pistons, connecting rods, engine valves, carburetor, ignition equipment, bearings, manifolds and muffler, etc. There are also sections devoted to the problems of balancing the engine, torsional vibration, water- and air-cooling, speed control and power output.

• LIBRARY NOTES

Introduction to electrical engineering.

Walter La Pierre. New York, Harper, 1956. 339 p., diagrs., $5.25 (U.S.)

This textbook is designed to give new students of electrical engineering a broad view of the field and, at the same time, some detailed knowledge of it. The first part of the book deals with electric circuits and basic electromagnetic relationships, including capacitive and polyphase circuits. The last twelve chapters describe the generation, use, and control of electric energy. Within this broad range, there are chapters on the polyphase synchronous machine, industrial power distribution, production of direct current, lighting, and electrical instrumentation.

There is also some discussion of the economic, industrial, and social aspects of electrical engineering, within the United States.

Job evaluation, 2nd ed.

J. L. Otis and R. H. Leukart. New York, Prentice-Hall, 1954. 532 p., $6.50 (U.S.).

Here is a comprehensive treatment of a fairly new aspect of industrial management. The aims of the first edition—to present the principles of sound wage and salary administration based upon job evaluation — have been retained. The authors have increased the number of practical illustrations and mechanical details of job evaluation, and have included case problems at the end of each chapter.

The book is divided into six large sections, beginning with an introducion to job evaluation. This is followed by a detailed description of nonquantitative and quantitative evaluation systems, and by chapters on methods of analyzing and evaluating jobs. The last two sections are devoted to the procedures used in establishing the pay system, and to the principles of wage and salary administration.

Melfort looks ahead. "A guide for community development."

Regina, Dept. of municipal affairs, Community planning branch, 1956. 74 p., mimeog., plans.

This is an example of what a small town can do in the field of town planning. The sub-title of the book is "A guide for community development" and it might well be used as a guide by other towns faced with the same problems of expansion.

The problem is divided into sections such as regional considerations, economic aspects, and population forecasts. The actual planning is considered in regard to residential, business and industrial districts, schools, public buildings, recreational areas, public utilities and roads.

Suggestions are also given for ways in which the recommendations may best be implemented.

Modern marine engineering.

D. W. Rudorff. New York, Philosophical library, 1956. 154 p., illus., $4.75 (U.S.)

In this book we find a concise review of various types of propulsion plants used in marine vessels. These include steam boilers, condensers and reciprocators, geared steam turbine drive, turbo-electric propulsion, and gas turbines.

There are also chapters covering the use of electricity on ships, and refrigerating techniques. Detailed treatment of technical matters is avoided; the book gives instead a broad descriptive view of modern trends in marine engineering.

Office work and automation.

H. S. Levin. New York, Wiley, 1956. 203 p., $4.50.

The tempo of change in office management is rapidly accelerating and the executive will welcome any book which attempts to keep him abreast of this change.

The central theme of this book is information handling—in three phases: first the initial handling of the great quantity of information flowing into an office, with discussions centering around the common-language concept.

The next chapter deals with electronic computers and their impact on business data processing. Various problems arising from the introduction of computers into an office are discussed.

• LIBRARY NOTES

The end result of office automation is the use of the information thus obtained, and this is described under the term "operations research". The last chapter deals with some of the changes which arise from these new developments.

A pocket-book for mechanical engineers, 6th ed.

D A. Low. Toronto, Longmans, 1956. 778 p. diagrs., $3.80.

Since the publication of the previous edition of this concise reference work in 1948 there have been new developments which necessitated the revision of some material. New editions of certain British standards have also caused some changes. The main alterations and additions are in the sections on iron and steel, non-ferrous alloys, wood, unified screw threads, bolt-heads and nuts, pipes and pipe joints, ropes, chains, and sand-blasting.

As in former editions there is a good deal of space devoted to the proportions of machines and machine details, with numerous rules and tables given.

Principles of turbomachinery.

D. G. Shepherd. New York, Macmillan, 1956. 463 p., diagrs. $10.00 (U.S.)

The originality and value of this text-book lies in the fact that the author has correlated the use of turbomachinery in pumps, fans, compressors, and steam, gas, and hydraulic turbines. There is no attempt to present design from the mechanical standpoint. Rather, the emphasis is on a general treatment of all forms of turbomachinery, including such aspects as dimensional analysis, energy transfer, thermodynamics of compressible flow, and the flow of fluids in the passages and over the blades of turbomachines.

These principles are then applied to the individual types of machines and a general description of design methods is given so that the reader is able to understand performance factors.

Early in the text attention is given to basic energy quantities and to the rather difficult problem of notation, to avoid confusion as much as possible.

°Resistance of materials, 4th ed.

F. B. Seely and J. O. Smith. New York, Wiley, 1956. 459 p., diagrs., $6.50.

Part I of this standard text consists of the basic topics usually included in the subject: relations among loads, stresses, and deformations; stresses in beams; statically indeterminate members; dynamic loads, etc. Part II deals with such additional topics as composite beams, unsymmetrical bending, continuous beams, and elastic vibration of load-resisting members.

Route surveys and construction, 3rd ed.

Harry Rubey. New York, Macmillan, 1956 282 p. illus., $6.25 (U.S.)

The tables contained in this reference book are for use in the survey, design, and construction of highways, railroads, airways, conveyor belts, canals, pipe lines and transmission lines. Some of the tables are not easily found elsewhere, for example, eight place natural sines and coisines.

In this edition there is more emphasis on professional engineering, engineered construction, professional management, contracting, and practical photogrammetry.

Sistemi elastici piani; metodo dell'incognita principale.

Attilio Linari. Naples, Pellerano del Gaudio, 1956. 2v., diagrs., tables, 3000 lire.

In these volumes the author presents new methods for calculating continuous beams, frames and Vierendeel beams, beams with various moments of inertia and continuous parallel beams.

The second volume is composed of tables of the various functions required in the calculations.

Stability functions for structural frameworks.

R. K. Livesley and D. B. Chandler. Manchester, University press, 1956. 33 pp., 6/—.

The tables in this pamphlet are for use in determining the critical loads of elastic rigid jointed structures, and were worked out on the electronic computer at Manchester university. As the functions are still unfamiliar to many engineers, examples are given of some of their methods of use.

Technology of heat.
H. W. Baker. Toronto, Longmans, 1956. 427 p., diagrs., $6.50.

The author's object in writing this book was to provide the engineering student with a fairly complete understanding of the technology of heat.

Following a general introduction to the subject there are chapters on actual working fluids and fluid mixtures; elementary working cycles for transforming heat into mechanical work; reversibility and entropy; fuels and combustion; the theory of air compressors and motors; steam engines and turbines; heat pumps; heat transference by radiation, conduction and convection; waste heat recovery and heat balances.

°Theory and practice of lubrication for engineers.
D. D. Fuller. New York, Wiley, 1956. 432 p., diagrs., $10.50.

In the first half of this book, fundamentals of viscosity and flow are dealt with, and the hydrodynamic and hydrostatic theories are developed from simple and readily understood principles. In the last half, two chapters are devoted to journal bearings, and single chapters to typical industrial bearings, materials, air-lubricated bearings, dry friction, and boundary friction. Many bearing designs are given, including those for machine tools, generators, rolling mills, and centrifuges. The book is intended both for class room use and for practicing engineers.

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

Air pollution

Toronto. Air pollution advisory board report, 1955.

Concrete

The pathology of construction: the causes of cracking of concrete. J.-P. Lévy. (N.R.C. Technical translation no. TT 574)

Construction

Winter construction. Bertil Naslund. (N.R.C. Technical translation no. TT 583)

Electrical engineering

A-c. network analysers . . . A. P. N. Ford and J. Miedzinski. (E.R.A. V/T127)

An adjustable ambient-temperature thermometer for use when testing transformers M. R. Dickson. (E.R.A. Q/T141)

Iron-loss tests on transformers with cores of hot-rolled and cold-rolled silicon steel. (E.R.A. Q/T140)

Picture book of TV troubles, v.5 Horizontal output and H-V circuits. New York, Rider, 1956. 100p., illus., $1.80 (U.S.)

R-F transmission lines. Alexander Schure, ed. New York, Rider, 1956. 63p., diagrs., $1.25 (U.S.)

Radio receiver laboratory manual. A. W. Levey. New York, Rider, 1956. 104p., illus., $2.00 (U.S.)

A stable synchronous detector for audio-frequency measurements. P. G. Kendall. (E.R.A. V/T125)

A study of domain structures in alnico. L. F. Bates and D. H. Martin. (E.R.A. N/T71)

Engineers. Unionization

Professional engineers and collective bargaining; selected references. Princeton University, Industrial relations section, 1956.

Frost

On the increasing danger of frost damage to our highways. Lothar Schaible. (N.R.C. Technical translation no. TT 568)

Miscellaneous

Argon arc welding of aluminium and its alloys. Electrical considerations. L. H. Orton and J. C. Needham (E.R.A. Z/T104)

Atomic energy: a Financial Times survey. April 1956.

La commande hydraulique: applications industrielles. Paris, Dunod, 1956.

Parking: legal, financial, administrative. Saugatuck, Eno foundation, 1956.

A.S.M.E. Boiler and pressure vessel code. Section IV Low-pressure heating boilers. 1956 ed. $1.25 (U.S.)

Shorter form of the national building code of Canada (1953) (N.R.C. Assoc. committee on the national building code)

Standards for distribution transformers. (E.E.I. no. 55-14)

Standards for wet-process porcelain insulators (Apparatus-cap and pin type (E.E.I. no. TDJ-58)

Standards for wet-process insulators (Apparatus-post type) E.E.I. no. TDJ-59)

STANDARDS REVIEWED

A.S.T.M. Standards, American society for testing materials, 1916 Race St., Philadelphia 3.

Petroleum products and lubricants, 1955.

The present issue of this compilation has been brought up to date by the addition of the following: nine new test methods covering the effect of grease on copper, sampling LP gases, lead in new and used greases, etc.: nine revised standards, including revised ASTM-IP petroleum measurement tables; and a number of new and revised tentatives. A detailed subject index is included. 954 p., $6.50 (U.S.).

Textile materials, 1956.

These standards cover testing machines; humidity testing; identification and qualitative analysis; quantitative an-

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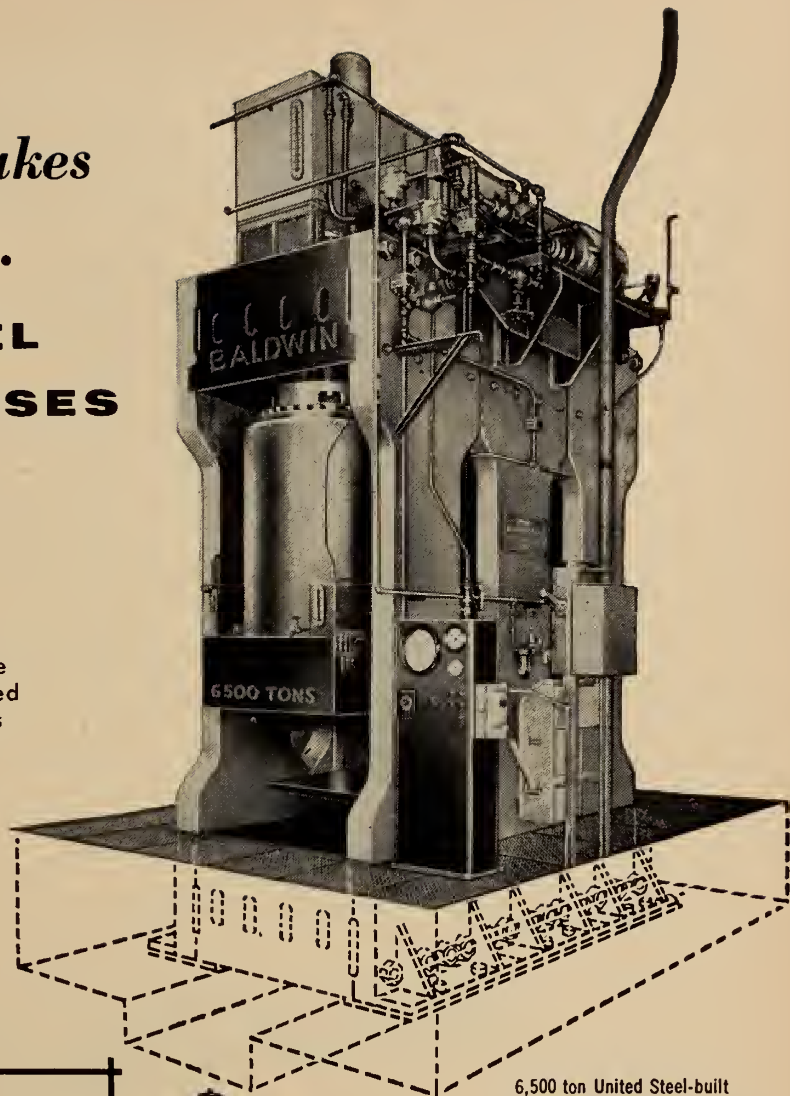

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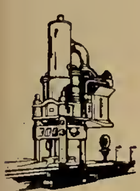

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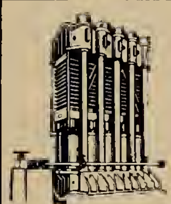

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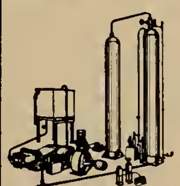

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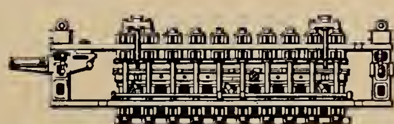

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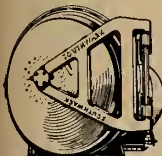

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• LIBRARY NOTES

alysis; fibers; textiles made of asbestos, bast and leaf fiber, cotton, glass, rayon, acetate, silk, and wool; and warp knit, pile, and unwoven fabrics. Twenty-two of the standards are new or revised since the previous edition was published in 1954. 761p., $5.75 (U.S.)

British Standards, British standards institution, 2 Park St., London W.1. British standards are also available from the Canadian standards association.

B.S. 602, 1085:1956—Lead pipes for other than chemical purposes.

For the first time these two standards have been included under one cover, as pipes complying with both standards mainly serve the same applications for other than chemical purposes, and they are made by the same extrusion presses.

In the revised B.S. 602 for some applications lighter weight pipes are permitted, and this has necessitated the introduction of additional tables, as the heavier weight pipes are still recommended for service underground. In the revised B.S. 1085 a slight amendment has been made to the composition.

The tables in both standards specify the minimum weight to be used for each application. When sizes above the minimum are required, the new standard specifies that they should be chosen from the list of standard bores and weights given in an Appendix in order to limit the number of sizes of pipes demanded. 6/-.

B.S. 2591: 1956 Glossary for valves and valve parts (for fluids) Part 2—Safety valves and relief valves. Part 3—Plug valves and cocks.

Part 2 defines types of, and parts for, the following types of ordinary safety valve: direct spring loaded; direct weight loaded; lever and weight loaded; lever and spring loaded; 'Ramsbottom' type. There are seven illustrations of typical safety valves.

Part 3 defines types of, and parts for, the following types of plug valve and cock: lubricated plug valve; non-lubricated plug valve (including lift plug and split plug types); plug cock; gland cock; compound gland cock; packed cock. There are six illustrations of typical plug valves and cocks. 6/- each.

B.S. 2654: Part 1: 1956—Vertical mild steel welded storage tanks with butt-welded shells, for the petroleum industry. Part 1: Design and fabrication.

This new British Standard specifies the materials, design and fabrication of vertical cylindrical tanks, with butt-welded shells, for erection above ground. The tanks are of the following types: a. Non-pressure fixed roof tanks (all sizes); b. Pressure fixed roof tanks (up to 128 ft. diameter only); c. Open top tanks (all sizes).

Tanks with floating roofs are excluded. Reference is made to mountings, stairways and handrailings. There are numerous tables and twenty-two illustrations. 15/-.

Canadian standards, Canadian association, National research building, Ottawa.

C92.2-1956—Canadian standard practice for street and highway lighting.

This code is based on the American Standard Practice for Street and Highway Lighting as sponsored by the Illuminating Engineering Society and approved by the American Standards Association.

It is believed that all improvements that are economically practicable should be made as soon as possible since it has been definitely established that adequate lighting results in a decrease in crime and in traffic accidents. The installation of adequate lighting costs the community less than the accidents caused by inadequate lighting and it is evident that the elimination of lighting inadequacies will not only remove the cause of a great loss of life and will reduce crime, but would also permit a more expeditious movement of traffic. 50 cents.

The Automotive Industry

This article covers the main fields of industry in Canada that offer scope for the automotive engineer and his associates. More specifically, these fields concern the production of automobiles, trucks, and buses, and the maintenance of large operating fleets, particularly of public service vehicles.

There are certain specialized applications and equipment, such as those used in the construction industries — special vehicles, earth-moving equipment, mobile cranes and other materials-handling units — that might be considered as coming into the province of the automotive engineer, but these concern a minority of such engineers and will be more appropriately dealt with in further articles on industries using such equipment.

In general, the mechanical engineer predominates in the industry, but there is also a demand for electrical and some civil engineers. Many senior production and administrative posts are filled by engineers, and several of the industry's top executives are engineering graduates.

The Automobile Industry

All the leading American automobile makers have manufacturing facilities in Canada, mostly located in Ontario, but with smaller plants in other provinces. The extent of these operations naturally varies, but covers the production of engines, chassis, bodies, and their assembly into the finished vehicle. Some British and European makers have engineering facilities in Canada, which may well be extended in the drive for the Canadian export market.

Annual production of passenger cars in Canada during the 1950's has approached 300,000, while the total number of male salaried employees has steadily increased to a present figure of some 5000 in the motor vehicle manufacturing industry. Although there is some seasonal fluctuation of employment in the industry as a whole, this does not affect those positions filled by the engineer.

The highly competitive nature of the North American automobile industry results in an exceptional degree of advanced planning for model changes, and the design engineer has a major role to play. Even minor modifications to engine or body style involve considerable work for the tool designer and for the production engineer, since this is a mass-production industry and there must be complete interchangeability of components made at high rates of output.

Design of tools and plant, in fact, is quite as important as the design of the actual automobile, and there is a similar division of other duties between engineering for the product itself and for the production plant, so that two separate departments may be, and often are, necessary.

Vehicle Engineering

The department responsible for the engineering of the product will usually have need of metallurgical engineers to deal with the many applications of ferrous and non-ferrous metals and alloys to be found in the modern motor vehicle. Project engineers are required for engine, chassis, body, and accessories and other equipment; here, also, the services of electrical engineers are needed.

This vehicle engineering group may range from junior project engineer, through senior and supervisory grades, to chief engineer.

Production Engineering

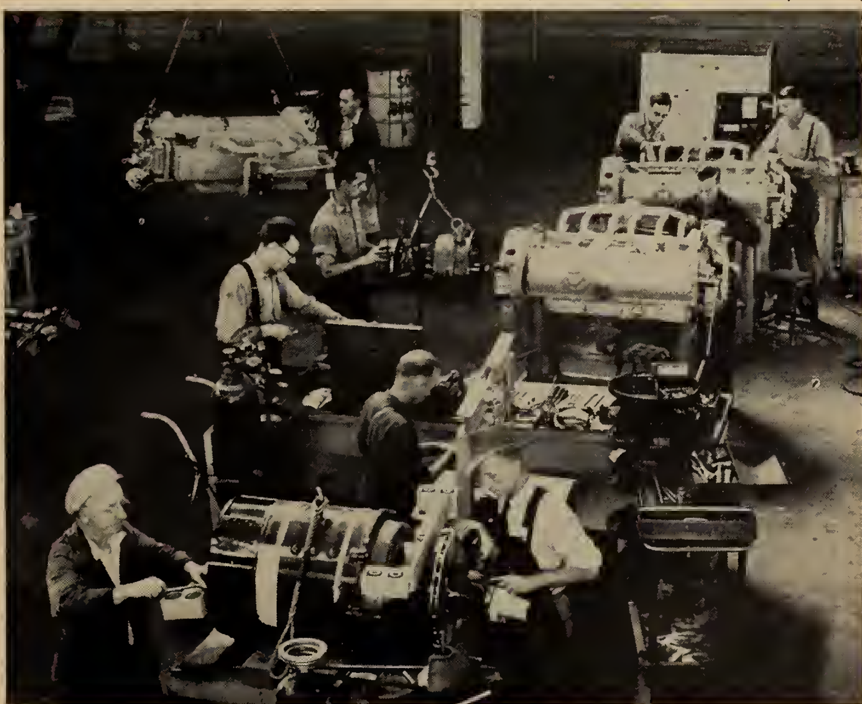
As already mentioned, the industry is generally based on mass-production, and efficient plant engineering is all-important.

When a major change in a car model is planned, new tooling and dies must be designed, made, and installed together with other necessary new production equipment in a short period limited by the demands of current production and starting the new run to meet sales demand.

Tools, dies, and patterns have to meet high standards, since all components and spare parts must be completely interchangeable. Furthermore, this accuracy must be maintained over long production runs, both for reasons of economy and for maintaining continuity. This is the field of the tool engineer, and some idea of its scope may be gathered from the fact that tooling costs for a new model may run into several million dollars.

A constant check must be kept on the quality of materials and products,

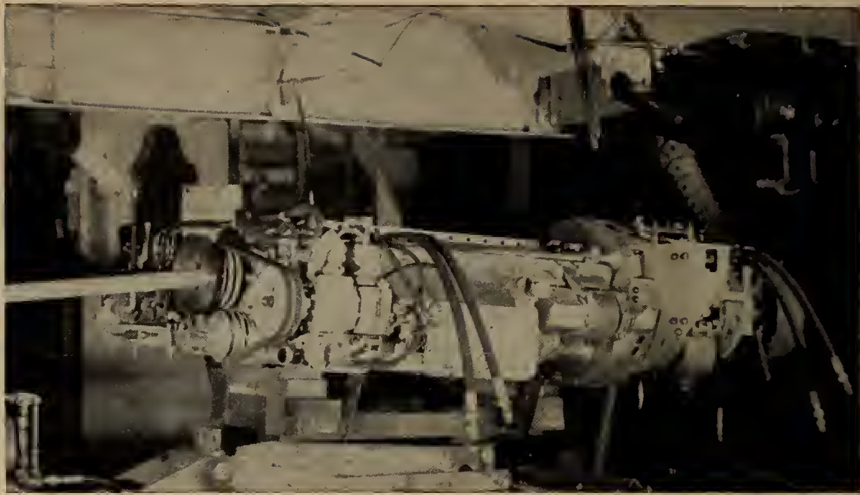
Assembling engines and electrical traction motor units
(Photo—Canadian Car and Foundry Limited)



and a staff of quality control engineers operates in the production departments.

Mass-production in this industry involves the use of much complex machinery including fully automatic transfer machines for the production of finished engine and other components from original stock. Maintaining the mechanical installations in a production plant requires the services of plant engineers, with an electrical engineering staff to look after the power supply systems and other electrical equipment.

The production field offers opportunities for engineers in the departments mentioned, and further to senior management positions.



Large engine assembly in position for lifting into chassis

(Photo—Canadian Car and Foundry Limited)

Trucks and Buses

There are several truck manufacturing plants in Canada, again mainly in Ontario, a large Canadian bus manufacturer in Manitoba, and other bus plants.

The requirements for engineers are much the same as found in the automobile industry, both for product and production engineering, with the same high standards for tooling and interchangeability of finished parts.

Opportunities for advancement to senior engineering and management positions are also open to the engineer.

Maintenance Departments

Most of the major centres of population across Canada operate public transportation systems, mostly using buses.

The conditions of service of these vehicles are particularly severe under normal conditions and become even more so during the winter. Consequently, a heavy load is placed on maintenance facilities.

The larger transportation systems operate maintenance shops with mechanical engineers on the staff; some electrical engineers may also be required, and civil engineers may be called upon for the construction and extension of the system's roads and premises. (Naturally, the systems that also use street-cars and trolley buses have a greater need for electrical engineers, but these systems are not considered in detail here.)

Many of the shops use systems of preventive maintenance, which may be designed and applied by the engineering staff.

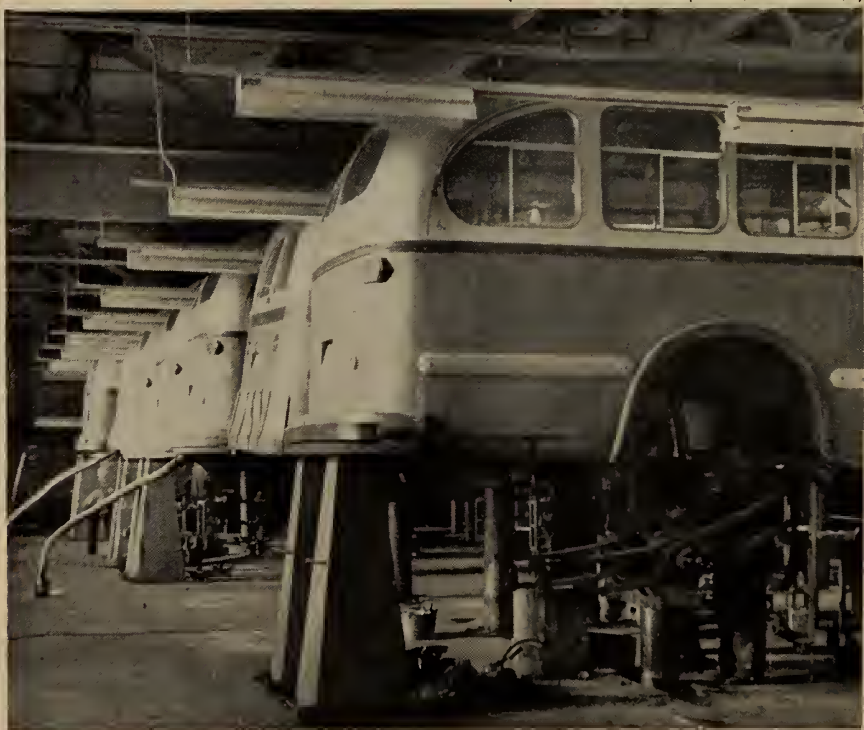
Although the practical engineering staffs of these undertakings may be small compared with those in other parts of the industry, there are opportunities for the engineer to enter the fields of administration and management in the transportation systems.

To a lesser extent there may be some need for engineers in the operating and maintenance departments of large users of trucks and other vehicles.

There is also an intermediate field of operation in which engineers are required to follow up on problems that may arise in the use of a manufacturer's vehicle or components or in servicing and maintenance.

Preventive maintenance is essential for large users of vehicles. Maintenance departments often need engineers.

(Photo—Montreal Transportation Commission)



Training Schemes

Manufacturers and maintenance departments take undergraduates for summer work to a limited extent.

The manufacturers generally provide the newly-joined recently-graduated engineer with training courses to suit the specialized requirements of the industry. Such courses may extend up to two years, initially, during which time the engineer is on salary and studies both theory and practice of all the industry's operations.

Salary Scales and Benefits

Engineering salaries are in line with other leading Canadian industries.

Paid vacations, pension and health schemes, and some bonus schemes apply. The automobile manufacturers may offer special terms on the purchase of new cars and components.

mine and mill conveying equipment, to huge post installations for stocking and transferring such basic raw material as gypsum and iron ore. Location Ontario. File No. 5756-V.

CIVIL OR MECHANICAL ENGINEER preferably early thirties to act as project engineer, and as such would have liaison work to do between construction jobs and chief engineer, and therefore must have a knowledge of construction, both structural phases in concrete, structural steel etc. and in erection of equipment. The salary can be mutually arranged and will be satisfactory. All usual benefits are available, such as pension plan, group insurance etc. File No. 5757-V.

ASSISTANT PUBLIC HEALTH ENGINEER required by B.C. Civil Service Department of Health & Welfare, Victoria, B.C. Salary $420.00 rising to $500.00 per month. To assist in supervising policy of sanitation, approving plans for water and sewerage systems and related work. Eligible for professional registration in B.C. preferably experience in public health engineering. British subject. Apply Chairman, Civil Service Commission, Parliament Buildings, 544 Michigan Street, Victoria, B.C. File No. 5758-V.

JUNIOR INTERMEDIATE AND senior engineers for the design and development of and field representation on: navigational aids, transistor application, fire control systems, air data systems, ice detection and production equipment, photographic processing equipment, optical plotting and measuring devices, armament control equipment and other forms of servo-mechanisms and computors. File No. 5759-V.

MILL SUPERINTENDENT. Metallurgical or chemical engineer, to take charge of privately owned uranium mill in Saskatchewan. Must be experienced in the operation of ore milling and hydrometallurgical plants. Will have a staff of several engineers and total crew of 60-70 men operating crusher, mill, acid manufacturing plant. Excellent housing available for family. Apply giving details of education and experience to File No. 5763-V.

A SPECIALIST in aircraft engines and propulsion is required to undertake studies and analyses for defence requirements; to evaluate research and development projects and plan test facilities in support of these; to be responsible for technical supervision of extramural research projects; to carry out liaison with research laboratories and the services on development projects. Candidates must be Canadian citizens or British subjects, and graduates of a recognized university in aeronautical or mechanical engineering or engineering physics with a good academic standing. Some pertinent experience is essential. Initial salary is dependent on qualifications and experience. Employee benefits include a five-day week, generous provision for vacation and sick leave, medical-hospital insurance plans, and an attractive pension scheme. Excellent opportunity for advancement.

Inquiries are invited from interested candidates. Write, outlining briefly your qualifications, to: Director of Personnel, Defence Research Board, Ottawa, Ontario. Please refer to 56-DRB-2. File No. 5787-V.

Mass Transportation in Cities

(Continued from page 938)

automobiles in motion, and one twentieth of the space when stopped. Trams and buses on Toronto's Bloor Street handle 9500 people per hour. Automobiles bumper to bumper could carry only 2000 people per hour. Trams would serve on Toronto streets for a long time yet, he predicted.

Comparing capacities of Toronto thoroughfares, he stated that before the subway was opened Yonge street carried 13,000 passengers hourly. The subway carries 40,000 passengers per hour. An expressway for bus and auto traffic combined could carry 2500 per hour, and with auto traffic alone could carry only 600 or less per hour. The subway costs $11 million per mile. The average street costs $5½ million per mile uptown and $8 to $10 million downtown.

Colonel Bingham explained that the basic problem was to open a way for people and commerce through streets now choked with automobiles. Transit, he said, was safer and relatively cheap, and would be faster if not impeded by autos, though in rush hours it was more crowded and uncomfortable.

Montreal, he said, was entering a period of accelerated growth due to the impact of the Seaway, and new problems were arising. Mass transit was the only alternative and must be encouraged by society and governments. Improvement of transit equipment had to be studied.

Montreal would need a subway soon, he predicted. Another solution might be the use of the newly designed monorail such as is now in service at Houston, Texas. Costing only $700,000 per mile as compared to $12 million per mile for subway construction, it could be designed for use underground with double track at a cost of $11 million per mile.

There was need to distinguish between the advantages of each type of service and to co-ordinate all systems to the maximum benefit of the city. Planning, he emphasized, should be along lines to take care of the predicted volume of traffic 20 years ahead.

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MEMBERSHIP

Indexed in The Engineering Index

Contents - August 1956

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Microwave Radio Project

of the Trans Canada Telephone System

J. A. Groleau, M.E.I.C.

Area Chief Engineer, The Bell Telephone Company of Canada

Chairman, Engineering Committee, The Trans Canada Telephone System

Read at the 70th Annual General and Professional Meeting of the Engineering Institute of Canada, Montreal, May 1956

By mid-1958 the Canadian continent will be crossed by a microwave radio system now under construction by the Trans Canada Telephone System. This is the largest such undertaking by the commercial companies, and will materially enlarge long-distance facilities and provide television network under contract to the Canadian Broadcasting Corporation. The electrical and constructional engineering problems involved are challenging, and the techniques are described here.

AT THE 1954 annual meeting of this Institute, Mr. A. G. Lester, M.E.I.C., presented a paper tracing the history of telecommunications in Canada and outlining some of the developments expected in the future. This present paper covers a current project of major importance, the construction of a transcontinental microwave radio system by the Trans Canada Telephone System. This undertaking will provide for a material enlargement of long distance facilities and for the provision of network television facilities under contract to the Canadian Broadcasting Corporation. This is the largest project ever undertaken by the commercial communication companies, and it is making large demands on Canadian engineering, construction and manufacturing skills.

There are seven principal administrations responsible for the provision of local and long distance telephone service in Canada. These are the Maritime Telegraph and Telephone Company, The New Brunswick Telephone Company, The Bell Telephone Company of Canada, the Manitoba Telephone System, the Saskatchewan Government Telephones, the Alberta Government Telephones and the British Columbia Telephone Company. Each of these administrations provides the plant and equipment required to furnish service in its own territory. About 25 years ago these seven administrations formed the Trans Canada Telephone System for the purpose of developing long distance communications on a national scale. The Trans Canada Telephone System is not a corporation, but rather is a co-operative undertaking in which the seven administrations agree to provide adequate facilities between provinces and to work to uniform standards of service and transmission with the objective of supplying long haul telecommunications adequate to the country's needs.

Figure 1 shows the circuit mileage devoted to the handling of interprovincial and long haul business, excluding that between Ontario and Quebec, from the beginning of the Trans Canada System until the present time. The expansion in Canada's economy since the end of the war has been accompanied by very rapid growth in long haul communications, and the circuit mileage and volume of business has doubled each five years.

Except for the heavily settled sections of Ontario and Quebec, the long haul circuits of the Trans Canada System are developed on open wire lines equipped with carrier systems, supplemented in the Maritime provinces by a microwave radio system of limited circuit capacity between Halifax and Saint John. About three years ago, it was apparent that with further growth the capacity of the existing structures would soon be exhausted and that major construction would be required to obtain additional facilities across most of the country. Long range studies were undertaken to determine if relief should be provided by the construction of more open wire lines, by the provision of cable, or by the construction of a major microwave radio system. The Bell Telephone Company of Canada already had under way a microwave radio system connecting Buffalo, Toronto, Ottawa, Montreal, and Quebec.

Looking well into the future, microwave was a very attractive solution. It is the most modern and flexible means of long haul communications. It has inherently a large capacity for future growth, and has the particular attribute of being suitable for the development of facilities required for network television service. In addition, it provides storm-free plant, a factor of major importance when one considers the vast distances and wide range of climatic conditions in Canada. Early in 1954, the Bell Telephone Company and the Manitoba Telephone System decided to proceed with the construction of such a system between Toronto and Winnipeg, and studies were continued for the rest of the country. At about that time, the Canadian Broadcasting Corporation invited tenders from the principal telecommunications companies for the provision of network television facilities on a transcontinental basis, and the Trans Canada Telephone System was awarded this contract in competition with the other carriers. Early in 1955 work was started on the construction of a microwave system through the rest of the country.

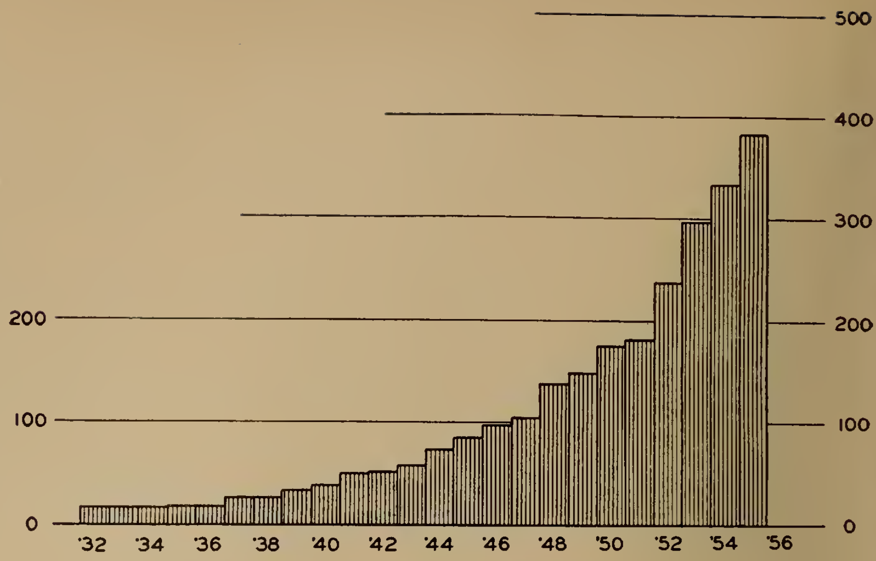


Fig. 1. Circuit mileage of the Trans Canada System.

The TD-2 Radio Relay System

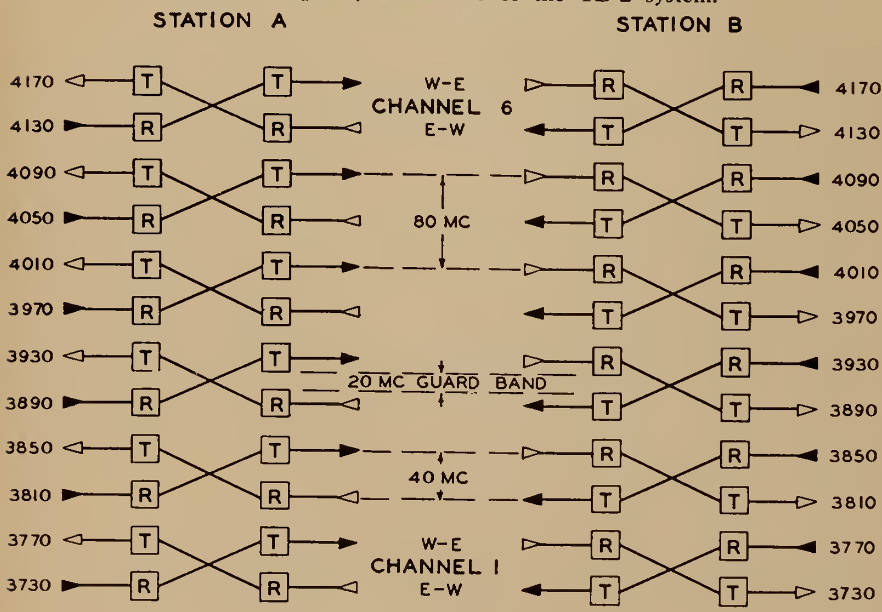
The project is using what is known as the TD-2 radio relay system. This is the type of system that has been in service between Buffalo, Toronto, Ottawa and Montreal for the last three years. It is designed to carry large quantities of high grade telephone circuits and network television over the long distances encountered on this continent, and many thousand channel miles of it are in satisfactory operation in the United States.

Transmission Design

It operates in the 4000 megacycle band with a corresponding wave length of approximately three inches, and the system has capacity for six radio channels in each direction. One radio channel can handle 600 telephone circuits or a black and white or colour video signal. Under certain conditions, a channel can handle a video signal and a limited number of telephone circuits as well. Channels may be equipped one at a time and the system can be readily expanded to care for growth. Of the six pairs of channels, one is normally reserved for protection purposes, and electronic devices switch the protection channel in to replace any regular channel on which transmission becomes unsatisfactory.

Although much has been achieved in the last few years in the transmission of microwave signals well beyond the horizon using tropospheric scatter propagation, this type of operation is not satisfactory where very large quantities of voice circuits or a video signal must be carried long distances. Consequently, the TD-2 system requires conventional line-of-sight transmission paths between repeater stations. The transmission design assumes an average repeater spacing of about 30 miles, with a corresponding free space transmission loss of about 135 db. Sufficient transmission margin is available to allow a limited number of repeater sections to be somewhat in excess of 40 miles and still provide adequate protection against propagation fades. This basic design parameter of about 30 miles checks out well with the practical limitations imposed by terrain, and it is the usual experience that the average repeater spacing on systems of this type is between 28 and 30 miles.

Fig. 2. Frequency allocations of the TD-2 system.



The frequency plan of the TD-2 system is shown in Fig. 2. The 12 channels occupy the spectrum between 3700 and 4200 megacycles. Channels are placed 40 megacycles apart, with 20 megacycles used for the channel proper and 20 megacycles as a guard band between channels. Alternate frequencies are used for opposite directions of transmission, providing an 80 megacycle separation between channels transmitting in the same direction, thus simplifying the design of filtering arrangements at transmitters and receivers. The frequencies assigned to a pair of channels are transposed by 40 megacycles at each repeater station. In this way, like frequencies are at about the same transmission level at each repeater point thereby reducing the problem of interference between antennas.

Terminal and Repeater Schematic

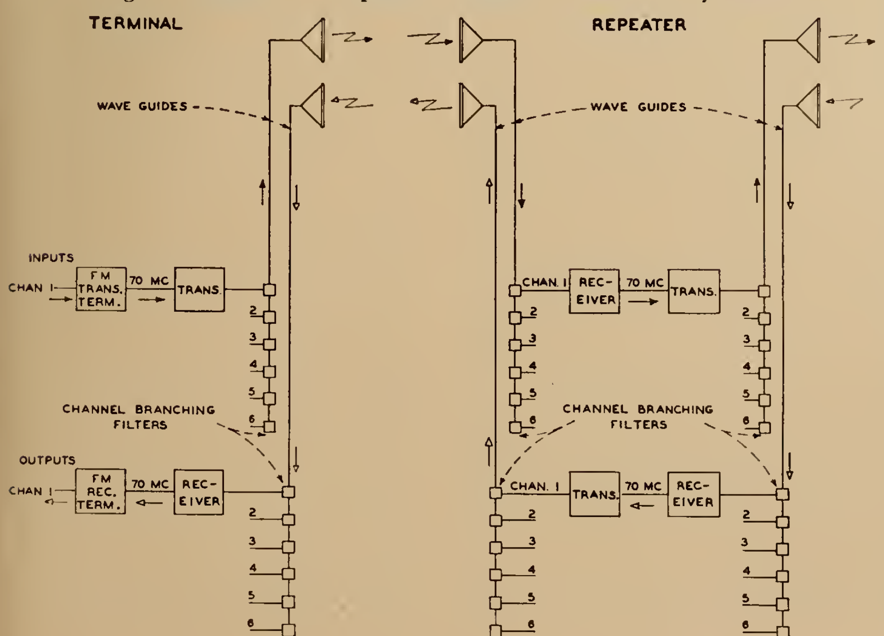
A block schematic of the terminal and repeater arrangements of the TD-2 system is shown in Fig. 3. The base band signal from either the telephone multiplex equipment or the video system is applied to a frequency modulation transmitter and the product is a 70 megacycle intermediate frequency. This is heterodyned with the microwave transmitting frequency in the 4000 megacycle band and supplied to the antenna through the waveguide. At the repeater station the line frequency is heterodyned in the microwave receiver, the product being the original 70 megacycle intermediate frequency. Amplification is provided at this intermediate frequency which is then heterodyned again with a line frequency 40 megacycles transposed from the received frequency and applied to the transmitting antenna. At the receiver the incoming signal is brought down to 70 megacycles and the frequency modulation receiver output is the original telephone multiplex or video signal.

Antennas and Waveguide

This radio system operates at very low power levels, the output of the individual channel to the antenna being in the order of one-half watt. Because of this, antennas with highly directional characteristics are required to focus the energy into a narrow beam. The type of antenna being used over most of the Trans Canada route is of a new design known as the horn reflector. The geometry of this antenna is shown in Fig. 4. The antenna is a combination of an electromagnetic horn capped by a section of a paraboloid of revolution. The apex of the horn coincides with the focal point of the paraboloidal reflector. In the side of the antenna opposite the reflecting surface, the horn is cut away to form an aperture of about 64 square feet through which the energy passes to the next station. As shown in Fig. 5, the antenna is a large device about 20 feet high and 11 feet wide, and weighs about 1700 pounds. Great accuracy is required in the manufacture of the reflecting surface as its contour must be accurate to within one-sixteenth of an inch. The antenna is highly directive, providing a gain of 40 db. over what the signal would be if it were radiated in all directions, and thus between the receiving and transmitting antennas there is a power gain ratio of 100 million over an isotropic antenna system. The radiated beam is very narrow and the power falls off to half the level of the main signal with a deflection of only one degree. This imposes some severe design requirements in the supporting tower structures.

The antennas are connected to the radio equipment by low loss copper waveguide. Circular waveguide, having a loss of 0.004 db. per foot and with an internal diameter of 2.812 ± 0.003 inches, is used for the long run from the antenna to the level of the entrance to the building. Rectangular waveguide is used for the entrance to the building and connection to the equipment, and an appropriate coupler is provided between the vertical run of circular waveguide and the horizontal run of rectangular waveguide.

Fig. 3. Terminal and repeater schematic of the TD-2 system.



Waveguide must be manufactured to great precision and erected with care as irregularities of the internal surface act as impedance irregularities at microwave frequencies. The waveguide and antenna system is kept under low pressure of dry air and compressor-dehydrators are provided to supply it.

With a fully developed TD-2 system, separate antennas are required for transmitting and receiving in both directions from a repeater station. When only a few radio channels are equipped, it is possible to use one antenna for both transmitting and receiving by resorting to cross polarization of the energy in two directions.

416B Electron Tube

One of the interesting features of the TD-2 radio system is the 416B electron tube used in the modulator and in the transmitting amplifier. It is a planer type triode and because it operates at 4000 megacycles, the elements and interelectrode spacings are very small indeed. The grid wire is 0.0003 inches in diameter and is wound at 1000 turns per inch. The cathode to grid spacing is 0.0006 inches and the plate to grid spacing is 0.01 inches. Very precise control is required in the manufacture of this tube and it is a remarkably satisfactory device. When one considers that some 5000 tubes of this and other types are involved in the transmission of a signal across the country, the extreme need of high reliability in the performance of these tubes is apparent.

Power Supply

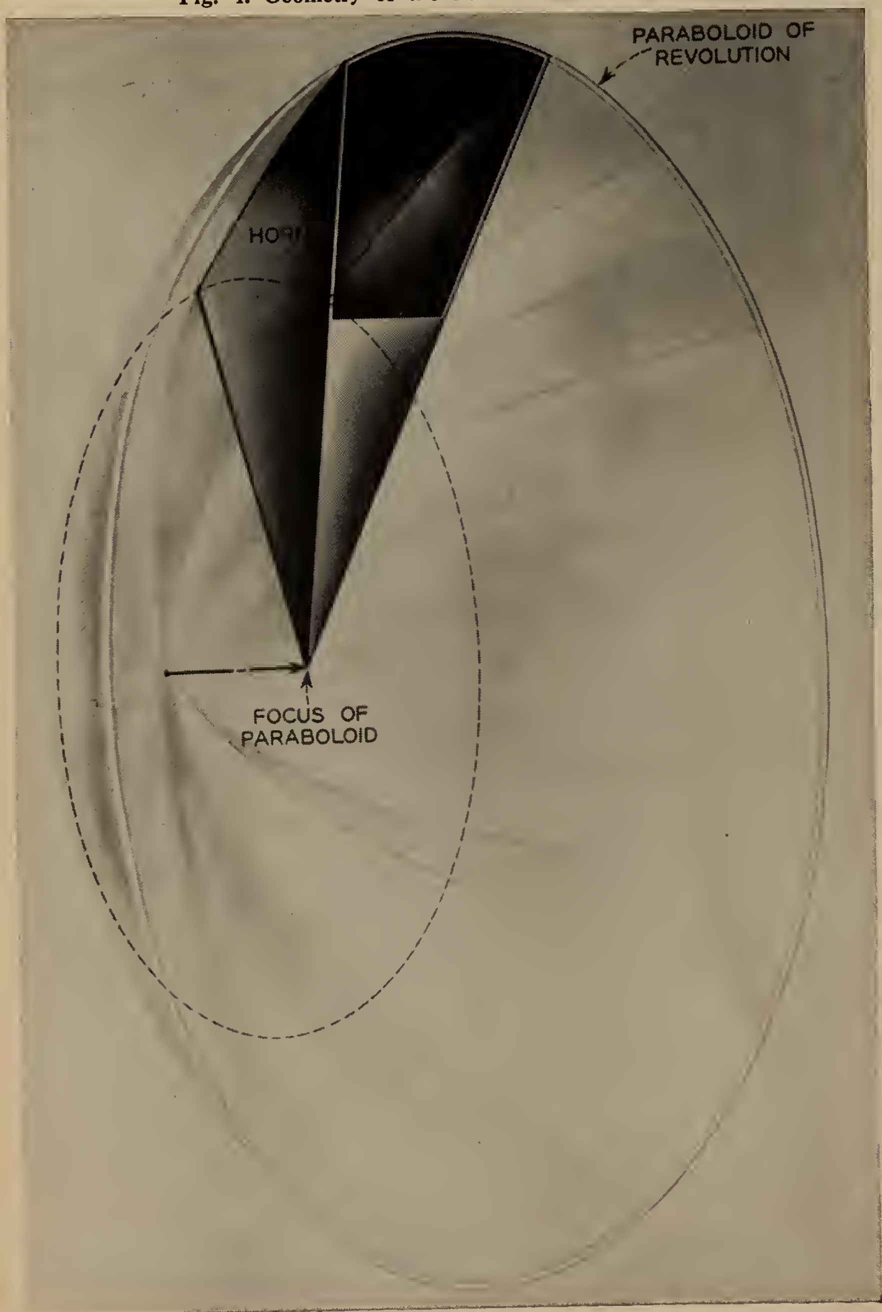
The radio equipment requires direct current power supplies at 12, 130 and 250 volts. A small supply of 24 volts is required for various items of control apparatus in the station. At the small repeater stations, the 12 and 250 volts supplies are normally obtained from rectifiers driven directly from the available alternating current source, with the rectifiers being provided on a per channel basis. No batteries are provided for these voltages. The 130 volt supply is from a battery normally floating across a rectifier. A 10 kilowatt diesel driven alternator arranged for automatic start is provided at each station for use in the event of failure of the incoming a.c. supply. This engine will take over the station load in a two to five minute period after power failure, and during this interval the 12 and 250 volt rectifiers derive their a.c. supply from vibrators operating from the 130 volt battery. Because of the lightning exposure involved at elevated sites with high towers, grounding arrangements must be particularly good, and tower, waveguides, and equipment are well bonded and connected to the power neutral if such is available.

At repeater stations where it is not economic to build out to the nearest available commercial power line, a large diesel plant designed for continuous operation is provided. Two 20 kilowatt engine alternators arranged for automatic timed changeover are supplied.

Equipment Assemblies

The equipment is designed for maximum shop assembly, wiring and testing of the radio, power, and miscellaneous bays. Through the use of fixed floor plan arrangements, cable racking and power cables can be cut in the shop before shipment, thus minimizing the installation effort at the many repeater stations on the route. A photograph of a transmitter-receiver radio bay is shown in Fig. 6.

Fig. 4. Geometry of the horn reflector antenna.



Selection of the Route

The major part of the engineering of a microwave system is the detailed selection of a route connecting the desired service points. Many economic and physical factors must be assessed if satisfactory transmission is to be obtained at minimum cost. Among the factors are the number of repeater stations required, the cost of access roads, the height of the antenna towers, the availability of commercial power and of communication facilities required for alarm purposes, and the physical aspects of the sites as affecting the cost of building and tower foundations.

As already mentioned, the system requires clear line-of-sight transmission paths between stations and these paths should average about 30 miles over a long system, although individual links can be well above this if required. Consideration has to be given to the nature of the terrain between repeater points, as microwave energy can be reflected off the ground and reach the receiving point in such phase relationship with the main signal that it can be either helpful or harmful to transmission.

Preliminary selection of the route is made from office study of topographical maps with at least 25 foot contour intervals. Diagrams similar to that shown in Fig. 7 are drawn for prospective paths, showing the topography in relation to the curved surface of the earth. From study of these diagrams, an assessment can be made of the probable transmission conditions and the tower heights that would be required at the repeater locations. A complicating factor in the selection of sites and paths is the fact that the route must be staggered in a planned manner so that energy will not be transmitted from one station and received several stations down the line, thus causing interference. In laying out the route across Canada, many hundreds of possible sites and combinations of paths had to be reviewed before starting field work.

For such a large country, Canada is very well mapped and the only sections for which adequate topographical data were not available were those between Orillia and the Manitoba border, and through the mountains of Alberta and British Columbia. For the section through northwestern Ontario, some general conclusions were reached from study of available maps and arrangements were made to take stereo aerial photographs of a narrow band through which a satisfactory route appeared feasible. Topographical detail was developed from the stereo photographs with very satisfactory results. The problem of selecting a route through the mountains was somewhat different as it had to do principally with obtaining adequate clearance over particular peaks in a proposed path. Preliminary study was conducted from large scale topographical maps and from reconnaissance in the field both on foot and from the air. Subsequently, heliograph tests were made between selected sites to ensure that adequate clearance was available.

When tentative sites had been selected from the office study, engineering teams made field visits to assess the suitability of the sites from the transmission aspect, and to evaluate the physical problems involved in construction. If the survey party found a site suitable, arrangements were made to obtain a rental option on a parcel of land about 800 feet square, as well as rights for the necessary access road from the existing public road. A contractor was then employed to clear sufficient of the land to provide access for path testing work.

Fig. 5. Preparing to install the horn reflector antenna.

Radio Path Testing

The suitability of the sites and paths selected from office study is verified by means of radio tests using portable microwave testing equipment. The microwave receivers and transmitters and associated transmission measuring apparatus are mounted in specially designed bodies on four-wheel-drive trucks and V.H.F. radio is provided for intercommunication between receiving and transmitting crews. The test equipment set up includes portable aluminum towers of special design that can be erected to a height of 200 feet in less than a day. Parabolic antennae mounted on carriages can be raised or lowered on these towers by means of winch lines. The antenna carriages also carry a microwave transmitter or receiver and two remote control motors, one for azimuth and one for vertical adjustment of the antenna.

Although the radio testing equipment and towers are normally taken in to the site location by means of trucks, there were two locations in the Rocky Mountains where it appeared impractical to provide roads for path testing purposes. At one site a temporary aerial cableway was erected and, at the other, helicopters were used to transport personnel, towers, and test gear.

A series of antenna height versus path loss tests are made as predetermined from experience and from study of the intervening terrain from the topographical maps. The results of these tests are plotted in diagrammatic form as shown in Fig. 8. The Fresnel zones shown are caused by the radio energy reaching the receiver over two separate paths. One of these is the direct line-of-sight path between the antennae, and the other is via an obstruction or reflecting surface in the terrain between the two sites. This second path varies in length as the height of the antenna is changed, and hence the energy arriving at the receiver over this path is alternately in phase and out of phase with the energy arriving over the direct path. Consequently, it alternately adds to and subtracts from the direct path energy, resulting in peaks above the computed free space loss and in valleys below the free space loss. A series of tests is run for various combinations of antenna heights and the results are analyzed to determine that there are no obstructions or conditions on the path that have not been determined from the study of the topographical data. This analysis also assists in arriving at decisions in respect of the optimum tower heights.

It is interesting to note that although a line-of-sight path is required between adjacent towers, actual line-of-sight transmission over this distance is seldom in a straight line. This is due to the fact that the atmosphere is not a homogeneous medium because its temperature, pressure and humidity vary with height above ground and with general weather conditions. This non-homogeneity is one of the causes of radio fading, as it is also the cause of mirage phenomena experienced with the transmission of light. For the majority of the time, there is a slight curve in the radio path as it tends to follow the circumference of the earth. Under certain atmospheric conditions, the wave can have what is called inverse bending and thus tend to go into the surface of the earth rather than toward the distant antenna.

Consequently it is necessary to allow more clearance over obstructions in the path than would be indicated from considerations of straight line propagation.

The Trans Canada Route

The final route selected across the country is shown in Fig. 9. Cities shown by circles are those at which either television or telephone use is to be made of the system. The total route including spurs is about 4800 miles long, and there will be some 160 repeater points, only a few of which are associated with existing telephone installations. Between Sydney Mines, N.S. and Saint John, N.B. the facilities of the Trans Canada System will be carried on the microwave system being built by the Eastern Telephone and Telegraph Company in co-operation with Canadian Overseas Telecommunications Corporation for the purpose of extending the Trans Atlantic cable circuits inland from the cable head at Sydney Mines. The spur routes to Halifax, Charlottetown, and Moncton will be built by the telephone companies concerned. It is likely that additional connections with the United States microwave network will be required within the next few years on new routes southward from Saint John, Montreal, Winnipeg and Vancouver.

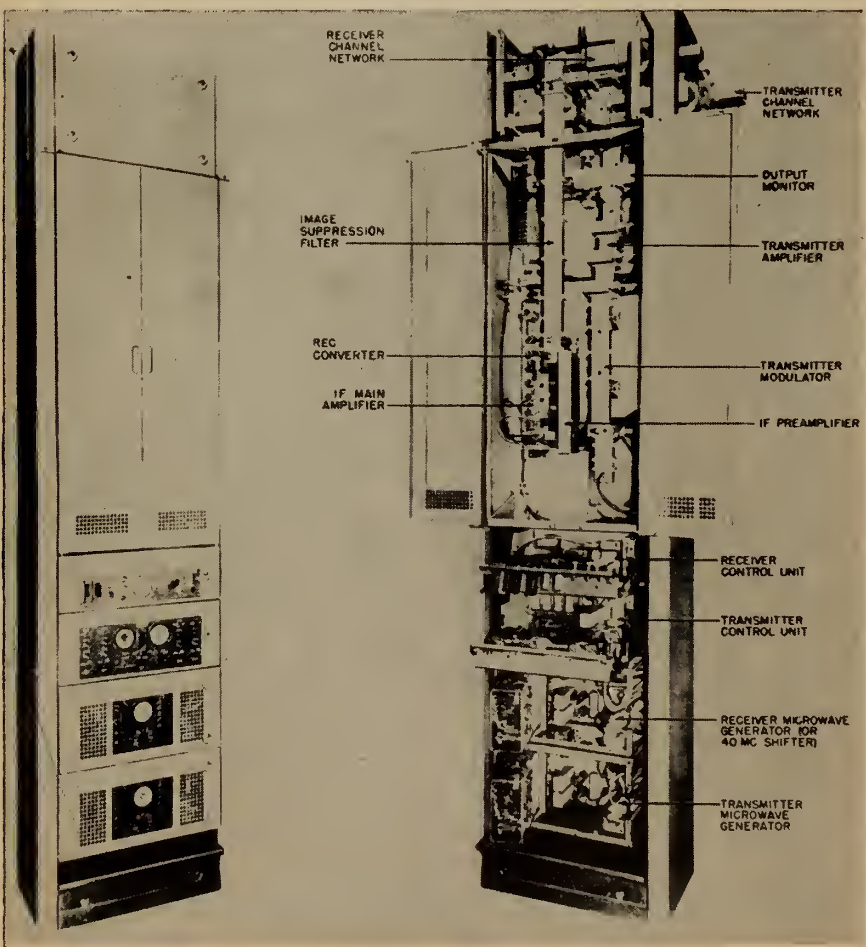
Construction of Relay Sites

Many engineering and construction problems are encountered in the development of the large number of repeater sites on this project, many of them in quite remote areas. Each site involves access roads, towers and footings, and buildings, and at most of them, construction is required to bring in commercial power and regular land line communications. Wide variations are encountered in terrain and soil conditions, including the Laurentian shield across the top of Lake Superior, the gumbo soils of Saskatchewan, and the particularly rugged conditions encountered in the Rocky Mountains where the highest site will be about 7000 feet above sea level.

Access Roads

In laying out the route, every endeavour was made to choose repeater sites close to existing roads, but, due to the need to take advantage of elevated ground, road construction is involved at almost every site, ranging from a few hundred feet to as much as 12 miles. At one site in the Rocky Mountains, it has been considered uneconomic and impractical to provide access by road, and an aerial tramway will be used. The line will be in seven spans totalling 11,800 feet, and the vertical lift will be 4400 feet.

Fig. 6. A TD-2 transmitter-receiver radio bay.



While the finished roads can be quite rough, they must be of sufficient quality to provide access at all times of the year for maintenance vehicles and fuel trucks. A final effective width of not less than 16 feet is required and, to obtain this, it is necessary to make the original road about 20 feet wide to allow for erosion. Because of the elevated nature of the sites, special attention has to be provided to grades, which have in general been limited to 10 per cent, and to the provision of adequate drainage and culverts to prevent washouts. In areas where snowfall is heavy, adequate space must be cleared beside the road to allow for disposal of snow by pusher type ploughs.

Towers and Footings

In laying out a microwave route, economic factors generally favour the use of high towers for the purpose of reducing the number of repeater stations required. On the Trans Canada route, a great many of the towers are in excess of 200 feet with a few as high as 350 feet.

The highly directional characteristics of the antenna require very stiff tower construction with design limits set at a one degree deflection under 100 miles of wind. This results in the use of very heavy steel and extensive cross bracing. The towers employ a modular design with 12½ foot panel modules. In the larger towers, the base legs are 8 in. x 8 in. x 1⅛ in. angles, the largest size rolled. On the very tallest towers, this is further strengthened by the use of a welded plate to provide a 1⅝ in. angle. The 350 foot tower weighs in the order of 120 tons. The steel is galvanized, and it is essential that this be a high quality job and that there be no damage to the surface in erection. Because of the galvanizing, rivets are not used in field assembly and erection and members are bolted using galvanized ribbed bolts. Close inspection of the work in progress and of the finished tower has been found very desirable.

Special design features include the antenna mounting arrangements, the waveguide supporting and restraining members and the arrangements at the bottom of the tower where the circular waveguide is coupled to the horizontal run into the building. Rest platforms are provided at 50 foot intervals, and the towers are painted and lighted to meet the requirements of the Department of Transport.

Because of the height of the towers and the heavy wind loading, footings have to be designed for large uplift. For this reason, large spread footings at suitable depths are required so that there is an adequate load of backfill to provide the necessary anchorage. The type of footing and pier is shown in Fig. 10. For a 350 foot tower, each footing requires an excavation of approximately 175 cubic yards, and the footing and pier require about 43 cubic yards of concrete. Because of the solid rock conditions encountered at many of the sites, consideration was given to a rock anchor type of construction and this was tried at two sites. It did not prove economic and was abandoned in favour of the pier type footings at all locations.

Over much of the route in southern Saskatchewan gumbo soil conditions are encountered. This is a peculiar soil of great depth that tends to be very liquid for some feet below the surface during the spring period of the year. While the regular spread footings were used, they were placed well below the frost line and each footing was tied to four reinforced concrete piles about 15 feet long constructed in holes drilled into the gumbo. The piles serve as friction devices only as they are not carried to bed rock.

Buildings

In the interest of overall efficiency and cost, a standardized layout has been adopted for the radio, power, and auxiliary equipment in the small repeater stations. This layout is sufficiently flexible to care for necessary minor variations in equipment provision at different sites and provides for growth for a reasonable future period. As shown by the floor plan in Fig. 11, the building is approximately 35 x 21 feet. The radio equipment, rectifiers, batteries and control equipment are located in the large room, and a smaller room houses the engine alternator and the compressor-dehydrator. At locations where locally generated power is required, a separate building is provided for the larger engine plant.

Various types of construction are being used over different sections of the route, including brick, concrete block and partially prefabricated metal buildings. A metal building has been used between Toronto and Winnipeg and has been found very satisfactory. It employs modular panels with corrugated aluminum outside and steel inside, with suitable insulation between. The same panel is used for the hipped roof which has been specially strengthened to protect against damage from ice falling from the adjacent tower. Experience with the erection of these buildings in isolated locations over many hundreds of miles and with a great deal of work done under severe weather conditions against a tight schedule, has been most satisfactory, and required a minimum of field supervision on the part of the owner. The foundations and floor slabs were put in by the contractor doing the tower footings. Erection of the buildings was by the supplier, with one crew erecting the structural frame and a second placing the roof, walls and ventilating hoods. A separate electrical contractor followed to install the service entrance, conduits, lighting and related items. A photograph of a completed building and the associated tower is shown in Fig. 12.

As the electronic equipment dissipates large quantities of heat, provision is made for thermostatically controlled forced air ventilation for use during the warmer seasons of the year. During the winter months, the temperature is maintained in the low 40's by means of thermostatically controlled heaters. Electric heaters will be used over most of the route, but in some sections where winter temperatures are severe and electric power costs are high, oil heating will be used. Sufficient capacity is provided that the temperature can be raised to a satisfactory point

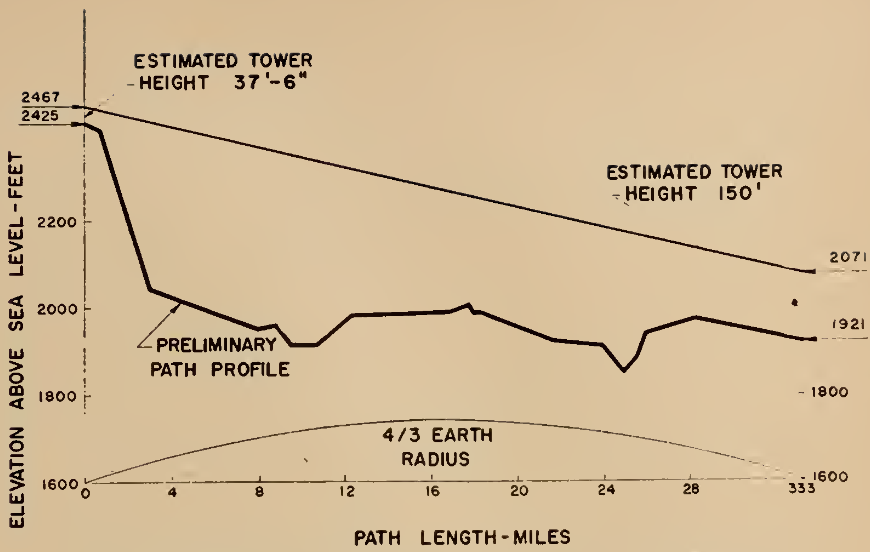
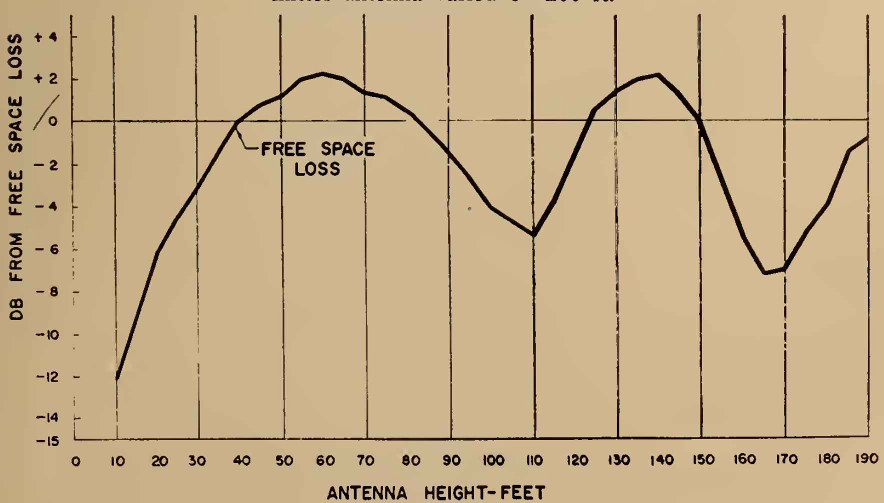


Fig. 7. Typical path profile relates topography to the earth's curvature.

Fig. 8. Typical height-loss diagram. Receiver antenna height 50 ft.; transmitter antenna varied 0—200 ft.



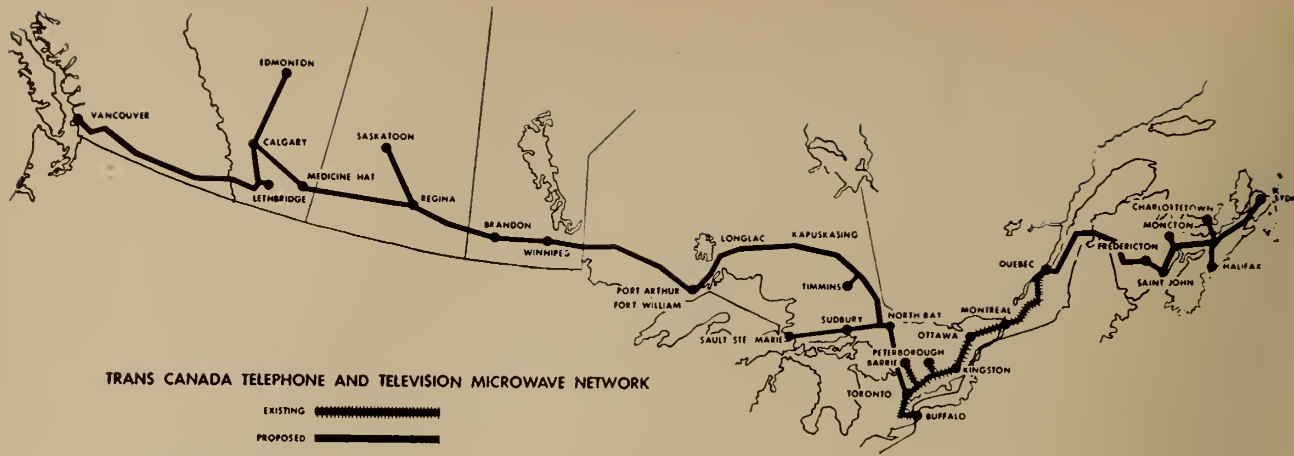


Fig. 9. Trans Canada microwave route.

when personnel are in the building.

Power and Communication Services

Arrangements are made with the various power utilities for the construction of run-offs to bring commercial power to the repeater sites. It is the practice to bring in commercial power whenever economically possible rather than rely on local diesel plants, and there have been several long builds required, the longest being about 18 miles. There are few locations where local diesel plants will be necessary.

Connection with the regular land line communication system is required for station alarms and controls. This has normally been established by building from existing open wire or cable routes, usually on a joint use basis with the power utility. In a few remote locations, radio is used to bridge the gap to the existing communication system.

Operation and Maintenance of the System

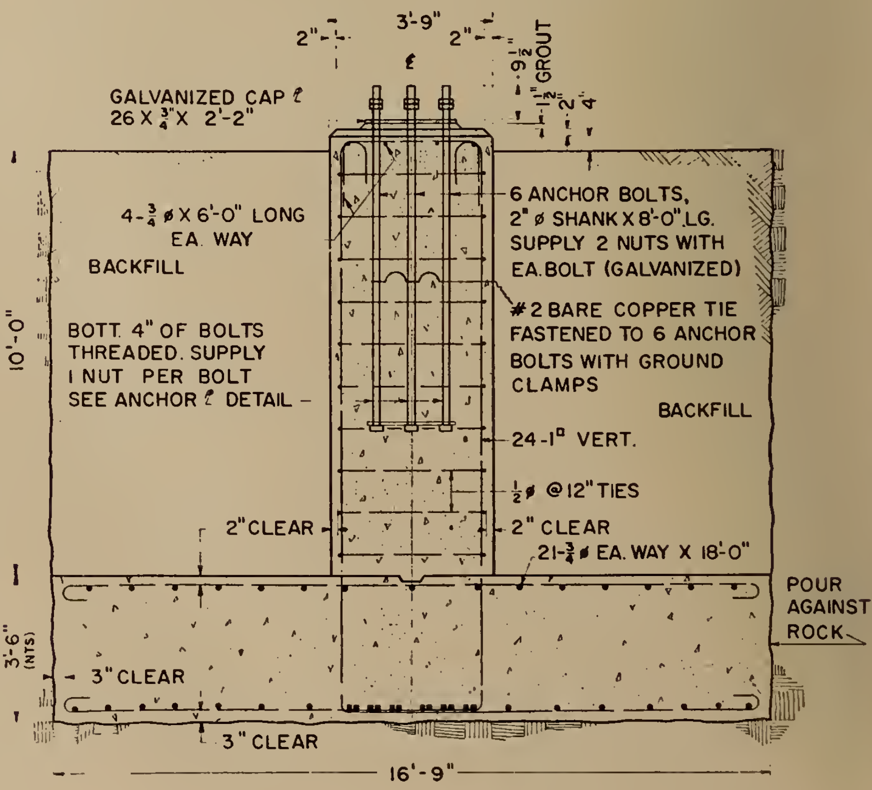
Because of the importance of the microwave system in the country's communication network, extremely high reliability in its operation is imperative, and the paragraphs that follow discuss certain of the steps taken to ensure this reliability of operation and to facilitate maintenance.

Electronic Protection Switching

Even with components of the highest quality and with a conservative approach to the transmission engineering of the route, some individual channel failures due to breakdowns and to radio propagation conditions are inevitable. As previously mentioned, to protect against these failures, one pair of channels on the route is reserved for the protection of the channels carrying the telephone and television signal material. The route is divided into protection switching sections of about 10 repeater sections each. Electronic devices at the receiving end continuously check the noise level on the radio channels. If the noise level on a channel rises above a predetermined amount, the electronic device calls for the protection channel. A signal is sent to the transmitting end, identifying the channel in trouble, and the protection channel transmitter and receiver are bridged to the regular channel. When this has been accomplished, the regular channel is disconnected. The interval from the time unsatisfactory transmission is recognized until the switch takes place is between 20 and 40 milliseconds and an additional 5 to 10 milliseconds is required to complete the switch. When transmission conditions on the original channel again become satisfactory, this is recognized by the switching system, and the original channel is restored to service and the protection channel returns to normal standby condition.

It is of interest in this connection that the system design is such that propagation conditions causing severe fading with resulting high channel noise will rarely affect more than one channel of the system at a time. Consequently, the provision of one protection channel on the route provides

Fig. 10. Typical tower footing.



a very susbtantial increase in the reliability of the system as a whole.

Alarm and Control Facilities

As the small repeater stations are operated unattended, provision must be made for the transmission of alarm information from the unattended points to master stations where maintenance forces are in continuous attendance. This is done by tying in the repeater stations to the regular land line communication system, and a maximum of 12 stations may be bridged to one set of alarm and control facilities. When trouble arises, the unattended station affected identifies itself to the master station by means of selective signalling frequencies. The attendant at the alarm centre can then dial up the station involved and the alarm system automatically scans conditions in the station and reports its findings on a visual display at the master station. As many as 42 alarm conditions can be scanned in this manner. Certain types of trouble can be corrected from the master station by means of orders sent over the control facilities, thus making it unnecessary to dispatch a maintenance man until later.

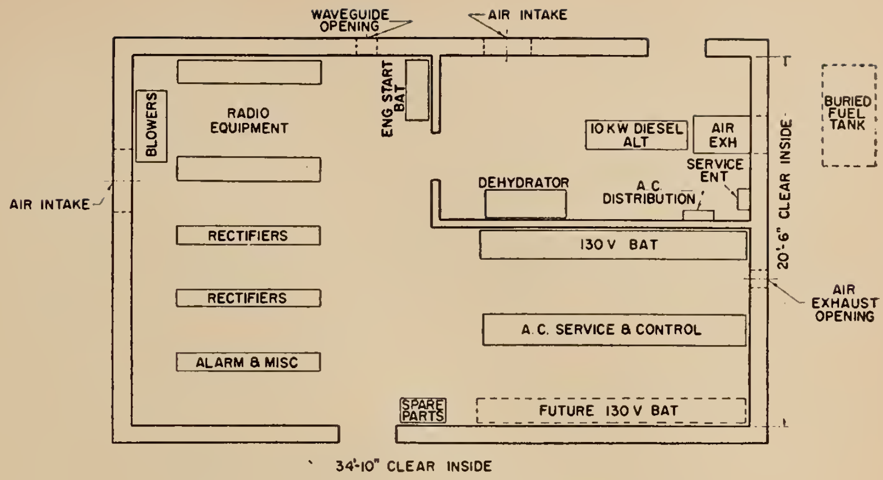


Fig. 11. Floor plan of a typical repeater station.

Maintenance Features

The system has been designed so that only routine inspections and minor maintenance operations will be carried out at the repeater stations. Because of the large volume of communication handled on the radio much of this work can be done without removing the system from service. Units that may require extensive readjustments are arranged so that they may be easily replaced and transported to maintenance centres where complete test bench equipment and trained personnel are available for these more extensive maintenance operations.

Fig. 12. View of part of the completed repeater station building and the associated tower at New Liskeard.

Telephone Multiplex and Video Transmission Equipment

At the telephone and television service points across the country, there will be large installations of telephone multiplex and video transmission equipment.

Telephone Multiplex Equipment

The telephone multiplex equipment employed is the well established Type L carrier telephone system. The basic 3400 cycle telephone circuit occupies a band of 4000 cycles, and 12 circuits are modulated to form a group in the band between 60 and 108 kilocycles. Five groups of 12 are then again modulated to form a supergroup between the frequencies of 312 and 552 kilocycles. The supergroups in turn are shifted in the frequency band to their appropriate place between 64 kilocycles and approximately 3 megacycles, and then this signal is superimposed on the frequency modulation transmitter of the radio system.

Video Transmission Equipment

The video or picture signal requires a bandwidth extending from zero cycles to approximately 4 megacycles. This signal is usually transmitted to the studio or television station over 16-gauge shielded pairs using polyethylene insulation. The attenuation-frequency characteristics of this type of facility are such that extensive use must be made of amplification and precise equalizing de-

(*Continued on page* 1040)

Control of Air Pollution in England

S. G. G. Wilkinson,
Ministry of Housing and Local Government, London, England

Read at the 70th Annual General and Professional Meeting, the Engineering Institute of Canada, Montreal, May 1956

This paper gives an account of the legal and administrative measures proposed for the control of air pollution in England, as seen from the viewpoint of an officer of the central Government. Sound administration will be required to implement these measures, together with the co-operation of the public, whose opinion now seems ready for action.

I PROPOSE in this paper to give a short account of the legal and administrative measures, past, present, and prospective, for the control of air pollution in England, as seen from the viewpoint of an officer of the central Government. It is not my purpose, and indeed it would be beyond my competence, to discuss the scientific or technological aspects of the subject, or to deal with details of local administration; the object of this paper is rather to present the problem as it appears to us at the centre of Government, and to outline the policy and general principles of our control measures.

In the immediate foreground of the picture three features stand out in prominent relief. First, the severe smog — perhaps the most serious incident of its kind that has ever occurred — which covered London for four and a half days in December, 1952, and caused no less than four thousand deaths. Second, the appointment by the Government in the following year of a committee to enquire into all aspects of the problem of air pollution, including causes, effects and methods of prevention, and the publication of the committee's report towards the end of 1954. Third, the adoption by the Government of a national "clean air" policy, in line with the committee's recommendations, and the introduction of legislation last year to implement that policy.

Before describing these events in detail, a few words about the background of the picture. It is an extensive background, receding far into the distance. We have been making laws to control smoke for something like seven hundred years. In the year 1273 the use of coal in London was prohibited as being prejudicial to health. A few years later, in 1307, a Commission was appointed to

> "enquire of all such who burnt sea cole in the City or parts adjoining, and to punish them for the first offence with great fines and ransoms, and upon the second offence, to demolish their furnaces."

At about the same time, it is believed that even direr penalties were imposed, and that at least one unfortunate was actually executed for burning coal illegally in London.

Even such drastic remedies as these were evidently ineffective, for it is known that the coal trade of London grew and prospered throughout the 15th and 16th centuries. But not without occasional protests. In 1578, we find Queen Elizabeth the First objecting to the burning of coal by the brewers of Westminster; and a little later, it is recorded that

> "the nice dames of London would not go into any house or room where sea coles were burnt, nor willingly eat of the meat that was roast with the cole fire."

Even that, apparently, was not sufficient to deter people from burning coal, and no doubt making smoke, in ever-increasing quantities. Wood fuel was becoming scarce, whereas the exploitation of the nation's coal resources had barely begun. But the real demand for coal came with the industrial revolution, and in particular, the development of steam-power from the latter part of the 18th century. Abundant supplies of coal were available not only to feed the furnaces of industry, but to supply the heating needs of a rapidly expanding population. Coal production increased six-fold between 1800 and 1850. The production of smoke must have increased proportionately. The fact that coal was plentiful and cheap afforded little incentive to economy or efficient methods of combustion, and the amount of fuel wasted in unnecessary smoke was of little consequence. Indeed, by a strange inversion of values smoke became a sort of index of production, the pall of smoke hanging over an industrial town being commonly regarded as a sign of its prosperity.

By the middle of the 19th century, however, smoke pollution was coming to be recognized as a social evil and a potential danger to health. The early public health legislation approached the problem with caution. Some general requirements were laid down for the design of furnaces, but emissions of smoke were dealt with in much the same manner as other public health "nuisances"; action could be taken only if it could be shown that the smoke from a particular chimney caused a nuisance in the locality. No serious attempt seems to have been made to deal with the overall problem of smoke pollution.

Separate legislation, beginning with the Alkali Act, 1863, was passed to control pollution by gases from the chemical industries. Here the approach was quite different. Certain gases were recognized to be inherently dangerous, and were controlled accordingly, regardless of the degree of local nuisance that might be caused. The industries to which these Acts applied were required in certain cases to keep the concentration of gases discharged within prescribed limits, and in others to use the best practicable means to render the discharges harmless. Further, whereas responsibility for enforcing the legislation against smoke was vested in the local authorities, that is, the councils of towns, and urban and rural districts, the enforcement of the Alkali Act was made the responsibility of a corps of inspectors, the "alkali inspectors", appointed by and responsible to the central Government. These differences stemmed logically from the conception that whereas smoke abatement was primarily a matter of enforcing the law for the prevention of local nuisances, the chemical gases were inherently obnoxious and should be strictly controlled, under the supervision of specially qualified inspectors, wherever the source.

Current Legislation

The pattern of our general legislation to-day reflects this distinction and is still fundamentally the same, although the earlier Acts have at various times been brought up to date and supplemented in detail. The control of local nuisances from smoke, grit and dust is the responsibility of the local authorities, while the central Alkali Inspectorate, which is now a branch of the Ministry of Housing and Local Government, is responsible for the control of emissions from the chemical industry and allied processes. The processes supervised by the Alkali Inspectorate now include virtually the whole of the heavy chemical industry, tar distilleries, the extraction of zinc and lead, petroleum refineries, cement works, and the manufacture of chemical manures.

All the legislation described so far has been general in scope, that is to say, it applies to the whole country and gives the same powers to all the local authorities. In recent years however a number of individual local authorities have been obtaining special smoke control powers supplementary to those available under the general law, by promoting local Bills in Parliament. The most important of these local powers is one which provides for the establishment of "smokeless zones", or areas in which the emission of smoke is entirely prohibited. Several of the larger local authorities have made a start with establishing these zones and gradually extending them. In Manchester, for example, there is now a very successful smokeless zone which embraces some 400 acres in the centre of the city. The City of London has now gone smokeless too, under a special Act of Parliament which came into force in October last year. This of course covers only the City proper — the square mile or so that lies between the Temple Bar and the Tower of London, but it is the heart of London, and we hope that the adjoining boroughs will follow suit before very long.

This brings us right into the foreground of the picture again, and to the three events which I have mentioned earlier. At the beginning of December, 1952, the whole of London was blanketed by a fog of unusual density. The fog lasted for 4½ days, and it was established beyond all reasonable doubt to have been the cause of approximately 4,000 deaths. That figure was computed by comparing the number of deaths which occurred during and immediately after the fog with the average for the preceding weeks, and also with the average for the corresponding period in previous years. Between 80 per cent and 90 per cent of the deaths were found to have been due to respiratory or heart disease or a combination of both; 90 per cent of the victims were over the age of 45, and the majority over the age of 65. Most of those who died had previously been suffering from respiratory or cardiac disorders and, so far as is known, there were no deaths attributable to the fog among normally healthy people.

Investigations to determine the particular element in the fog which caused the deaths were inconclusive. It was noticeable that the number of deaths rose sharply during the first two days of the fog, that is, *before* the maximum concentrations of pollution were reached. Further, the maximum recorded concentration of sulphur dioxide during the fog never came anywhere near to what is normally accepted as the safe limit for prolonged exposure to SO_2. After an exhaustive examination of all the evidence, the investigators found it impossible to state that any one polluting agent was the cause of the deaths. Their report[1] did however suggest that the interaction of SO_2 with moisture and with solid particles in the fog may have been responsible.

The Beaver Committee

In the following year, a comprehensive inquiry into the whole question of air pollution, embracing causes, effects, and methods of prevention was set on foot by the appointment by the Government of a committee of inquiry, commonly known as the Beaver Committee, after its distinguished chairman, Sir Hugh Beaver. This committee produced a factual interim Report[2] in December, 1953, and its final Report[3] in the following November. The final Report dealt with all aspects of the problem. It started by laying stress on the fact that abnormal fog episodes such as the London fog of December, 1952, were but manifestations in an acute form of the more or less chronic incidence of air pollution, and that it is this — the continuing level of pollution, rather than the occasional extremes—that needs to be tackled.

The committee's report dealt separately with visible pollution by smoke, grit and dust, and with pollution by sulphur oxides. It recommended sweeping reforms in the law for the control of visible pollution not only from industrial sources, but also from domestic chimneys. It proposed that the emission of dark smoke, that is smoke as dark as, or darker than, shade 2 on the Ringlemann chart, should be made an offence, without proof of nuisance. It also recommended that measures to arrest grit and dust from industrial furnaces should be made obligatory wherever practicable.

The report showed that domestic fires were responsible for nearly half of all the smoke in the atmosphere, and concluded that the problem of domestic smoke would have to be tackled, despite the difficulties, if any worthwhile advance was to be made towards cleaner air. For us, this presents some quite formidable problems, owing to the somewhat peculiar arrangements for domestic heating that are traditional in England. Because our climate is variable and we seldom suffer from prolonged spells of cold weather, comparatively few houses are equipped with central heating. The great majority have open coal-burning fires which heat, or are supposed to heat, single rooms. There may be two, three or more such fires in a house, and sometimes a coal-fired cooking stove or water-heater as well. These open fires are lit as and when required, and they are usually let out, or go out, at night. Most of those now in use date, in the fundamentals of design, from the days I have described, when coal was plentiful and cheap and nobody bothered much about the amount of smoke in the air.

Nevertheless, the open fire is still a cherished feature of millions of homes. Now, it is impossible to burn bituminous coal in fires of this kind without making smoke; and our supplies of natural smokeless fuels are very limited. The elimination of domestic smoke would therefore entail a minor revolution; it would mean replacing the house coal now used by gas, electricity and manufactured smokeless fuels. For various reasons, gas and electricity are only likely to fill the gap to a limited extent, and the main substitute must be coke. As a measure of the problem, some 19 million tons of coal a year would have to be replaced in the larger urban areas alone, and greatly increased supplies of coke would have to be found, from increased production and by diversion from other uses, to enable this to be done.

Then there is a further obstacle—those fires again; the kinds of open fire most commonly in use are not constructed to burn coke. You cannot get a sufficiently high temperature to ignite the coke and keep it burning. Therefore, not only must the coal be replaced by smokeless fuels, but the existing fireplaces must also be replaced by more efficient types of appliance in order to enable the smokeless fuel to be burned. So it will be clear that the abolition of smoke is not going to be a quick or simple process. The Beaver Committee envisaged a long-term program of some 10 to 15 years to deal with the large urban areas of the country alone, and they recognized that the operation would involve major problems of finance and administration as well as of supply and re-equipment.

The committee devoted a lot of attention also to pollution by sulphur oxides, but were forced to the conclusion that in the present state of technical knowledge practicable means of prevention were not yet in sight, except at very large fuel-burning plants such as power stations, where it would be worth while to put in gas-washing equipment. They recommended that this should be done at all new power stations in or near built-up areas as soon as an efficient technique could be developed. The committee also recommended intensified research on other means of prevention which would be of more general application, including the removal of sulphur from the fuel before use, and methods of preventing the sulphur in the fuel being released with the combustion gases.

Damage by Air Pollution

Apart from its recommendations, the most important feature of the Beaver Committee's report, to my mind, was their assessment of the damage done by air pollution. The report showed beyond doubt that pollution is a dangerous enemy of human health. It also contained an estimate, certainly the most comprehensive and thorough so far attempted in England, of the economic cost. The estimate was built up from all the evidence that could be obtained both of the direct costs, including such items as cleaning, laundry, repairs and redecoration of buildings, damage to goods, the replacement of corroded metals, additional lighting and extra medical services; and of the economic loss or loss of efficiency resulting from, for example, damage to agriculture, interference with transport, and the loss of working efficiency due to ill-health. Aggregating all these items, the Commitee arrived at the staggering total of £250 million per annum. That, in their view, was the size of the bill, in terms of money alone, which the nation is now paying year after year for air pollution. That figure might seem incredible until one has studied the detailed account of how the estimate was arrived at. Further, it stands comparison with figures which have been obtained elsewhere; the estimate for Pittsburgh in 1952, for example, produced a figure equivalent to £14.10s.0d. for each inhabitant, whereas our £250 million represents £5 per head over the population of the country as a whole.

The Government lost no time in announcing their acceptance of all the committee's main recommendations, and legislation to implement them was introduced in the summer of last year. The "Clean Air Bill", as it is called, is now on its way through Parliament and it may have become law by the time this paper is read. It repeals almost all the present legislation about smoke pollution, comprised in twelve different Acts ranging in date from 1845 to 1939, and substitutes a single new code, the main features of which are as follows:—

(1). The discharge of "dark smoke" from any chimney is prohibited, subject to some limited exceptions and to short emissions which may be unavoidable on occasions such as the lighting-up of furnaces from cold. The prohibition will apply also to dark smoke from railway locomotives and ships. "Dark smoke" is defined as meaning smoke which is as dark as, or darker than, shade 2 on the Ringlemann chart. The Bill makes it clear that the Ringlemann chart is to be used as a standard of darkness rather than as means of proof in a court of law, that is to say it will not be necessary to produce evidence in proceedings that an actual comparison with the Ringlemann chart was made in each case. Again, we are in accord with practice across the Atlantic; I see that in the United States a little while ago a court judgment affirmed the competence of a trained observer to record violations of the law, even though he did not have a chart in his hand. As the judges remarked, it is not necessary to hold a colour chart in your hand in order to recognize "a red flower, a blue sky or a black bird."

(2). Any practicable means that may be available must be used to minimize the emission of grit and dust from furnaces. All new furnaces which are to burn pulverized fuel, or solid fuel at more than a specified rate, must be equipped with plant approved by the local authority for arresting grit and dust. The local authority may also require measurements to be made of grit and dust passing through the flues, and the results of the measurements furnished to them, in the case of furnaces burning pulverized fuel, or solid fuel at more than the specified rate.

(3). The foregoing provisions, which will of course mainly affect industry, will operate over the whole country. Enforcement will be the responsibility of the local authorities, who will be empowered to prosecute offences summarily.

(4). Smoke from other sources, including domestic smoke, is dealt with somewhat differently, and on a local, and in a sense voluntary, basis. The Bill empowers local authorities, by means of orders requiring confirmation by the central Government, to establish "smoke control areas" in which the emission of smoke from buildings, or from specified classes of buildings, will be entirely prohibited. Householders in these smoke control areas will be entitled to grants towards the cost of converting or replacing their heating and cooking appliances, where this is necessary in order to enable smokeless fuels to be burnt; 30 per cent of the cost will be borne by the local authority, and 40 per cent by the central Government, leaving the householder to bear 30 per cent. We thought that this was a fair distribution of the cost, having regard to the relative interests of the individual, the local community and the nation at large in the prevention of smoke.

When making orders to establish these smoke control areas, local authorities must give public notice of their proposals and anyone affected will then have the right to object to the Minister of Housing and Local Government if he wishes. The Minister must consider any objections made, and hold a public local inquiry, before deciding whether or not to confirm an order.

(5). The Bill does not disturb the present arrangement whereby the control of pollution from special processes is the responsibility of the central Alkali Inspectorate; indeed it envisages an extension of this system to some further industries in which the prevention of smoke, grit and dust presents special problems. The purpose is, of course, to ensure effective technical supervision of the "difficult" processes and to stimulate the development of improved methods of control.

The Bill also contains a number of supplementary provisions dealing with, among other things, the design of new furnaces, the provision of smoke density meters and recorders, the height of new chimneys, and pollution from colliery spoilbanks.

The administration of the Bill, when it comes into operation, will therefore rest on a division of labour, the local authorities having the major tasks of securing that the general standards required by law are complied with, and of initiating action to control domestic smoke in their area, while the central Inspectorate will be responsible, over a more limited field, for enforcing the most effective methods of prevention in those industries in which control still presents special difficulties. The administrative burdens will be heavy. Many local authorities are at present short of qualified smoke inspectors and are not yet fully prepared for the responsibilities the Bill will place upon them. There is a little anxiety lest the new measures should lose some of their force by starting off, as it were, at half-speed. That is one of the disadvantages of introducing reforms on a national basis; we cannot be sure that everybody will be at the starting gate at the right time, yet we do not want to delay the start. But we have, of course, no intermediate unit of administration between the central Government and the 1,500 or so local authorities, large and small, who make up local government.

Good Administration

The success of the measures now contemplated will, however, depend on the manner in which they are administered. It would be, I am sure, a profound mistake to think of administration only in terms of enforcement, that is to say, of detecting and prosecuting infringements of the law and exacting the appropriate penalties. The law must depend for its effectiveness upon voluntary compliance by the majority, rather than on compulsion against the minority. The real responsibility for the prevention of air pollution must, after all, rest with those who control its sources — the industrialist, the man in the boiler-house, and the householder; and the most important task of the administrator, whether in central or in local Government, is to win and maintain their co-operation. He cannot afford to rest on legal sanctions alone, but must go out and get goodwill by publicity, advice and the personal approach.

This element of goodwill is going to be all-important, indeed indispensable, when we come to apply the measures we have in view for reducing domestic smoke. We shall be asking a lot from householders in the first smoke control areas. They will be expected to give up the fuel they are used to and change their fireplaces and stoves, and to put their hands in their pockets for at any rate a part of the cost; all for a benefit which may in the early stages seem intangible and somewhat uncertain. They may well feel that they are being asked to buy an unripe nut, and an expensive one at that. The establishment and administration of these smoke control areas will therefore be a delicate exercise in democratic government, and a challenge to the skill and enterprise of the local authorities and their staffs. In the early stages, progress is likely to be tentative and gradual. But I think it very likely that the process will gather momentum as administrative experience is gained, and as people become familiar with smoke control and recognize the advantages of living in smoke-free surroundings. After the initial steps, it seems probable that progress will be governed more by the supply of smokeless fuels than by unwillingness to use them.

These, in short, are our plans for a new attack on visible pollution by smoke, grit, and dust. They will be accompanied by further research, and we hope technical advance, on methods of controlling invisible pollution, particularly by the sulphur compounds. At the moment, they are no more than plans; their execution lies in the future. But we believe that they are workable and that there is a general desire to put them into effective practice. Public opinion seems ready for action. There is, I believe, a growing realization in people's minds that air pollution is not only an evil, but also an unnecessary one, and that although the cure will entail difficulties and sacrificies it will be worthwhile in the end. People no longer accept "smog" with its inconvenience and discomforts as something inevitable; they want to do something to stop it. That action is needed has been demonstrated. If I may quote, once more and for the last time, from the report of the Beaver Committee:

"Enough has been said to prove that air pollution as it occurs in this country to-day is a social and economic evil of the first magnitude. It not only does untold harm to human health and happiness; it is also a prodigal waste of material resources. Expenditure on curing it would be a fraction of the savings which would result from the cure. The case for preventive action is overwhelming."

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[1]Ministry of Health; Reports on Public Health and Medical Subjects, No. 95.

[2]Interim Report of Committee on Air Pollution, Dec. 1953. Cmd. 9011.

[3]Report of Committee on Air Pollution, Nov. 1954. Cmd. 9322.

Automating the Engineer's Task

J. Kates, M.E.I.C.
President, KCS Data Control Limited, Toronto

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Following a sketch of the history of industrialization and automation this paper shows that the principles of automation are applicable to the tasks of the professional engineer, particularly to the processes of engineering analysis. The digital electronic computer is one of the most important tools for automatically carrying out engineering tasks.

WHEN discussing the automation of engineering tasks it is useful to reflect for a minute on the nature of engineering itself, how engineering has brought about automation and then how automation techniques may affect engineering techniques.

Engineers might well appropriate to their art the invention of the wheel, the early metallurgy of copper and brass, the fashioning of various tools, and so on. We could discuss the construction of the pyramid, the design of Phoenician ships, the war contraptions of Leonardo da Vinci, the experiments of Galileo and Newton. But in those early days engineering was not a separate profession and the men who noticeably advanced the art of applied science were usually a combination of artists, writers, scientists, medical practitioners, alchemists and architects.

Engineering as a separate profession, which requires the entire devotion and skills of an individual and which is marked by a body of disciplines, an educational curriculum, professional organizations and accepted public status, grew out of the increasing technical tempo of the industrial revolution (19th century).

Engineers have been concerned with the conversion of nature's raw materials and energy potentials into goods and services for mankind. Engineering deals not only with the development and design of a wide range of goods of increasing utility, but also with the more efficient production and wider distribution of those goods. Items which were once luxuries have quickly become household necessities. This lowering of the real price of goods, motivated by economic laws finding their expression in marginal profit returns, has been a prime achievement of the engineer.

Just as the industrial revolution was marked by the substitution of mechanized power for human or animal power, so the mass product of today is made possible by the introduction of interchangeable parts and the assembly line. It is the assembly line which enables society to exploit to the fullest the increase in efficiency which accompanies division of labor.

When an overall operation is broken down into a number of simple steps machines are frequently able to perform them more economically, more precisely and more reliably than human operators. There emerges a moulding together of productive and assembly processes in which a sequence of machines, gauging and transporting operations is carried out with little intervention of the human operator. This has been dubbed automation. It is interesting to reflect how much controversy, how much writing, how many speeches we would have been spared, had a Ford executive in Detroit in 1947 not added this one word to the dictionary.

The increasing replacement of man by the machine in production and distribution, coupled with the increasing complexity of goods and machines, is placing a growing emphasis on the part that engineering takes in our economy. The total number of engineers is rising, the ratio of engineers to other workers is quickly increasing, engineering is taking a bigger and bigger bite of the consumer's dollar. For example in 1945 Ontario had 4,291 engineers, in 1955, 14,000 engineers, and the Association of Professional Engineers of Ontario forecasts 26,000 engineers for 1965. This means that the working force per engineer has fallen from 368 in 1945 to 145 in 1955 and is expected to fall to 100 in 1965. In the United States about one engineer is required for every 75 production workers, whereas one engineer used to suffice for every 200 production workers. Shortages of engineers are developing in many areas. Our economy seems to be headed into a bottleneck; an engineering one.

Engineers have no vested interest in inefficiency. They alone can provide the answer to this rapidly growing problem, an answer which lies partly in the application of the engineer's methods to his own art. No longer can we look at the rest of humanity blessed with methods and efficiencies generously dispensed by engineers, while engineers themselves carry on from specification to end product as in the days of old, from slide-rule to drafting board, from approximation to pilot model. In short, if, for better or worse, we are to continue our present rate of material progress, engineers will have to automate some of their own tasks.

There appears to be agreement on two chief characteristics of automation. These are (1) that automation involves processing of information as well as processing of materials, and (2) that automation involves the performance of lengthy and complex sequences of operations without human intervention.

If we look closely at engineering techniques we find that in essence they involve lengthy and complex sequences. The process of meeting a specification by means of a design is essentially an information-processing problem which involves bringing together the data of the specification with data about materials, performance data of machines and experimental facts. The processing of these data with the know-how and experience of the designer eventually results in a design, a blueprint, a production or a distribution method. The automation of such processes will require information processing machines. Engineers have provided us with these in the form of high speed computers, and the automation of engineers' tasks will to a large extent involve the application of computers by engineers to their problems.

Electronic Computers

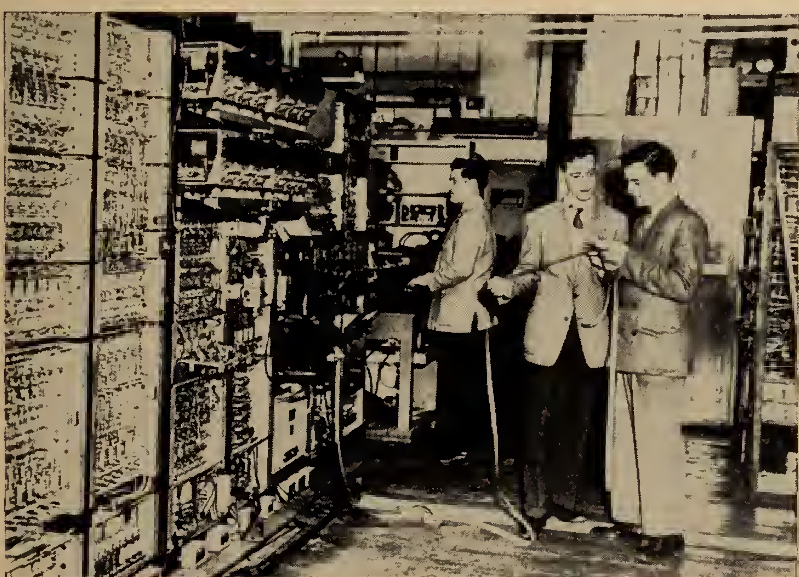
In some engineering fields such as nuclear and aircraft engineering, where engineering has always been the major bottleneck, computers have already been accepted as an essential part of the engineer's tool kit. While computers have also been applied successfully to almost every other engineering endeavour, we believe that the surface has still only been scratched and that fuller utilization of computers in engineering is bound to follow when there is intensive training and deeper understanding not only of computer essentials but of the scientific and mathematical basis underlying each engineering discipline.

The concept of a machine capable of performing long chains of calculations automatically is over 100 years old but electronic computers have become a practical reality only during the last decade and they are being introduced as a business and management tool during even more recent times. Ten years ago computers were only gleams in the eyes of research workers at Universities. The first prototypes were designed and built painstakingly and more often than not were maintained by the original designers (Fig. 1).

Today these machines are rolling off assembly lines and are achieving enviable reliability, while whole new categories of technical personnel such as computer maintenance engineers, coders, programmers and analysts are emerging.

A safe estimate indicates that electronic computers have already carried out more basic arithmetic operations than have been done by all humanity since Adam and Eve, including all the calculations that have been carried out by ancient and modern astronomers, by money lenders and by traders in the market place, all the counting of sheep done by shepherds or insomniacs, and all the painful arithmetic lessons we and our forbears were subjected to in school. Investment in computers in North America has passed the half-billion dollar mark and is rapidly reaching towards one billion dollars (Fig. 2).

Fig. 1. Computer research at the University of Toronto in 1950.



There are two classes of electronic computers, digital and analogue. The former works essentially on a sequence of digits or numbers, the latter by measurement. The abacus could be cited as a simple digital computer, the sliderule as an analogue computer.

While well before the days of the digital machine the analogue computer was applied to engineering problems, especially those involving the solution of ordinary differential equations, and while the analogue computer will always remain an engineering tool of first rate importance, the digital computer surpasses it in flexibility, in accuracy and in ability to handle large complex sequences automatically. For this reason we shall confine our discussion to the digital computer.

Essentials of Electronic Computation

Three essentials are required before an electronic calculation can begin. These are, (Fig. 3): (i) an electronic computing machine; (ii) a program; (iii) input data in mechanical form.

The general purpose digital computer is a device consisting of four main parts:

(1) The input unit, which feeds information into the computer — the eyes and ears of the machine.

(2) The storage unit, which stores information and makes it available to the other parts of the computer—the memory of the machine.

(3) The processing circuits, which process the information according to a previously adopted plan — the brain of the machine.

(4) The output unit, which furnishes us with the results of a computation — the voice of the machine.

When a computer is installed in an office or a laboratory it is at first useless and its store or memory is as empty as the mind of a newborn child. To convert this mass of aimless circuitry into a powerful tool we must feed into it a series of detailed instructions called a program. This program breathes life into the computer and unlocks the door to its tremendous possibilities.

Into a program can go man-weeks, man-months or man-years of preparation, but once a program is completed it can be fed into the machine in a few minutes, and may thereafter be used year after year. Moreover as many programs as required may be developed for the same machine and by means of these different programs it may produce a payroll at 9. a.m., a structural analysis at 10. a.m., the design of a motor at 11. a.m., a management analysis at 12. a.m. and so on. Not only is such versatility possible but this is precisely the way a computing machine should be used for greatest efficiency.

We may embody into a program many years of the know-how and training of an engineer, accountant, economist or statistician. When the program has been completed the application of this know-how becomes an automatic procedure and the electronic computer becomes the equivalent of a battery of engineers, accountants, economists, mathematicians or statisticians. Engineering has been automated. The original professional worker's skill and energies can be released for the programming of further tasks or for the carrying out of tasks which cannot be automated or where automating does not pay.

At this point it should be made clear that the programming of engineering tasks requires that they be analysed and defined with a degree of clarity, which is often absent where engineering tasks are carried out by human organization. This analysis of engineering problems for automation by computers promises to be an exciting and rewarding engineering task in itself.

Programming involves the following sequences of operations:
(i) Definition of the objective. (ii) Analysis. (iii) Flow Diagramming. (iv) Checking of the flow diagram. (v) Coding. (vi) Checking the code. (vii) Punching the program onto cards or tape. (viii) Checking the program in the machine by means of trial cases. (ix) Final release of the program for useful application.

Due to errors, or discovery of better methods, programmers often repeat the earlier steps in the above sequence after partially completing later steps.

Fig. 2. Large-scale computer installations in North America. In 1951 (top) units were only for engineering and scientific use about half the present units (bottom) are for business use. Annual investment in computers:

Year	**1950**	**1951**	**1952**	**1953**	**1954**	**1955**	**1956**	**1957**
$ millions	**7**	**16**	**20**	**30**	**50**	**220**	**500**	**800**

Techniques for Applying Computers

Many practical engineering situations which heretofore have been tackled by approximate techniques or by scale models defy analysis. Fortunately techniques have been developed which greatly extend the application of computers beyond those which can be described by a neat mathematical formula. Direct simulation of a physical process or statistical sampling methods — called Monte Carlo methods — are two important methods which have been widely applied in cases which defy elegant formulation. These methods are illustrated and contrasted with the analytical approach for a trivial example in the Appendix.

Simulation involves the step-by-step carrying out of a process. In an optical problem this would involve the tracing of every ray rather than using formulae which relate objects and images, in a traffic problem the tracing of every vehicle, in a diffusion problem the tracing of every particle. The great speed and storage capacity of computers has made simulation methods quite practicable in many cases.

Some simulation problems, however, are of such magnitude that they would be quite impractical even with electronic computers. For these problems the Monte Carlo method has been developed. This is essentially a statistical sampling method by means of which a relatively small number of samples can give results to limited but predictable accuracies. For instance, the entire simulation of a diffusion process might involve the tracing of many billions of particles, but a random sample of 100 such particles might supply a 10 per cent estimate of their distribution.

We have already mentioned that automation of production processes requires the automatic carrying out of lengthy complex processes. Similarly automation by computers becomes more economical the longer the sequence which has to be programmed.

A good example is the analysis of a grid type bridge which is illustrated in Fig. 4. Such an analysis requires the determination of symmetries of the structure in order to reduce the computational effort, following which one must determine the moments of inertia of all the members of the grid and then families of deflection curves for each member of the structure. These deflection characteristics must be combined into equations. A series of matrix inversions, matrix multiplications and matrix additions are required for the determination of the interaction forces between members of the grid. These interaction forces can be used for the computation of shear and moment influence fields which, in turn, can be used to determine the effects of subjecting the structure to typical loads such as trucks rolling through lanes or a line of cars parked on a bridge.

Manually each of these computations is quite lengthy and would be considered a separate assignment. But with an electric computer it is considerably more economical and faster to leave the results of each step in the computer and let the computer proceed automatically to the next step in the calculation, printing eventually only the worst stresses encountered and the conditions under which they are encountered. A program of this nature has been developed recently for a consulting structural firm and it has made practical an analysis which previously would have been quite prohibitive in cost and time.

Wide Range of Application

Among the engineering projects to which computers have already been applied with great success are:—

- Structural analysis
- Traffic analysis
- Nuclear engineering
- Analysis of air frame stresses
- Analysis of turbines
- Hydrodynamical calculations — seaway design
- Motor and generator analysis
- Interference analysis of broadcast antennae
- Antenna field computations
- Analysis of oil refinery processes
- Electrical network calculations
- Design of radio tubes

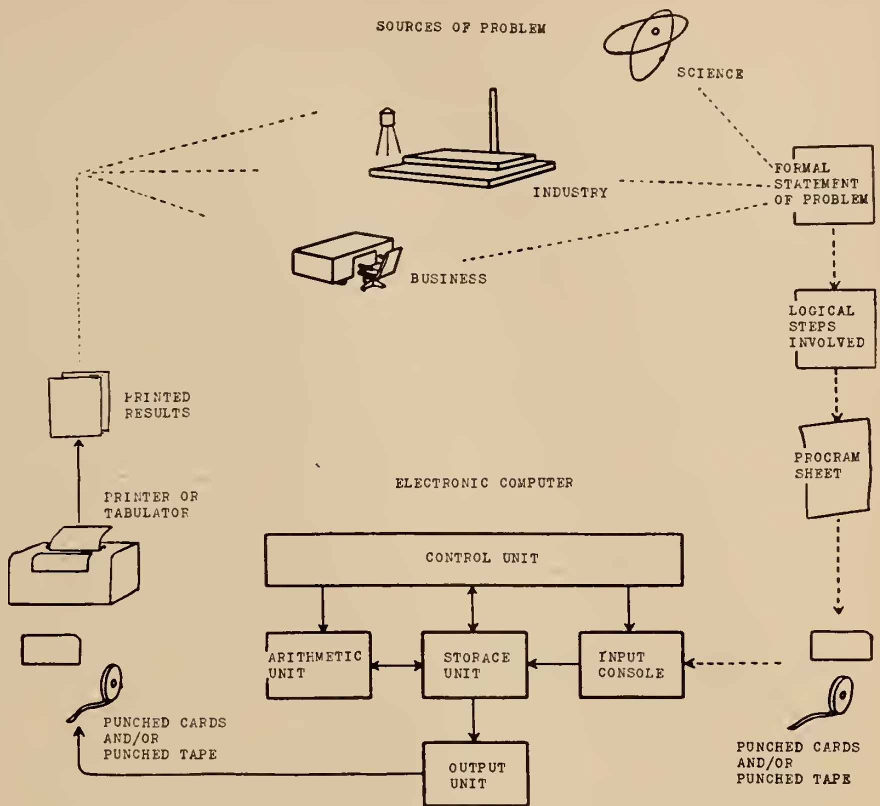


Fig. 3. The essentials of an electronic calculation.

In this brief list the word analysis predominates. This is no accident.

Many engineering tasks have the following pattern. A specification is laid down. Experienced designers make a synthesis, that is, they propose a design which will probably come close to satisfying the specifications. This proposed design is then analysed and if the analysis shows discrepancies between the forecast performance and the specifications, the design is altered slightly and analysed again until the specifications are met. In this sequence the synthesis carries most of the glamour and leans most heavily on engineering imagination, know-how, judgement, and experience; analysis on the other hand is typified by much of the drudgery, cost and time delay in arriving at a satisfactory design. For instance, the bridge analysis referred to above must be preceded by a design proposal. Here the structural engineer uses his experience to propose the number of longitudinal and transverse members to be used, their shapes and the positions of supports. This initial design proposal can then be subjected to analysis and evaluation. At present so many factors seem to enter the formulation of the initial design that it would probably be entirely uneconomical, if not impossible, to entrust this part of the engineers' work to the computer.

For this reason most computer applications have concentrated on analysis, whereas synthesis in the majority of projects will for a long time remain the prerogative of the engineer. It has proved quite difficult and usually quite uneconomical to feed varied and wide experience and engineering know-how into a computer. Compared to the human memory the memory of even the largest machine is quite minute. In other words we can reach a point of no return even with computers. On the other hand analysis usually requires the carrying out of some specific calculations for which the computer is very much faster, more reliable and more flexible than the human operator. It follows that the best use of computers will result where the experienced engineer teams up with the computer and the computer is entrusted with the carrying out of the lengthy routine sequences. Since most engineering techniques do not fall by themselves into such a happy combination of sequences (which involve experience, imagination, and know-how, followed by lengthy routine analytical procedures) efficient application of computers to engineering problems will require considerable analysis and regrouping of techniques if the fullest benefits are to be obtained. Experience to date shows quite conclusively that this ar-

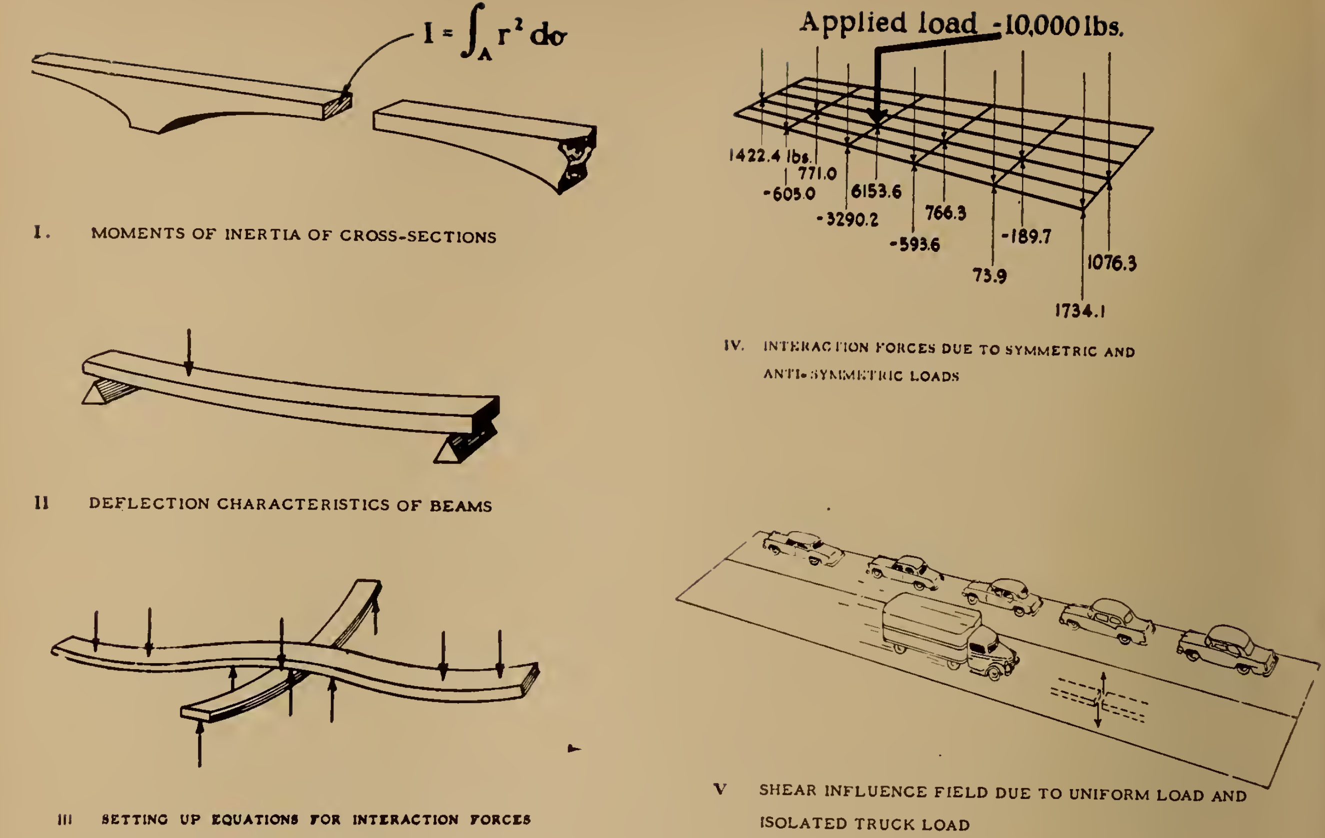


Fig. 4. Grid bridge structure analysis.

rangement of engineering techniques can have very effective results in speeding up and lowering the overall costs of projects. In addition, such analysis often results in a deeper understanding of the engineering application studied.

The division between analysis and synthesis is, of course, not rigid and immovable. On the contrary, if automatic methods are to be fully exploited, continuous effort will be needed to develop analytical procedures in replacement of synthetic procedures, to standardize, to make routine, and to refine existing routines even further.

It is typical that most engineering applications of computers to date have not been merely replacement of identical techniques carried out manually before the introduction of computers. For instance the type of stress analyses described above have been quite impractical to do manually and the testing of structures had to be done previously by building and loading scale models. So we do not find many instances where an engineering function has been replaced exactly by the computer. Rather computers are used to a large extent for the carrying out of analyses and refinements which would have been impractical previously.

It should be mentioned that, though a computer can be used for quite short sequences, the longer the sequence for which a computer is put to work the greater the economy effected. If we plotted manual and computer costs against problem complexity we would obtain curves such as shown in Fig. 5.

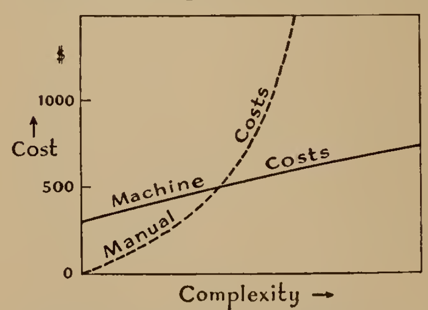


Fig. 5. Manual and machine costs *v.* problem complexity for medium size computing installations.

With the computer there is always an initial outlay on programming time which may make computer use more costly for very small problems occurring only once. If, however, the total cost of a calculation exceeds a few hundred dollars then the use of computers is indicated. This holds for lengthy isolated calculations as well as for very short repetitive calculations. In one instance traffic forecasts are made for 11½ cents a forecast. The number of forecasts required each month justify the use of an expensive computing machine. Similarly computers are used for a motor analysis which could be done by slide rule in a few hours. Cost, speed, reliability and more efficient use of engineering personnel justify such applications.

The present era is not only the era of automation but also the era of the team. The increasing complexity of modern life requires specialists teaming up on the solution of problems.

The computer is not an engineering tool alone. In the computer room the engineer will meet the manager, the accountant, the methods and procedures man, the scientist, and the statistician. In analysing situations for computer applications the engineer will often find it wise to get together with these other members of the industrial team. Production efficiency is tackled at present under two labels; industrial engineering, in the factory and, in the office, systems and procedures. Both disciplines finally lead into more general problems, the systematic solution of which has been labelled Operations Research. Operations Research has as its chief object the most effective utilization of men, machines and raw materials; it draws from engineering and accounting techniques and leans heavily on mathematical methods which often require computers.

It is interesting to note that computers have been received by engineers with enthusiam rather than with the suspicion and barriers which are often thrown up against new techniques and machines. In most instances engineers have been quick to realize that computer techniques open up new opportunities rather than displacing engineers. Engineering groups provided with such potent tools display unmatched zeal and intensity. Programming itself is one of the first tasks to be automated by engineer-programmers; the means that programs are developed by means of which the computer carries out automatically much of the burdensome coding and checking required for further programs. One might consider this as the automating of automation.

It should now be clear that electronic computing techniques can be used to automate those functions of the engineer which can be made routine; and in automating these functions engineers can be freed for other functions in the performance of which the human being far surpasses the machine. Naturally the increased engineering productivity which will accompany automation ought to increase the engineer's standard of living just as rising productivity has increased living standards of the population in general.

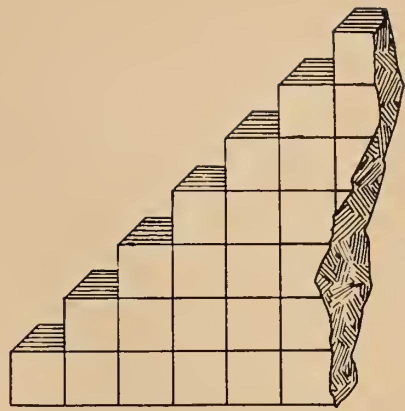
Above all, technical competition between industries, and competition from abroad whether economic or political, whether friendly or hostile, requires that each industry and this country as a whole see to it that technical personnel be used as efficiently and effectively as possible. In times of boom or times of war programmed computers will be an invisible reverse which will go a long way towards alleviating critical personnel shortages.

In reviewing ten years' developments in this field, and recalling some of the dire predictions which have been made, one thing becomes clear. Man may fashion ever more powerful tools for the harnessing of nature's forces; yet it is plain that these tools will never simulate so closely man's infinite variety and versatility that they will become more than a tool. They can never take the place of man himself. We will always need engineers.

Appendix

Three typical methods of attacking a problem are illustrated below by a trivial example which is intended as a sketch of the techniques rather than as a rigorous presentation. This problem might have arisen as follows:

In ancient Egypt Pharaoh decided to build a pyramid as high as possible and yet having provision for easy ascent. He had a supply of 400,000 blocks and he decided that the design shown below would meet his requirements:



Two-dimensional pyramid

He asked his court mathematician how high the pyramid would be. The mathematician unrolled his parchment and proceeded to analyze the situation as shown in the table.

The Mathematician's Analysis

$$1\text{ bl.} + 2\text{ bl.} + 3\text{ bl.} \ldots + n\text{ bl.} \sim 400{,}000\text{ blocks}$$

or

$$n\text{ bl.} + (n-1)\text{ bl.} + (n-2)\text{ bl.} \ldots +1\text{ bl.} \sim 400{,}000\text{ blocks}$$

Adding

$$(n+1)\text{ bl.} + (n+1)\text{ bl.} + (n+1)\text{ bl.} \ldots + (n+1)\text{ bl.} \sim 800{,}000\text{ blocks}$$

There are n terms on the left side, and therefore

$$n(n+1) = n^2 + n = \text{(approx.) } 800{,}000$$

Adding ¼ to each side to form a perfect square

$$n^2 + n + \tfrac{1}{4} = (n + \tfrac{1}{2})^2 = \text{(approx.) } 800{,}000.25$$

$$n + \tfrac{1}{2} = \text{(approx.) root } 800{,}000.25 = 894.4$$

$$n = \text{(approx.) } 893.9$$

$$n = 893$$

Thus the analysis of the mathematician showed that the pyramid would be 893 blocks high.

However, the mathematician being a pure scientist could not be rushed in this analysis and so Pharaoh turned for an answer to a young engineer who was used to getting things done. The young engineer attacked the problem directly. He took his staff and wrote in the sand:

The first step adds	1 block	= 1
The second step	2 blocks	= 3
The third step	3 blocks	= 6
etc.		
	+4	=10
	+5	=15
	+6	=21
and so he continued on and on	+300	=45,150
	+301	=45,451
	+302	=45,753
	+303	=46,056
	+891	=397,386
	+892	=398,278
	+893	=399,171
	+894	=400,065

Finally the engineer also concluded that the pyramid would be 893 blocks high. This was the brute force approach which is nowadays termed simulation.

However, while the engineer scribbled figures slowly in the sand, which was frequently blown away by the wind, a court gambler happened to pass by and enquired as to the nature of the problem. After the engineer explained the court gambler asserted that he would obtain an approximate answer by picking a few numbers at random. As a matter of fact the court gambler offered 20:1 odds that he could determine the height of the pyramid with an accuracy of 10 per cent if he were allowed to pick 100 numbers at random.

He first guessed that the pyramid would be 1000 blocks high, and he picked 100 random numbers between 0 and 999 inclusive. (See p. 1040)

The average of these random numbers was 468 and the gambler reasoned that there would be approximately

$$n \times 468 = 400{,}000\text{ blocks}$$

or that the pyramid would be

$$n = 400{,}000/468 = 854\text{ blocks}$$

(Continued on page 1040)

The Influence of Tropical and Sub-Tropical Features on the Design of Thermal Power Plants

W. K. Carruthers, M.E.I.C.

Chief Mechanical Engineer, Montreal Engineering Company, Limited.

THE objective of this paper is to evaluate some of the requirements of good tropical design in the hope that some measure of improvement might be achieved in lower capital costs, better efficiencies, lower maintenance costs and higher continuity of service.

The writer's experience with power plants in the tropics is limited to the Central American and Caribbean areas. In these regions there are few influences which might be considered as peculiar, but a good many which, although not unique, are much more severe in intensity than in more temperate zones. Both types will be discussed under the following headings:

(1) Types and choice of thermal plant; (2) ambient temperatures; (3) humidities; (4) precipitation; (5) winds & weather; (6) water supply; (7) topography; (8) load characteristics; (9) staff; (10) plant control.

Types and Choice of Plant

Fundamentally and inevitably the choice of plant type depends entirely on economic conditions, and the plant which can produce the required number of kilowatt hours and meet the expected kilowatt peaks for the least annual total cost, should be the one selected.

As elsewhere, steam, diesel, and more recently and much less extensively, gas turbine thermal plants, are the familiar types to be found. The relative advantages of these vary with the type of fuel available, the quality and quantity of water supply, and the ambient conditions of temperature, humidity and weather. These will be briefly discussed for each type of plant.

Steam Plants. Steam plants can burn any type of fuel, but as coal is generally very limited in supply in the tropics and quite expensive, oil, which is fortunately quite abundant, and natural gas are the usual fuels. As cooling waters are usually quite warm, exhaust pressures are seldom less than 6.25 cm. Hg absolute and some 4.5 litres per minute per kw generated are required. High wet bulb temperatures generally preclude the use of cooling towers, except in the dry portions of Mexico. Heat rates therefore are relatively high and vary from 3520 to 4530 kg. Cal. per kwh. (14,000 to 18,000 Btu/kwh.). Other types of generation are favoured for loads less than 10,000 kw., as the smaller sizes of steam units are less efficient and not available in the higher temperatures and pressures that modern high efficiencies demand.

Diesel Plants. Diesel plants require a higher grade of fuel than steam plants, but where transport costs are high, this is an asset rather than a liability. Only about 20 per cent of the cooling water required for a steam plant is necessary, and as approach temperatures to the wet bulb temperature are in the region of 15 deg. C., various types of air and evaporative cooling are feasible. Plant sizes are not recommended in excess of 10,000 installed kw., but even for small units thermal rates of from 2520 to 3020 kg.Cal. per kwh. are easily obtainable (10,000 to 12,000 Btu/kwh.). However, the costs per installed kw. are considerably higher than for steam units or gas turbines, which tend to offset the thermal advantage.

Gas Turbine Plants. Gas turbine plants require a relatively high grade of fuel if blading troubles are to be avoided, and for highest efficiencies low temperature inlet air, high barometric pressures, plenty of cold water for compressor inter-cooling and system demands which will permit continuous full loading of the units. The heat rates possible, subject to the limitations mentioned above, vary from 3280 to 6300 kg. Cal. per kwh., (13,000 to 25,000 Btu kwh.) and these are only for units fully loaded. At lesser loads the efficiencies drop off sharply. Site preparations are simple and transportation and installation problems are usually not significant.

Ambient Temperatures

Probably the most familiar climatic feature of the tropical region is that of very high ambient temperatures. In British Guiana for example, temperatures below 26 deg. C. are rare,

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whilst any over 35 deg. C. are likewise unusual. On the other hand, in Venezuela, the shade maximums often reach 40 deg. C., and in the sun 60 deg. C. are not uncommon. These temperatures are not nearly as severe as those to be experienced in the Persian Gulf for example, but they are of sufficient magnitude to influence design.

Power plant buildings must be very open affairs, and allow for a maximum of natural air movement throughout. Any more or less unavoidably confined areas should be, if possible, open at each end, or failing that, air conditioned. Control rooms would fall in this last category. Whilst open as much as possible, care must be taken that sides are blanked off, where necessary, to protect vital equipment from rainfall or excessive wind. In other words, when temperatures are high the avoidance of draughts as opposed to natural and slow movement of large bodies of air, is of the utmost importance. Steel supported asbestos cement for roof and side walls has been found to be satisfactory and economical.

The physical location of thermally actuated relays is rather critical. Cases are on record where unnecessary outages have resulted from relays being placed in "dead air" areas where the temperature build-up was above the normal plant average. Again false interruptions have been caused by improperly ventilated relay cases. The remedy would seem to lie in better ventilation of thermal relays, both inside and out, by natural means where possible, and artificially induced by fan, if not. In extreme cases it might be necessary to use the next higher rating of thermal element in a relay, but this method is not favoured as it reduces the amount of electrical protection afforded to its associated equipment.

All motors must be conservatively rated, particularly well ventilated, and the tendency is now to specify such vital motors as those driving feed pumps, fans or circulating water, to be water cooled, unless it be that the supply of such water would in turn set up too much of a problem. The only other answer, in that case, would be to employ unusually large shaft mounted self-cooling fans, in order to achieve the necessary heat transfer.

Bearings on driven equipment, such as ID fans, and also FD fans, particularly those employing re-circulation of FD air to combat cold end air heater corrosion, must be adequately protected against heat. It is necessary that heat flingers or other heat absorbing devices be liberally designed. Required factors of safety in this respect might well be considered as varying as the square of the temperature involved. Heat insulation on piping is not materially different from that in any ordinary plant, but the placement of lines can warrant special attention. These lines carrying steam or hot fluids should be in well ventilated areas so as to cause as little super elevation of ambient temperature and interference with adjacent lines as possible.

The question of sun and shade quite naturally falls into the category of high ambient temperatures. Obviously in tropical regions the sun is hot and right overhead at noon. Shaded areas have to be provided, and also means employed to cut down the glare, even from normally mat or uneven surfaces. In any consideration of the so-called outdoor plant these aspects would have to be included, as it has been found that personnel are quite sensitive to these comfort features. The establishment of a relatively pleasant, cool place to work is usually very worthwhile.

The author discusses the tropical and sub-tropical regions of the Caribbean and Central America, of which he has first-hand experience. The choice of plant should be determined by economic considerations, and the various types are discussed in the light of conditions that may be met. The effects of the climatic and other physical features of these regions are presented, together with particular considerations of load characteristics, staff, and plant control.

Humidity

Whilst by no means unique in tropical regions, the relative humidities there found are generally higher and of longer duration than in more temperate regions. This means that the general corrosion problem is much more severe and that particular care must be taken to protect relays, meters, switchboard wiring and sensitive mechanical equipment (boiler meters, etc.) which are not in themselves adequately rust protected against moist tropical atmospheres. The use of drying lamps and even small heaters will be found to be worthwhile, when equipment is not in use. Good design would incorporate in such equipment the means to keep it relatively dry, particularly when not in use, and therefore deprived of any heat which might accrue from normal usage. Good circulation of air will also be highly beneficial.

Electrical insulation should be not less than Class "B" (AIEE Std. No. 1, June 1940). Where feasible, totally enclosed, self and externally cooled motor construction should be employed, if freedom from excessive maintenance is sought. In cases where this type is not justified or available, particular care should be used in specifying insulations when ambient temperatures are apt to exceed 40 deg. C.

Where ample cooling water is not naturally available, high tropical humidities greatly limit the capacity and effectiveness of cooling towers. This capacity is limited by the closeness with which the tower effluent must approach the wet bulb temperature. This approach temperature in our experience seems to have an economic minimum of about 11 deg. C. which pretty well precludes the use of cooling towers for steam plants except in the drier regions.

Due to the much higher approach temperatures of about 15 deg. C. usable in a diesel installation, cooling towers are quite feasible, provided, of course, that ample make-up is available, and that expensive chemical treatment is not required to prevent jacket water scaling or corrosion. In this case a closed cooling system using radiator or evaporative coolers is satisfactory, resulting in lower total annual costs, despite the somewhat higher capital investment.

Precipitation

Again, rainfall is not unique to tropical regions, but perhaps the amount of it is. Plants should be designed to cope with rainfalls up to 3.5 cm./hr. and 25 cm./day, oftentimes with accompanying winds. This means that equipment in pits, unless completely unaffected by water or protected by adequate sump pumps, is to be avoided. Generally speaking, it is safe to say that the entire plant should be on at least ground level or above. This means that a problem exists for those engineers who like to have positive suction heads on their horizontal centrifugal circulating water pumps, as such installations are usually in sunken pits. Surface flooding is a constant menace, and good design should recognize this and plan to be independent of surface floods.

Tropical rainfall is generally very sudden in addition to being of considerable proportions. From the maintenance viewpoint this feature tends to make the selection of an outdoor plant a more significant problem. At this stage it might be well roughly to summarize the position of this type of plant.

Opinion is still well divided as to the respective merits of enclosed and outdoor installations. At first glance it would seem that the latter type is ideally suited for tropical regions, but actually there are advantages each way. The main difficulty with an outdoor installation is the difficulty of carrying out routine maintenance and emergency repairs in the open, irrespective of weather conditions. If shelter for such operations is envisaged, then it should be of such type as to permit the operation of the gantry type crane, either through it (with the main hook) or underneath it. If shelter comparable to the enclosed design is to be achieved, this shelter would have to be of such proportions as to cover both the turbo-generator area and the maintenance bay, and to permit free movement of the gantry crane inside it. If weather conditions are sufficiently stable and uniform, as perhaps in Texas, doubtless some less measure of shelter can be justified, and advantage therefore may be taken of reduced building costs inherent in the outdoor plant. If not, and this has proven so to be in our experience, a reasonable compromise may be taken by enclosing the turbine room and boiler fronts only, as these are the portions requiring the most maintenance, and leaving the rest outdoors. This method has been employed with excellent results in our construction in Demerara and Venezuela.

Winds and Weather Hurricanes

To the layman, hurricanes are almost invariably considered a feature which is peculiar to tropical regions, but this is not strictly true. In the mid-western States, tornadoes and twisters are on record which rival in velocity and severity any tropical hurricane. The fact that they are generally less frequent, does not indicate that good design does not have to take them into consideration. It will be found that in the regions we are considering, as in the north, structures may have to be designed for winds up to 250 km./hour. Fortunately available records define very well the relative dangers of the various areas and structure design practice can be modified to suit.

However, the "prevailing wind" so evident in some tropical regions can be made quite useful in achieving good draft free ventilation. The N.E. trade winds in British Guiana are a good example of this type. They rarely cease and generally blow steadily from the N.E. at velocities ranging from 7 to 20 km./hr. with gusts up to 30 km./hr.

Water Supply

Water, in the tropics, is usually more of a problem than in the temperate zones. Sometimes it is a question of quantity, there being either too much or too little. Then again some of it is so hard that, as one wit once stated, it wouldn't go around a long radius elbow without groaning. Invariably, what water there is is rather warm, which of course, in the case of circulating water, materially increases the size of condensing plant and auxiliaries.

With feedwater, the problem is generally one of scarcity of supply, rather than treatment, for fortunately there are adequate systems available for any water—it just being more difficult in some cases than others. The best answer would seem to be water reclamation from all possible sources, rigid control of all water usage, and adequate storage.

With circulating water of a tidal sea water source, problems exist with respect to shellfish, mussels and marine borers and the deterioration of surfaces which are alternatively wet and dry. It is not believed that the last two conditions are any more severe in tropic regions, but it would appear that shellfish and mussels might be more controllable. These types of marine growth seem to be very sensitive to temperature change in the South, as sea temperatures are very uniform, whereas their cousins in the temperate regions are quite used to the relatively slow seasonal variations experienced there. This means that if advantage can be taken of the rise in circulating water temperature through steam turbine condensers, shellfish and mussels can be given a systematic treatment of temperature rise and fall, which is most effective in destroying them. This is amply borne out by the fact that cooling water discharge mains are free of such growth, whereas in force mains the problem is most difficult. The answer lies in a system of flow reversal whereby pipe lines are alternated in function between force and discharge mains, with the resultant temperature changes being sufficient to kill all such growth in both groups.

If of river origin, water in the tropics oftentimes carries a large amount of silt, algae, or contaminants, involving expensive and constant filtering and chemical treatment. Although good revolving screens can usually be depended upon to screen out most of the debris, it is the wise designer who provides for a reversal of flow in his condensers to allow rapid clearing of tube sheets. There are several good types of three and four way valves on the market which will accomplish this very nicely. In addition, the condensers themselves can be arranged to permit this feature, with internal flat type valves of their own. Tube sheets can therefore be kept nicely clean in this way. The problem is, of course, not essentially different than the one existent in temperate regions, except in the quantity of suspended and entrained material. Tropical regions are usually densely vegetated, and there is a high proportion of leaves and grass to be found. Pumping equipment, heat exchangers and valves should be specified to handle silt in suspension, and of erosion-resisting materials. Where tidal or flow levels permit, screens should be of the cup type, which do not employ any bearings or wearing surfaces below water level, except easily replaceable seals.

In the case of brackish water it seems that cast iron attack is more severe than in either fresh or sea water. High-silicon cast irons, being more dense than the ordinary type, give better results. Where valves are concerned it is better to avoid dissimilar metals when cast iron bodies are used, the best trim being ordinary 18-8 stainless steel.

To conclude with respect to these problems, for both feed and circulating water, the solutions are, generally speaking, no more diverse or difficult than in Northern regions. Cases are rarely found anywhere that some form of feed water treatment is not required, and in fact, with the advent of higher temperatures and pressures, waters which a few years back would have been considered excellent in their natural raw state, would now be totally inadequate. As to circulating water, silt is always a problem and may be found anywhere, although due to the nature of some tropical soils and the heavy downpours of rain that take place, the tropical problem may be greater on occasion.

Topography

Again, topographical features represent a problem which varies only in degree from those experienced in Northern regions.

Tropical areas were never subjected to ice erosion and therefore little rock is exposed, but much earth. This results in a difficult erosion and debris problem due to the high intensities of rainfall so characteristic of the tropics. During a recent flood in Salvador lasting only a few hours a riverside plant was flooded and shut down for over a week.

It is probably safe to say that the greater part of the coastal areas of the Caribbean regions under discussion are on the sea side of a belt of delta, and therefore the disposal of circulating water must be carefully watched. Fortunately in these areas either tidal currents exist, or the prevailing winds help to such an extent, that normally a fixed position of intakes and discharges is possible.

In interior regions, whilst topography may effect transmission lines emanating from thermal plants, this is not truly within the strict scope of this paper. Generally the greatest inland problem is water, which is fundamentally due to (provided the area has sufficient rainfall) improper features for natural reservoirs, or a soil, such as those of volcanic origin, which permits the rapid percolation of large amounts of water through it. Lastly topographic features may make the supply of fuel to a plant difficult, if not totally impractical, for economic reasons. Sometimes poor roads, small tunnels or other barriers may exist to preclude the transport of equipment over a certain specified size to a plant site. This means that it is possible for a designer to be rather limited in his choice of equipment size, when other more normal considerations would indicate larger sizes of prime movers or steam generators.

Tropical systems, except in highly industrialized and progressive areas, are inclined to be independent of each other, and not infrequently consist of only one plant. In this case, assuming a uniform quality of service, the designer has to take extra measures to ensure continuity of supply, which would not be essential if the plant were one of two or more in the system. To be more specific, means must be provided for a separate source of station service, even to the extent of a gas or diesel driven a.c. generator. Ample spare equipment must be carried and duplicate auxiliaries for each main unit provided. Perhaps if a unit system of one-boiler/one-turbine is used, and this is certainly the modern tendency, then it likely follows that each generator has its own transformer, and if this be the case a tertiary station service winding can be employed in this transformer for station service. However, this method may not be adjudged safe, unless it is quite apparent that there will never be less than two machines on the bus at any one time. A further proviso is that the tertiary winding must be, in each case, large enough to service at least two machines, and preferably more, depending on the size and nature of the other units existent.

Load Characteristics

One of the most significant features of tropical loads is the effect brought about by the lack of a normal twilight period. For example 7 degrees north of the equator in British Guiana, it is dark ten minutes after the sun goes down. This means that lighting is necessary within two or three minutes after sundown, and this produces a very sharp evening peak condition. To be more specific, in Georgetown some 2500 kw. is added in from 10 to 15 minutes to produce a peak of 5300 kw. Approximately one hour later, the drop-off of some 4100 kw. to night loads begins at a rate which is almost as fast as the build up rate. Fortunately the loads which bring on these peaks are essentially lighting or cooking loads, and therefore the power factor is not adversely effected. In the more industrialized areas, the growing use of air conditioning equipment is tending to reduce the effect of this lighting peak and raise the annual system load factors to well over 50 per cent. The existence of this sharp evening peak quite naturally effects the method of plant operation but this is not significant. However, it is felt mostly in the designer's choice and timing of additional equipment. These peaks must be met, but since they are so sharp and usually of such short duration, the use and retention of normally obsolete or inefficient equipment is usually obligatory.

Staff

The problem of staffing a modern thermal plant in tropical regions can be a rather difficult one, compared to the situation further north. The high cost of fuels in the areas under discussion make it economically necessary that a relatively modern type of design be employed, which means of course subscribing in part at least to the present trend towards higher pressures and temperatures. Even in low cost fuel areas like Venezuela, medium pressures and temperatures (60 kg./cm². and 482 deg. C.) are easily justified. It therefore follows quite naturally that it would be most desirable for plant staffs to have had operating experience with similar plants elsewhere. This is not always possible, for economic reasons, and this means that intensive training programs will likely be necessary, in order that operators, workmen and technicians may be trained in plant operation and maintenance. Such training schemes are playing a very necessary and integral role in the supply of plant staff the world over, even where adequate trade and manual training schools exist, for it seems that practical, specific, on-the-spot instruction is needed to augment the general technical foundation learned at schools.

Unfortunately, not all tropical areas are as fully developed with respect to trade schools as they might be, or indeed as they no doubt will be. This fact makes such utility training schemes more important than ever, but none the less successful, except that probably the number of trainees produced will likely be somewhat reduced. This set of circumstances usually results in more and more automatic and remote control appearing in plant design.

The efficient operation of a steam plant demands the presence on each shift of a capable well trained shift engineer, sufficiently experienced to act wisely in a crisis. However, on the shift also are boiler tenders, water tenders, oilers and machine drivers, all of whom must be trained to a certain extent—it being physically impossible for the shift engineer to be available to each of them at all times. It is this factor that makes it usually desirable for the designer to include automatic equipment, whenever possible, for plant operation. This practice should not be limited to the automatic operation of boilers and turbines, or those processes which are normally controllable, but also the automatic cut-in of "back-up" devices. For example, if a feed pump fails, it should be so arranged that the spare pump should cut in without delay and without any human hands being required in the process. This same feature should be applied to extraction pumps, circulating water pumps, priming devices (when continual in nature), etc. It is questionable whether boiler fans could reasonably be included, for their failure would probably be electrical in nature, rather than because of the air being handled, and this is not likely. As an alternative to the "back-up" device, spare units remotely controlled from a central control room have much merit, and generally tend to make the system less complicated technically, but more difficult to actually operate. The choice should depend on the quality of operating staff and instrument men available.

A staff training program has been established in one case that is working out very well indeed. It was started off by the employment, for two months, of an expert from Consolidated Edison, New York, who concentrated on teaching the supervisory plant staff how to teach shift and maintenance personnel. A precis in Spanish was made up covering all pieces of equipment in the plant, with a complete description of how each worked, what operating steps were necessary in order to bring it into operation, and what maintenance and repair steps could be expected. Copies of this precis were mimeographed and placed in the hands of the plant staff. A regular series of lectures, twice weekly was then set up and the precis covered in detail. A goodly amount of time was allotted to questions and answers. This precis, by the way, consisted of some four hundred pages of standard 8 x 11 in. paper, of single space typing, and provided with a profusion of illustrations. It is too early at time of writing to evaluate the results of this policy, but the interest being displayed is high and genuine progress is being made. In this particular case it was not even necessary to provide any additional incentive other than the opportunity to learn, so it would seem that what has been achieved here can be duplicated almost anywhere—for of all the important prerequisites to learning, desire is by far the most important.

Plant Control

Probably the most important aspect of power station operation is that of the control system, for it is here that uniform and maximum efficiencies for a given set of equipment may be achieved, and continuity of service best maintained without jeopardizing unduly the safety of operation. The components of a control system are many and inasmuch as they are all integral parts of what might be termed the plant's nervous system, absolute reliability, simplicity of operation, and ease of maintenance are prime requisites. The problem is, of course, not confined to tropical areas, and a good many of the ideas expressed below would be good practice anywhere. However, an attempt to differentiate between the regions under discussion would be rather involved, so for the sake of continuity some of the principles which we have found desirable are mentioned, without regard to geography.

Electrical relays, contractors, timers, switches, and assorted equipment of like nature should be as airtight as possible, even to the use of hermetical seals, except where normal heat generated within would preclude this. Mechanical assemblies should be treated similarly and, if possible, lubricated for life.

Too much thought cannot be devoted to the control room and placement and grouping of instruments and controls. Gauges, and other means of indicating temperatures, pressures, levels, quantities, velocities and other pertinent items should be small in size, and grouped so that when one changes any others that are affected are reasonably near the one causing the variation. It also follows, if such control is to be understandable and easy to operate, that wherever the means of measurement exist there also should exist the means of control, so that adjustments may be made and the results easily interpreted. Quite obviously, the means of changeover from automatic operation to hand operation should be capable of being carried out rapidly and simply, for when this operation is necessary it is usually at a time of some stress, if not crisis.

Ample and extensive use should be made of line diagrams and charts associated with the various instruments and their means of control, for in this way it is possible to set up the process in natural cyclic form, which would make it simple and logical to follow. This method, whilst normal in electrical layouts, is also capable of being employed on the flow cycle of a modern plant. It makes it possible for new personnel to pick up the details of the plant much faster than would otherwise be possible. Colour coding of piping, both on charts and drawings and as actually installed, should be used.

The use of annunciators should be considered very carefully. The tendency is to use audible annunciation whenever anything, however small, goes wrong. This has the double fault of being unable to discriminate between cause and effect, and also as a corollary of this failure, the audible trouble signal has not got the warning and action-producing effect on staff that it should have. To be effective there should be distinct discrimination between cause and effect, making the annunciation, as such, visual and audible respectively. In other words, the variation of any quantity beyond reasonable limits, which is not in itself immediately damaging, other than the contributory effect it has on other more important quantities, should be visually indicated, so that means for correction may be started without any audible alarm. An example of this would be a low surge tank level, or a low machine vacuum — not in themselves necessarily damaging, unless left unattended. However, the end result of any inattention to these contributing causes, such as dangerously high bearing temperatures, machine winding temperatures, high superheat or low steam pressure, should be both audible and visual. Oftentimes, it would be desirable to arrange it so that on some quantities the visual signal should come whenever any variation takes place, and an audible one whenever that variation has exceeded preconceived and reasonable bounds.

It is felt that the control room itself should be air conditioned for the comfort of the operating staff and the protection of instruments and controls against excessive humidities and varying ambient temperatures. The economic advantages for so doing are almost impossible to evaluate accurately in any units, but good judgment seems to indicate that a happy staff and adequately cared for instruments constitute a worthwhile investment.

The Alexander Graham Bell Museum

S. L. Roberts, *Editorial and Information Division*

Department of Northern Affairs and National Resources

"Don't keep forever on the public road, going only where others have gone. Leave the beaten track occasionally and dive into the woods. You will be certain to find something you have never seen before. Of course, it will be a little thing, but do not ignore it. Follow it up, explore all around it; one discovery will lead to another, and before you know it you will have something worth thinking about to occupy your mind. All really big discoveries are the results of thought."

These are the words of Alexander Graham Bell, inventor, scientist, teacher, and humanitarian. They sum up simply his philosophy towards research. Bell did not follow the "public road"; his intellectual excursions into the unexplored territories of science yielded many "little things" that advanced human knowledge tremendously. His most popular and most successful invention was the telephone but many other branches of science attracted his searching attention. To medicine, aeronautics, marine engineering, genetics and eugenics, electricity, and the science of speech, Alexander Graham Bell gave generously of his intelligence and energy.

This month, August, the Alexander Graham Bell Museum at Baddeck, N.S., is to be opened to the public by the Department of Northern Affairs and National Resources. This museum will be of interest to many engineers, since it contains much material and records from Bell's researches. This article summarizes the main work of Alexander Graham Bell and the examples that are shown in the museum, of which a general view is published on this page.

Bell's remarkable scientific achievements are being presented in their full scope to the public at the Alexander Graham Bell Museum at Baddeck, Nova Scotia. Displayed here are many experimental models and documentary records of his work. These relics, which will be of great interest to modern engineers, have been donated to the federal government by Mrs. David Fairchild and Mrs. Gilbert Grosvenor, both of Washington, D.C., the inventor's daughters.

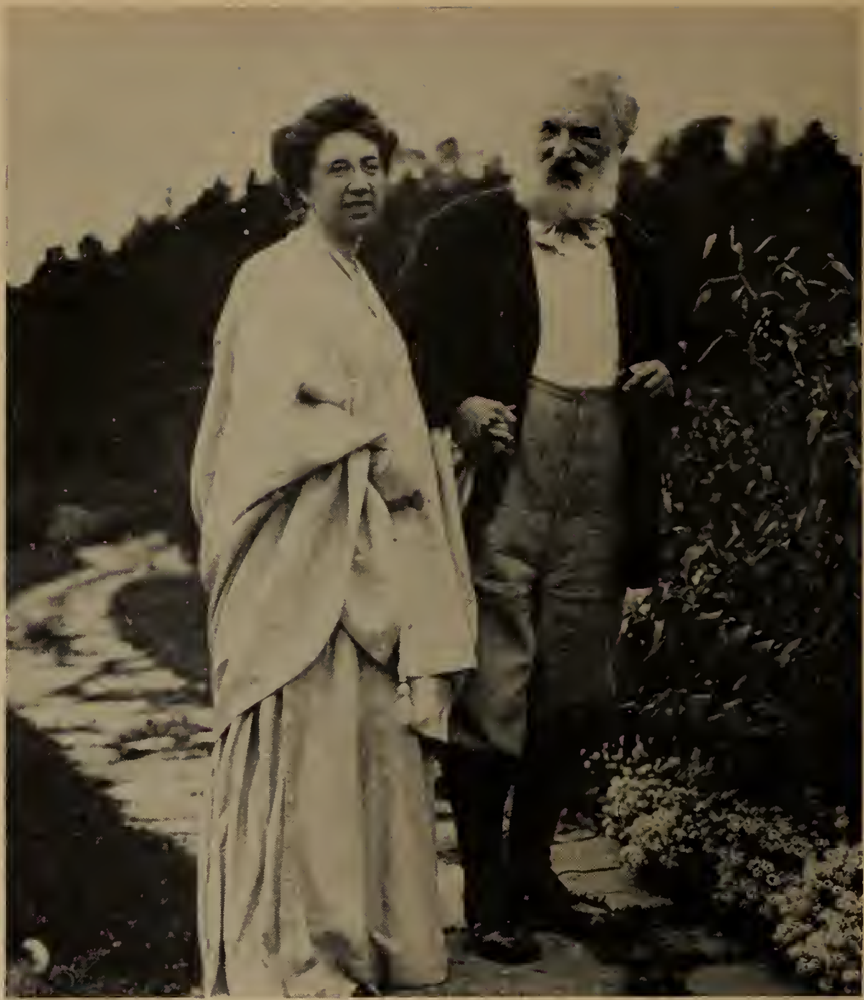
The museum has been established by the federal Department of Northern Affairs and National Resources and will be administered and maintained by the National Parks Branch of that Department. Built mainly of native Cape Breton sandstone and laminated wood, the museum's dominant architectural motif is the tetrahedron, the design Bell used for the cells of large kites, some of which were strong enough to carry a man. The tetrahedral design is repeated in a canopy over the entrance, the display cases, the large window areas, and details of the museum design. Architects for the building were O. H. Leicester and A. Campbell Wood and Associates, of Montreal.

Within the 4,300 square feet provided for display area in the triple-level building are displayed propellers, kites, ailerons, early telephones, an early hydrofoil boat, an experimental iron lung, and other scientific devices developed by Bell. Bell's research office at Beinn Bhreagh, the Baddeck summer home of the inventor, has been reconstructed within the museum and furnished with authentic furniture and personal belongings of the inventor. An unusual touch is the sketches from Bell's laboratory notes that are reproduced in black ceramic enamel on the large plate-glass doors leading into the vestibule.

Baddeck is one of the places most closely associated with the inventor's life. From 1892 until his death in 1922, he spent his summers at his beloved estate, "Beinn Bhreagh", which stands on a headland across the bay from Baddeck. To the laboratory and workshops he established in his estate, he brought his experiments and at Beinn Bhreagh in 1907 was formed the Aerial Experiment Association. The aeronautical research carried out by the Aerial Experiment Association under Bell's leadership is important in the history of aviation development in the world; from it came the aileron, the controllable tricycle undercarriage, floats for seaplanes, and many successful aircraft, one of which made Canada's first flight from Baddeck Bay on February 23, 1909.

Bell's research led him into many fields. His first investigations were directed toward a harmonic telegraph that would send multiple Morse messages over a single line. At the Volta Laboratories, which he established at Washington with the aid of the financial grant associated with the Volta Prize awarded by the Republic of France for his telephone invention, Bell and associates experimented with selenium in a "photophone" that would carry speech in the form of light waves. The Volta Laboratories also improved on Edison's gramophone, developing its own "graphophone" that used wax cylinders which were the ancestors of modern records. Bell also conducted research into genetics and such medical techniques as the iron lung, the use of radium for deep-cancer therapy, and surgical probes that would locate pieces of shrapnel or bullets embedded deep in wounded men. He experimented with the use of sound waves to reveal the presence of icebergs and in measuring the ocean depths.

In aeronautics, Dr. Bell was a pioneer. Before the nineteeth century ended, he had experimented extensively with kites. To achieve human flight in a powered heavier-than-air machine, he developed the tetrahedral cell, a geometric type of construction that would combine lightness and strength in the cells of his experimental kites. The tetrahedron, the design of Bell's kite cells, is revived in the design of the Alexander Graham Bell Museum.



Dr. Alexander Graham Bell and Mrs. Bell in the garden of their home, Beinn Bhreagh, at Baddeck.

(Photo Dr. Gilbert Grosvenor, National Geographic Society)

Although a giant tetrahedral kite built by Dr. Bell was flown by Lieut. Thomas E. Selfridge, the U.S. Army's aviation expert, in 1907, the design offered too much wind resistance for successful development.

An important chapter in the development of aviation was written by the five men who founded the unique Aerial Experiment Association at Beinn Bhreagh on October 1, 1907. Banded together under the leadership of Dr. Bell and with the moral and financial support of Mrs. Bell, four young men pledged their united efforts to construct an aircraft that would fly under its own power carrying a pilot.

F. W. "Casey" Baldwin, mechanical engineering graduate of the University of Toronto and superb athlete, Glen H. Curtiss, the young American engine expert whose motorcycle plant at Hammondsport, New York State, provided an alternative site for the experiments, J. A. D. McCurdy, the daring Nova Scotian engineer and pilot, Lieut. Selfridge, the U.S. Army's first aviator and later international aviation's first victim of powered flight — these formed the Aerial Experiment Association.

At Baddeck and at Hammondsport, the Association built "aerodromes", a name that Bell consistently applied to the frail flying machines that took to air. Their first craft, the "Hammondsport Glider" was flown successfully in 1907. Later came the "Red Wing", their first motor-propelled aircraft, and the "Baldwin's White Wing", the first aircraft in the world to achieve control by the use of hinged ailerons and to make a self-propelled take-off from land. The "Silver Dart" flown by McCurdy made the first recorded heavier-than-air flight by a British subject in the British Empire in 1909.

When the Aerial Experiment Association dissolved in 1909, under the terms of its agreement, it left a legacy to aviation. It had shown what could be accomplished by a

The Silver Dart, with J. A. D. McCurdy at the controls, flies over the ice of Baddeck Bay while spectators skate madly in its course. (Photo National Geographic Society)

research team working under the leadership of a brilliant inventor. It passed on to others the aileron and the tricycle undercarriage and in Bell's notes are records of other theoretical devices which have only been developed in recent years. Bell visualized rocket-powered missiles, helicopters with jet-propelled rotors, and other advanced aeronautical designs.

Although the Aerial Experiment Association had ended, Dr. Bell and his group remained at Baddeck to form an aircraft manufacturing company. They built five aircraft, of which two were very successful. The aileron from one of these aircraft, the "Baddeck II", is on display in the museum and it is probably the oldest aileron left in the world. Failure to develop a market for their production ended Bell's association with his young experimenters but Baldwin stayed with the inventor to experiment with hydrofoil boats.

Dr. Bell believed a boat could be built to carry heavy loads at great speed if the driving force of air propellers was harnessed. To avoid the opposition of the water, he and Baldwin devised hydrofoils, sets of small wings attached to the sides of the boat. Working first with models and later with small boats, the two men developed the hydrofoil, a boat that rose on its hydrofoils like an air craft when it attained speed. In 1919, the "HD-4", their fourth full-sized experimental hydrofoil boat, sped over Baddeck Bay at the record speed of 70 miles an hour, a mark that was not equalled for many years.

The hydrofoil boat was the last great inventional accomplishment of Dr. Bell. Three years later, he died at Beinn Bhreagh, leaving the world richer. His research is perpetuated today in the achievements of modern scientists and inventors, who have extended much of Bell's basic research into practical machines to serve mankind.

Members of the Aerial Experiment Association shown here are (from left): Glenn Curtis, J. A. D. McCurdy, Dr. Bell, F. W. ("Casey") Baldwin, and Lieut. Thomas E. Selfridge, U.S. Army. (Photo—Dr. Gilbert Grosvenor, National Geographic Society)

DISCUSSION

of Technical Papers

MICROWAVE RADIO PROJECT OF THE TRANS CANADA TELEPHONE SYSTEM

A. J. Groleau, M.E.I.C., *Area Chief Engineer, Bell Telephone Company of Canada*

The Engineering Journal, 1956, Aug., p. 1001

J. E. Hayes, M.E.I.C.[1]

Mr. Groleau's paper has been a most interesting and worthwhile presentation, not only because of the lucid description of a very large and complex engineering enterprise, but also because it deals with a subject which goes beyond the sphere of engineering. A microwave network capable of carrying television pictures from coast to coast in Canada, represents a major step in the development of the nation, and might well be compared with the linking of the East and West by the first transcontinental railway.

Just as the railway provides the physical means for transporting materials from one end of the country to the other, so also the microwave system provides the technical facilities for carrying ideas in the form of words and pictures from one coast to the other; and, as the value of the railway is dependent on the importance of its cargo, so the value of the microwave system is proportional to the importance of the information it carries.

The Canadian Broadcasting Corporation has found from years of experience in radio broadcasting that the smooth functioning of a broadcasting network depends on close co-operation and co-ordination between the broadcaster and the communications companies. To this end, joint engineering committees have been formed, through the medium of which the technical and operating problems, which arise from time to time, may be thoroughly discussed and solved.

During the first year or so after the commencement of the television network service, a large number of problems arose which required the attention of the Bell-CBC committee. As solutions were found to these problems, and systematic operational procedures were established, the committee's work decreased considerably. The committee has already set up methods of reporting faults so these may be traced and corrected as quickly as possible, and it is now working on a standard terminology which will speed up the passing of information concerning specific troubles, and reduce the possibility of misunderstandings. The CBC has done a considerable amount of work on the development of over-all test procedures, and the results of this work have been reviewed by the committee. It is planned that, very shortly, the CBC will supply from its TV master control centres in major cities a test signal which can be sent out in less than one minute, and which will give fairly complete information with respect to system performance when received at stations along the network.

It may be of interest to mention briefly the relationship between a TV master control and a TV microwave network. As an example, I might refer to the TV master control at the CBC Montreal television studios. At this particular location, there are eight incoming and outgoing network feeds, plus ten local circuits. It is the function of the master control operator to see that the correct programs are sent out on the correct networks at scheduled time, and also to accept incoming programs from the networks, as required by the schedule. In this particular location, the TV network and local connections are as listed in the accompanying table.

Most of the listed feeds are on facilities provided by the Bell Telephone Company, but the French network feeds to and from Eastern Canada (items 7 and 8) are on facilities provided by the Canadian National and Canadian Pacific Telegraph Companies. Items 11 and 12 are circuits to master control from a CBC microwave receiving point on the transmitter site on Mount Royal, and item 18 is a circuit from a similar

TV Networks and Local Connections at Montreal

	Usual Language
1. Network feed from Toronto, U.S.A., and West	English
2. Network feed to Toronto, U.S.A., and West	English
3. Network feed from Ottawa	French or English
4. Network feed to Ottawa	French
5. Network feed from Eastern Canada	English (1957)
6. Network feed to Eastern Canada	English (1957)
7. Network feed from Eastern Canada	French
8. Network feed to Eastern Canada	French
9. Local feed to CBFT transmitter	French
10. Local feed to CBMT transmitter	English
11. Local feed from transmitter site	French
12. Local feed from transmitter site	English
13. Local feed from Stanley St. studio	French or English
14. Local feed to Stanley St. studio	French or English
15. Local feed from Forum	French or English
16. Local feed from Montreal Stadium	French or English (seasonal)
17. Local feed from McGill Stadium	French or English (seasonal)
18. Internal feed from CBC microwave on Radio Canada building.	French or English

[1] Chief Engineer, Canadian Broadcasting Corporation, Snowdon, Quebec.

microwave receiving point on top of Radio Canada Building. These are used for relaying local pick-ups.

This complexity of network terminations results in a type of operaiton which is considerably more complex than that normally carried on by any of the large broadcasting companies in the United States. Many of the problems that arise must be solved by our own methods and it is only by close co-operation and understanding between the TV broadcaster and the communications companies that satisfactory solutions are found.

I believe that we may be justly proud of the technical quality of the television network service which has been achieved in so short a time, and as techniques improve we may, with confidence, anticipate still further expansion and improvements in the future.

I am sure that Mr. Groleau and his associates, and all of us in the television broadcasting industry, are looking forward eagerly to the day, which is not far distant, when the last link in the transcontinental microwave relay circuit will be put into operation. All those who have worked on this project will then have the satisfaction of knowing that they have participated personally in an important contribution to the development of Canada.

AUTOMATING THE ENGINEER'S TASK

J. Kates, M.E.I.C., *President, K.C.S. Data Control Limited*

The Engineering Journal, 1956, August, p. 1014

J. C. Scrimgeour[1]

Dr. Kates has presented an interesting and worthwhile paper on the application of digital computers to engineering problems.

There are many people who believe that the development of automatic digital computers which has taken place in the last 10 to 15 years will prove equal in importance to, or even greater than, the first industrial revolution or the discovery and control of atomic energy. Certainly it will rank as one of the most important developments in the history of mankind.

The distinction drawn by Dr. Kates between design by analysis and design by synthesis is an important and valid point. In the past most design has been done by analysis and most computer applications to date still follow this approach; that is, a configuration or set of parameters is determined by human thought and presented to the computer, which calculates the performance which would result. A few choices or decisions may be made by the computer but for the most part they are established beforehand by human judgment. Only a few applications have been described in the literature where the computer chooses all the parameters for a given configuration (or even chooses the configuration) which are required to meet a given set of performance characteristics. This may be done by an iterative solution of the equations formerly used for analysis or in some cases these may be solved so that a direct solution can be made with the required performance characteristics as a set of simultaneous conditions which must be met. Dr. Kates has stated, synthesis will not be possible in many applications —at least until the engineer states in exact form the basis on which this has formerly been done mentally; and apparently often by intuition. I believe eventually that this will be done and the great decision-making power of automatic digital computers truly put to use.

An interesting question in engineering ethics and the acceptance of responsibility can be posed in connection with some computer applications — particularly where a previously written computer program is used repetitively to solve the same engineering problem. The question is, "How much of the operation and theory behind the program must the user understand in order to accept responsibility for the results?"

Once the computer program has been checked out, its operation can usually be accepted as correct but the results obtained can only be as good as the input data provided. This in turn is open to human error or even complete misapplication of the program in an extreme case. The engineer must find the point which permits delegation of routine operation of checked out programs to less skilled personnel and yet keep close enough contact to permit him to accept true responsibility for results.

Dr. Kates has given examples of three different approaches to a sample problem; by direct analysis, by simulation, and by a statistical approach. I believe a fourth approach may be added; namely, solution by iterative analysis. This could be applied to his sample problem in the following manner. We might attribute this approach to a second engineer.

Second engineer's solution

Inspection of the pyramid diagram shows that the top row contains one block and the bottom row contains n blocks. The average row therefore contains (n + 1) /2 blocks. The total number of blocks is consequently n (n + 1) /2. This must be slightly less than 400,000, i.e.

$$n\,(n + 1)/2 \sim 400{,}000$$

or $$n\,(n + 1) \sim 800{,}000$$

It is only necessary now to solve this equation for n. The second engineer reasoned that if he tried n = 800,000 for a first approximation it would surely be just a little too large. As a first approximation he should then try

$$n = \sqrt{800{,}000} - 1 = 894$$

$$\text{check: } 894\,(894 + 1) = 800{,}130$$

This is too large, so as a second approximation try n = 893

$$\text{check: } 893\,(893 + 1) = 798{,}432$$

The pyramid may therefore be built with 893 rows and 1658 blocks left over for wastage, spoilage and so on.

Leo J. Lacey[2]

In this paper Dr. Kates is discussing a topic which should be of the greatest interest to all engineers who are interested in improving the science of their profession. Computers have been and are being applied to engineering problems, but up to the present they have only nibbled at the edges of the vast area of possible applications which seem to be waiting for them in the engineering field.

At the Ontario Hydro I have been associated since early in 1953

[1]Advance Engineering Section, Peterborough Engineering Laboratory.

[2] Chairman, Data Processing Team, Hydro-Electric Power Commission of Ontario.

with the computing centre, equipped with a small electronic machine, which was established to assist the engineering staff in computational work. Since the centre was established there has been a gradual increase both in the number and the variety of applications which have been brought to the machine. Power system analysis, hydraulic calculations, survey work, and a variety of statistical studies are just a few examples of the type of work which has been handled at the centre.

It has been noticeable that the increasing number of applications has followed a steady education of the engineering staff, not so much in the intricacies of programming, but in knowing the general capabilities of the equipment and in being able to recognize where it can be of service to them in their work.

Probably the biggest barrier to be overcome in achieving more widespread use of computing equipment in engineering, is that of bringing together the computing specialists, who can solve the problem when he knows what the problem is, and the engineer who knows the problem. Unless engineers in general become computer conscious, many problems will never be brought to machines.

The Author

I agree entirely with Mr. Lacey's and Mr. Scimgeour's remarks. Certainly, as Mr. Lacey points out, it is very important for the engineer to realize the capabilities of computers. As Mr. Scrimgeour points out, it is also important for the engineer to understand exactly what a specific program does or does not. The fact that a specific program carries out a given task exactly has advantages as well as disadvantages.

As Mr. Scrimgeour has pointed out, if an engineer does not fully realize the nature of a specific program he may misinterpret the results which he receives from the computer. This is partly due to the fact that two human beings rarely deal with the same complex design situation in exactly the same way. On the other hand, if a group of engineers and computer experts *can* agree on how a certain program is to deal with any of the situations that will be incurred, there should be little further difficulty in interpreting the results. The fact that we can mechanize lengthy sequences of operations and be certain that these sequences of operations will always be carried out in the way in which we intended them to be carried out has proved one of the greatest advantages of electronic computation.

MOVING-BED PROCESSES

E. H. Lebeis, *Catalytic Construction Company, Philadelphia, Pa.*

The Engineering Journal, 1956, July, p. 915

Discussion at the Meeting

Chairman (W. H. Gauvin): Can you tell us whether the moving-bed technique produces greater attrition than fluidized-bed methods?

E. H. Lebeis: On the contrary, attrition in the former case should be considerably less because of the absence of the violent boiling action present in a fluidized bed.

T. W. Hoffman (McGill University): Could Mr. Lebeis tell us whether heat and mass transfer rates are comparable with fluidized-bed technique?

E. H. Lebeis: Mass and heat transfer rates are generally lower in moving-bed processes, primarily because of the larger size of particle that is handled. However, for most industrial applications which we have studied, mass and heat transfer rates in moving-bed processes are not unduly limiting.

N. Themelis (McGill University): What is the optimum particle size for moving-bed operation?

E. H. Lebeis: Particle size considerations are quite important. Higher rates of heat and mass transfer can be achieved with small particles than with large. On the other hand, the pressure drop of the fluid passing through the bed is higher with small particles. The optimum size will vary from process to process. In catalytic cracking the particle size is about one-eighth of an inch. For other processes, the optimum will usually be somewhere between one-tenth of an inch and one inch.

Chairman: For equal capacities, could you give us an idea of the relative plant costs of fluidized-bed and moving-bed equipment?

E. H. Lebeis: For equal throughputs, the two plants would be roughly of the same order of cost, the moving-bed plant being possibly somewhat more expensive. However, operating and maintenance costs must also be considered as well as ease of operation. In catalytic cracking, many plant operators feel that moving-bed units are easier to operate. Any general statement on relative investment costs can be misleading, especially when one has no specific process in mind.

F. R. Archibald [1]

The Catalytic Construction Company and Mr. Lebeis are to be congratulated, firstly for actively renewing and extending development of a valuable engineering principle and secondly for bringing it to the general attention of engineers by presentation of this paper. My particular interest lies in the application of moving-bed techniques to metallurgical processes and the mechanics of carrying them out. A number of considerations prompt examination of the possibilities in the field of extractive metallurgy at this time and it is hoped that Mr. Lebeis might follow the present paper with a guiding analysis of developments in solids flow, materials of construction, instrumentation, and ion exchange which he has briefly mentioned under "Future Applications".

Among the considerations that make the idea attractive in the metallurgical field are: (a) the increasing cost of fuels and the consequent emphasis in heat economy of furnaces; (b) the increasing awareness and use of solid state reactions and solid-vapour reactions such as those at which he hints in his last paragraph; and (c) recent developments in pelletizing and briquetting techniques which permit the preparation of finely-ground materials for "moving-bed" treatment.

John M. Mortimer [2]

I would like to congratulate Mr. Lebeis for his presentation which, for

(*Continued on page* 1040)

[1] Chief Metallurgist, Falconbridge Nickel Mines Limited.

[2] Metallurgical Engineer, Ventures Limited.

ABSTRACTS

BASED ON CURRENT LITERATURE AND EVENTS

RADAR RESEARCH IN A BIRD SANCTUARY

The late Jack Miner became internationally known through his work for conservation and his bird refuge at Kingsville, Ont. Now, eleven years after his death, this bird sanctuary has been used by the Defence Research Board, Ottawa, as a radar research station to determine effects of mass bird flights on radar screens.

In the spring of 1955 four radar towers were erected, two at the sanctuary, one ten miles away, and one forty miles away. Observations were made of the effects of flights of birds at various distances from the towers, and specialists in the field of radar research from the United States were also invited to attend.

The results of the trials have not been made public, but Dr. O. M. Solandt, then chairman, Defence Research Board has referred to them as being very successful. Jack Miner would doubtless be delighted, though perhaps a little surprised, at the contribution his life's work had made to science. The experience of his sons has apparently proved invaluable in the basic preparations for the trials and in the interpretation of results. Certainly, few other men could have made large flocks of Canada geese fly on pre-arranged schedules and otherwise predict their movements, as they seem to have done.

In such ways is the work of the physicist and the engineer helped by the knowledge of those in a vastly different field.

ENGINEERS AND INDUSTRY IN BELGIUM

A report to the general meeting, in April, of the Société Royale Belge des Ingénieurs et des Industriels gives an insight into some of the problems of productivity and technical manpower in Belgium.

Conditions are generally favourable and there is a tendency to full employment, with shortages of labour in some fields. Belgium is handicapped by a relatively high level of wages and social security contributions, the average hourly wage in Belgium of 31.50 francs comparing with about 27.50 francs in Germany and France, and 21.80 francs in Holland. Although this gap has tended to diminish, wage demands may annul any potential improvement.

Substantial investments have helped towards increased productivity and hence to meet foreign competition, but the report forsees a tightening of revenue authority concessions and further problems in disposing of the increased production.

Some of the industrial achievements include complete mechanization of coal cutting, with marked improvement in output, air-conditioning in deep mine workings, and the recovery and industrial use of firedamp. The thermal efficiency of electrical power stations has been increased some 20 per cent over prewar days; rating of individual units has risen from 50,000 kva. in 1949 to 115,000 kva. in 1955. Basic steel production has been improved by the introduction of oxygen-process plants. Progress has also been made in various fields of mechanical engineering, electronics, and petroleum.

The good financial results of 1955 have not been regarded in their true relation to the overall economy by the trade unions, who have claimed an appreciable reduction in working hours without any reduction in wages. Though many of the working class are considered to be exceptionally able, and therefore deserving of due recognition, the general adoption of a major labour reform could well prove dangerous to a country that must export 40 per cent of its production, especially if its competitors did not reform similarly.

It is apparent, however, that this risk will have to be run, and it is hoped that all will turn out well; inevitably the country's engineers and industrialists "will be called upon once more . . . to devise new solutions adapted to the changed circumstances."

Scientific training and research are ever more essential; more skilled engineers are needed. With this object in view, the society created a scholarship fund twelve years ago to assist men of ability who could not afford higher technical studies. The society is very conscious of the universal importance of engineering training and would like to see more attention paid to the young person in secondary school, who should be told what possibilities there are in technical fields and how they may be entered. Particular emphasis should be placed on pure research and the value of team work.

Better use should be made of available engineers. Observation of employment notices and recruitment regulations of the civil service and public bodies indicates a certain lack of flexibility in the employment of engineers, due to increased specialization and strict age limits; these rules should be relaxed. The engineer must be prepared to adapt himself to new techniques and industries, in which he may be invaluable, even if they are outside his original field of training and experience.

Before ending on an optimistic note, the report views with some caution the burst of activity, particularly in the building industry, connected with the 1958 Brussels Exhibition. Some of the projects are described as grandiose, and it is regretted that the program was not intiated earlier to avoid a rush that may result in harmful labour demands and may also encourage some industrialists to expand facilities unduly, so that they will be over-productive under normal conditions.

MAN-CARRYING CENTRIFUGE FOR AVIATION MEDICINE

United Kingdom Information Service

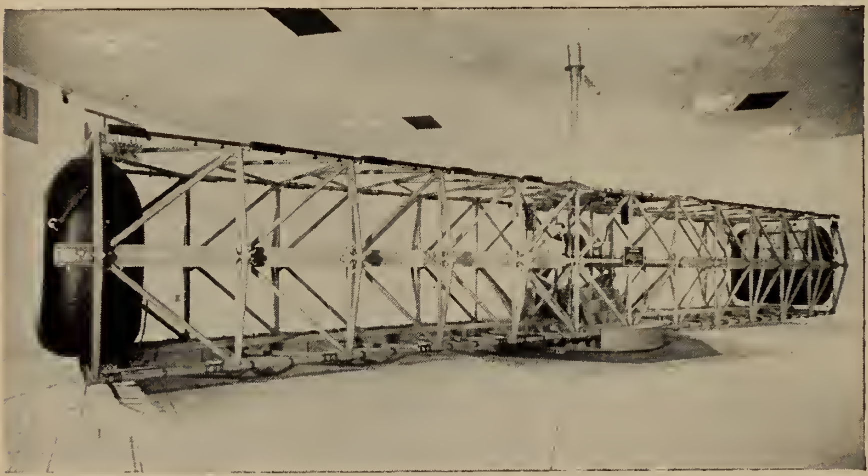
To facilitate medical research into the reaction of high speed flight on the human body, a man-carrying centrifuge has been designed and installed at Britain's Royal Air Force Institute of Aviation Medicine. A communication system enables the subject to describe to an observer what happens during a test.

The centrifuge is basically a horizontal arm rotating under a controlled cycle of acceleration and deceleration. The 60-foot arm has a car suspended on trunnions at each end, and is mounted on a 12-ton flywheel attached to a vertical spindle driving-motor in a central pit in the centrifuge chamber.

Complex design problems were involved in the design of the structure. The cars are subject to an acceleration in the direction of the axis of rotation proportional to the square of the angular velocity and the effective radius of the arm; the rate of change of acceleration is governed by rate of change of motor speed.

At maximum motor speed of 53 r.p.m. and at full radius of 30 feet, an acceleration of about 30 times gravity can be produced.

Main contractors were M. B. Wild and Company Ltd., Birmingham, and electrical and control equipment were installed by the General Electric Co. Ltd., London, England.



Man-carrying centrifuge at Britain's Royal Air Force Institute of Aviation Medicine.

WILL FUTURE TRANSPORTS BE TOO FAST FOR CONVENIENCE?

Canadian Aviation, 1956, v. 29, n. 4, April.

During the first world war, the average speed for an aircraft was 100 m.p.h. Now we consider 300 m.p.h. slow and fully expect to be able to travel at 500 to 600 m.p.h. within the next four or five years.

Many technical problems must be solved before commercial operations can be carried out at speeds above the sound barrier. However, in terms of speed alone, it is possible to assess some interesting passenger reactions on possible air schedules.

Supersonic speeds of the future may not offer the gain expected and may even become embarrassing.

Even today a traveller can make a trip between two cities by air in one hr. 10 min. Yet many people find it both convenient and comfortable to take a night train with sleepers.

Once 200 m.p.h. has been reached, so much time is used up driving out to the airport, waiting to embark, etc., that the time spent on the ground often exceeds the time in the air.

Take the Montreal-London route. The present-day aircraft can make one revenue trip during a 24-hour period. The 500 m.p.h. aircraft could accomplish two revenue trips per day, the 1,000 m.p.h. aircraft four trips, and 3,000 m.p.h. 10 trips.

A further study shows that the 500 m.p.h. flights have convenient departure and arrival times, especially the 9 p.m. service eastbound from Montreal which would allow a certain amount of rest during the normal night period before arrival in the U.K. However, as speed increases, the difficulty and inconvenience of several of the services becomes very apparent. At 3,000 m.p.h. you can leave Montreal at 1 a.m. and arrive in London at 7 a.m. having had less than one hour rest during the night period.

A basic feature in an average passenger's idea of comfort stems from the local mean time of his place of departure. To illustrate this point, take the passenger who leaves London at 8 a.m. on the 3,000 m.p.h. schedule and arrives in Montreal at 3 a.m. What will his reactions be?

A quick study of the world's time zones shows that on east-west routes, high speed flights are definitely inconvenienced by the changes in local time. On north-south routes, high speeds can provide services with the maximum of convenience.

The tendency of present air line operations over long routes, such as Vancouver-Australia, is to give the passenger a rest during his journey somewhere en route. The futuristic trend, evident in the BOAC Comet operation, is to rush the passenger through to his destination with only short refuelling stops.

This may suit certain people in a hurry, but not everybody.

Disorganization in a passenger's meal schedule occurs on east to west flights, especially trans-world flights.

On the trans-world services, although you arrive at your destination quicker at 3,000 m.p.h. you cannot, in most instances, take any useful advantage of the fact.

It will obviously be of paramount importance to an operator of supersonic aircraft to minimize unnecessary time spent on the ground.

There is every possibility that the operator who finds that 3,000 m.p.h. equipment is available, will endeavour to sell high speed services to the travelling public. The argument will be that high speeds give greater earning potential which will, in turn, reduce the travel cost per mile. Economizing of the over-all operation might easily encroach on comfort and convenience of the average traveller.

Speed must be regarded in its proper perspective and an overall assessment of the whole trip must be made before any advantage can be given to travel around 3,000 m.p.h.

COAL MINERALS AND BOILER DESIGN AND OPERATION

Combustion, 1956, v. 57, n. 11, May.

In the second of two articles Dr. Wilhelm Gumz, of Essen, Germany, provides a report of research being conducted by the West German coal mining industry to investigate the behaviour of coal minerals at the high temperatures encountered in boiler operation. The effect of silica compounds upon boiler fouling is discussed.

The situation as outlined in Part 1 of this article calls for a new approach to the problems of boiler surface fouling. Recently activity in this field has been revived in the U.S.A. and in Germany. In England the Boiler Availability Committee has taken successful steps toward a solution, the main points being coal selection and mixture.

The many open questions have incited the Steinkohlenbergbauverein, Essen, a research organization of the West German coal mining industry, to investigate the behaviour of coal minerals at high temperatures (in the presence of coal) to supplement current analyses of field samples from shutdown boilers.

This work has begun with the study of behaviour of single minerals which are the major component of the inorganic matter of coal and proceeded to the mixture of "synthetic coal minerals" and "pure" coal (extremely low-ash coal, 0.4 per cent ash content) at various temperatures and rates of heating.

From the laboratory tests it may be concluded that a partial melt rich in silica is required to volatilize the silicon as monoxide and that the concentration of SiO_2 is an important factor. The residue is a silicate glass with mullite, corundum, magnetite or hercynite ($FeAl_2O_4$) and α-iron depending upon the material used and the temperature reached.

These results demonstrate that the flue gas of a high-temperature furnace carries two types of material, entrained slag in the order of magnitude of 5 microns (and also much larger), and an extremely fine aerosol of silica with diameter of 0.1-0.2 micron (and sometimes a few larger particles). Deposit formation starts by the accumulation of these fine particles which, as shown in microscopic studies, are not always of a smooth surface but may show some protruding material or rough skins or deformations. It is supposed that these deviations from the spherical shape are due to products of sublimation of alkali compounds at the surface of the spheres which may act as an additional binder between the spheres. This hypothesis will be studied further and it is hoped that by studying the sublimation products new light will be shed on the problem of fouling.

THE LURE OF THE DOLLAR

Engineering, 1956, v. 181, n. 4708, p. 421

There is a grave danger that the cream of British technological students will be lost to the United States unless something is done to induce the students to return to Britain after getting scholarships or jobs in the U.S.

Lord Chorley, general secretary of the Association of University Teachers, speaking in support of a resolution calling on the Government to grant permanent deferment from national service to science and technology graduates, did not consider the students' decision to get jobs in the U.S. was a deliberate intention to evade national service. "When they . . . get offered salaries equivalent to £2000 a year it is a great attraction for a man of 24 or 26 to stay."

The conference of the Association at which Lord Chorley spoke supported the resolution calling for permanent deferment, and was strongly in favour of higher salaries and better prospects for technologists. Salaries for university teachers should compete with those outside.

It has been stated that (in 1952, in Britain) over a third of the public companies of the engineering industry had no technically qualified voice on the board, and that more than two-thirds of the directorial oligarchy were without technical qualifications.

The article concludes that there lies the major weakness of British industry; in this light the reluctance of the promising graduates to return, after furthering their education in the U.S., can be understood. The remedy is to raise their status as well as their pay and to give tangible proof at all industrial levels that the young technologist will not be led up a blind alley while his university friends who followed one of the so-called liberal professions climb the carpeted stairway to the boardroom.

AMERICAN CONCRETE INSTITUTE BUILDING

A new building, designed for the American Concrete Institute by Minoru Yamasaki, features a folded-plate reinforced concrete roof system. The roof, cantilevered front and rear from concrete interior corridor walls, projects over the exterior walls of precast concrete panels and glass; shorter end walls are shielded by perforated screens of coloured concrete pipe sections. The building, to be started early 1957, in Detroit, will house the society's technical activities.

TELEVISION AS AN AID TO BOILER CONTROL

Engineering, 1956, v. 181, n. 4708, June 1.

The observation of furnace conditions tends to become more difficult as the size of boilers, especially the large pulverized-fuel units which are now being installed in power stations, is increased. The combustion chambers can no longer be inspected from one, or even two, levels and a tour of inspection may take as much as half an hour.

Moreover, the plain mirror periscope, which has been in use for this purpose for many years, has its limitations when remote control of the boilers is installed, while with pulverized-fuel firing it is important that a close watch should be kept on combustion conditions.

These considerations have led to the development of periscopic television equipment which has been installed on a 400,000-lb. pulverized fuel-fired boiler at Barking C power station and which incorporates optical principles which enable the whole of the burner wall and the burners themselves to be observed from a single position, and to be televised thence to any part of the station.

The periscope, which is completely water-cooled and is also provided with an air blast arrangement to prevent fly ash from settling on the lens windows, is mounted on the pneumatically operated carriage.

The camera is of the standard Marconi industrial type which measures 5¼ in. by 4 in. by 8½ in. and weighs only 4½ lb. It incorporates a Vidicon pick-up tube, the signal from which is capacity-coupled to a three-stage video amplifier and fed thence to a mixer stage.

The periscope which has just been described, is normally used only during lighting up. Under stable operating conditions it is withdrawn and monitoring is effected by a photo-electric cell.

ALUMINUM AND ALUMINUM ALLOYS FOR PRESSURE VESSELS

The Welding Journal, 1956, v. 35, n. 6, June

This paper reviews the properties of the aluminum alloys that are especially desirable for pressure vessels and certain chemical and processing equipment. Aluminum alloys are resistant to the chemical action of many materials and, for those materials where there is some action, the resulting products are colourless; hence, they produce no discoloration. They also show remarkable resistance to atmospheric corrosion.

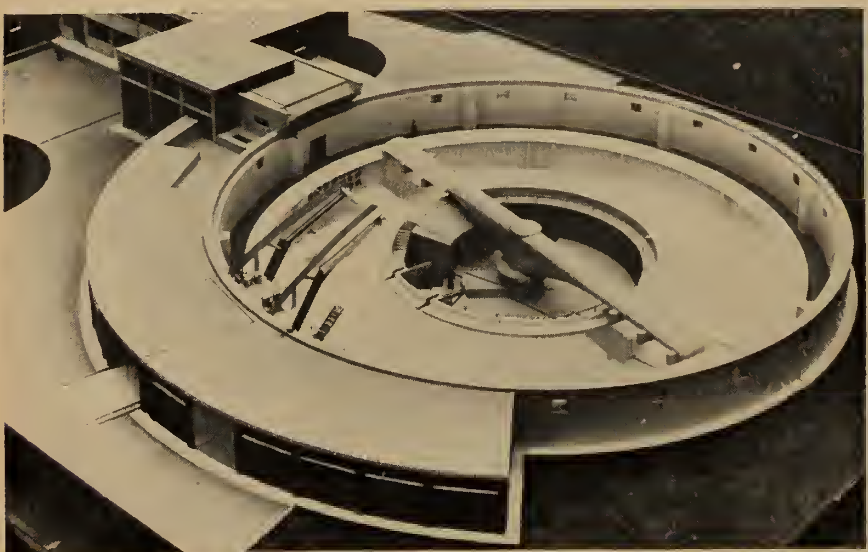
Aluminum alloys are non-magnetic and non-sparking. Conductivity ratings for heat and for electricity are relatively high. Commercially available alloys suitable for pressure vessels represent a wide range of tensile strength. Ten of the alloys in the form of plates covered by ASTM Specification B178-54T have specified tensile strengths in the annealed condition from 9500 to 30,000 psi.

Aluminum alloys do not show a decrease in ductility with depressed temperatures as does mild steel; in fact, the tensile strength, yield strength, elongation and impact resistance of most of the alloys discussed show a distinct increase as the temperature decreases to -420 deg. F. They are readily workable and easily welded.

The service record of aluminum alloys is outstandingly satisfactory. The leading producers have, as a result of many years of experimentation and experience, published much data and prepared handbooks that may be consulted for answers to specific questions.

HYDRODYNAMIC RESEARCH LABORATORY

This is a model (with dome removed) of a 60-ton rotating beam at a new underwater hydrodynamic laboratory at Teddington, near London, England. The purpose of the beam channel and a complementary water tunnel is to discover the behaviour of such missiles as torpedoes at speed. The building which houses the rotating beam is a striking engineering design with a dome 160 feet in diameter, larger than the domes of St. Paul's Cathedral, London, or St. Peter's, Rome.



MATHEMATICS FOR DECISION MAKERS

Harvard Business Review, 1956, May-June.

Modern business has "discovered" statistics and mathematics. In this article the authors discuss the application of mathematical techniques to such areas as inventory and productivity analysis. Apart from these specific uses, however, there seems to be confusion over the general role of mathematics in management. On the one hand, executives seem to underestimate the opportunities for using mathematical methods of one kind or another; on the other hand they tend to overestimate the amount of mathematics they need to know themselves in order to supervise work in the new methods. The article should help businessmen to see the problem in clearer perspective, and it should give them some ideas also as to what to do about it.

Canadian Developments

NEWS OF MAJOR ENGINEERING DEVELOPMENTS IN CANADA

Canadian Pipeline Projects

With close to 2000 men employed, Westcoast Transmission had reached the peak construction period in June. The bulk of the clearing of right of way through heavily timbered areas had already been done, with a view to avoiding the danger of forest fires during the hot dry summer. Some 17 ships are due at Vancouver by the end of September to complete deliveries for 30-inch pipe coming from Britain.

Inland Natural Gas Co. Ltd., has renegotiated its gas purchase contract with Westcoast Transmission Co., and will now take 48 million cubic feet daily instead of the 32 million feet originally contracted for. This represents an increase of 50 per cent from the originally anticipated needs, and follows the recent successful efforts in lining up markets in interior British Columbia communities.

Inland Natural Gas will build laterals from Westcoast main pipe to service Prince George, Quesnel, Williams Lake and Merritt, and will build a major pipeline from Savona to Kamloops, thence to Osoyoos, and Grank Forks. Air surveys have already located the pipeline routes. Financing will be carried out in September and contracts will soon be let, which will employ 600 men this summer and 150 permanently. Orders for pipe are placed for the pipelines and distribution lines. Completion is called for the summer of 1957.

El Paso Natural Gas Company president Paul Kayser sees a market for at least 100 million cubic feet of gas daily more than already contracted for by the time the Westcoast line starts operating next fall. El Paso is already constructing facilities that will boost deliveries by a further 650 million cubic feet a day.

Current estimates of gas reserves in the Peace River fields, of 3½ trillion cubic feet will have to be added to over the next few years to supply the growth in this biggest untapped market on the continent. Under terms of the contracts Pacific Northwest Pipelines, B.C. Electric, and Inland Natural Gas Co. have all reserved the right to purchase substantial additional quantities of gas when they become available.

Pacific Northwest Progress

Meantime the Pacific Northwest Pipeline Corporation has been building at the average rate of three miles per day on its 1487-mile main from the San Juan Basin to connect up at Huntingdon, 45 miles east of Vancouver, with Westcoast Transmission. When the deal was made with Westcoast a year ago, the design of the pipe was changed from one resembling a funnel with the large end at San Juan Basin, to one like an hour-glass, 26 inches diameter at either end, reducing to 22 inches in the centre. This is because the gas comes from either end, with main markets in the centre.

The pipeline passes through Monticello and Moab, Utah; Rangely, Colo.; then through the mountains in Idaho and Oregon via Pocatello and Boise to Pendelton, Oregon. Here it forks in three directions, the main going via Portland, Tacoma and Seattle to join Westcoast at the Canadian border, and branches serving the Yakima and Spokane areas. It crosses the Columbia River in three places, the Snake twice and the Colorado once. The project, costing some $217 million, is due for completion late in 1956. By the middle of May 1000 miles of main and 800 miles of laterals were laid. Gas was expected to reach Portland early in August.

Trans Canada Pipelines

Within a few hours of final passage of the government's Pipeline Bill 298 by Parliament and Senate and the granting of Royal Assent on June 7, official signing of the agreement took place between officials of Northern Ontario Pipeline Crown Corporation, which will advance an $80 million treasury loan, and Trans Canada Pipelines, Ltd., which is to build the Alberta-Winnipeg section. This put the company in a position to start work immediately. The western leg must be completed by December 1, 1956.

By mid-July Trans Canada had contracts awarded for most of this western leg and already had delivery of enough 34-in. pipe to lay the first 120 miles of line. How much of the pipe for the balance of 455 miles to Winnipeg would be delivered this year was in some doubt on account of the steel strike in the United States. Unobtainable in Canada, this pipe had been ordered from U.S. Steel Corporation and A. O. Smith Corp.

Trans Canada has until April 2 next year to repay the treasury loan with 5 per cent interest. Default would permit the government to seize all the company's assets including the gas line itself. With repayment on time, the Crown Company, financed by the Federal and Ontario governments, can build the $118 million Northern Ontario section from the Manitoba border to Kapuskasing, Ontario, leasing it to Trans Canada with an option to purchase. First, however, Trans Canada must prove ability to finance all other parts of the line.

The Crown Corporation will be headed by D. A. Golden, deputy minister of defence production, as president. Directors are Marc Boyer, deputy minister of mines and technical surveys; M. W. Sharp, associate deputy minister of trade and commerce; R. G. Johnson, president and general manager, Defence Construction, Ltd., and H. R. Balls, Department of Finance. William Mulock of Defence Production is secretary, and Col. M. W. Kynch is treasurer.

Way Cleared For Immediate Start

Trans Canada has already optioned easements on most of the 60-foot right of way required for the western leg. The land can be worked and cropped by the land owner but no building may be erected thereon within 20 feet of the pipe. Company officials estimate 120 construction days will be needed, including allowances for bad weather and other delays.

Under terms of the government loan, should the line not be completed to Winnipeg by December 1, Canada may take over Trans Canada's entire assets at 90 per cent of cost. However, there is little chance of default, since interference with progress due to "force majeure" such as floods, riots, or strikes would automatically extend the time for completion.

Financing Possible Without U.S. Market?

Federal Power Commission hearings on the export of Canadian gas to the United States, opened at Washington last February, are currently recessed for the summer. But forces opposing import of gas by the U.S. met early in June in Chicago to map future plans for their battle before FPC. More than 40 coal producers, railroad representatives and labour executives discussed 'development of the opposition case' at a private meeting. They oppose importation of gas because of the possible "displacement of the coal and rail interests and their employees". They will determine the best approach for fighting the case.

But Federal Trade Minister C. D. Howe contends that the proposed export of surplus Canadian gas to the United States is no longer so important a factor in Trans Canada's ability to get private financing for the project. After the first year of the Canadian line's operations the company would be able to carry all debt charges without U.S. export. He believes repayment of the $80 million loan may be made within a few months through private financing by Trans Canada.

Trans Canada officials have set themselves a formidable objective: to negotiate sufficient long term Canadian sales contracts this summer and fall to support the necessary $250-million financing of the entire line with exception of the Northern Ontario gap to be built by the Crown Company.

Even without FPC approval of import by the United States, company officials feel there is a good chance of doing this on Canadian business alone by the end of 1956. Loan institutions would require sales revenue the third year to clear all fixed charges and the bulk of operating expenses. An overall profit would have to be shown by the fourth year.

Faster Canadian Market Build-Up Seen

There are several reasons for this new optimism. Trans Canada's latest market survey shows a potential market for 150 billion feet of gas in Canada for the third year of operation. Under a new contract with Union Gas Co. of Canada, Trans Canada will now supply a maximum of 12½ billion feet of gas in the first year, increasing to 64 billion cubic feet in the thirteenth year. Because of underground storage facilities, two thirds of this gas will be delivered during the summer months when the general load is at a seasonal low level. The contract which runs 20 years will bring Trans Canada a total revenue of $300 million during its life, or almost four times the revenue from the previous contract.

Another year of load building in Consumers Gas territory, where the Toronto market has expanded throughout Metropolitan Toronto, east of Oshawa and Whitby and west to Port Credit and Streetsville, now shows a potential market that covers more than a quarter of the population of Ontario. A $10 million debenture issue has been marketed by Consumer's Gas Co., to finance the expansion.

Further west, Northern Ontario Natural Gas Company has signed a 20-year contract for 100 million cubic feet daily, beginning at 57 million the first year, and building up to 100 million feet daily the fifth year. This company and its affiliate Twin City Gas Company have permits to serve the entire Northern Ontario area. Some 13 pulp mills are major industrial customers. The market also includes processing gas sales to International Nickel, but excludes the potential 40 million feet daily for nickel smelting.

Winnipeg and Central Gas Co. has authorized $24 million for capital expenditure for a 5-year expansion program with the Canada Cement plant at Fort Whyte, requirements for which will be between 10 and 15 million feet daily in summer and between 5 and 10 million feet daily in winter.

Ultimate Export Inevitable

At the same time, the prospect of export to the United States is by no means being written off. Delivery of Canadian gas to the Tennessee Gas Transmission Co. at Emerson, Manitoba, appears to be ultimately inevitable for the rapidly growing midwest United States market. An early FPC approval of the case enabling U.S. companies to import Canadian gas, would of course immediately solve all the problems of financing.

Alberta Gas Trunk Line Co. Ltd.

Earlier plans contemplated a 547-mile gathering system in Alberta to feed Trans Canada Pipelines, 219 miles of which were to be built in 1956. A further 328 miles would be built the following year, all connecting with the main near the Alberta-Saskatchewan border. This system will require 120,000 tons of pipe; 74 miles of 34-in. pipe west of the "gate", and a few hundred miles in varying sizes from 30 in. down to 8 in. The estimated cost runs to $52 million.

Due to Trans Canada's current schedule to build as far as Winnipeg only this year, however, it is reported Alberta Gas Trunk Line Company plans will be now modified to building only 30 miles this year from Bindloss. This is due to the smaller volume of gas needed for the first year of operation, which will be of the order of 10½ million cubic feet daily. This field has dry, sweet gas with a field pressure sufficient to push it right through to Winnipeg.

Meantime a start has been made on B.A. Oil's new sulphur plant 13 miles southeast of Pincher Creek with a crew of some 150 workers. Operation is scheduled for about October 1, this year, for production of 225 long tons of sulphur and 2200 barrels of concentrate daily. Capacity will be doubled when the Trans Canada Pipeline reaches the eastern market, while ultimate capacity will be 780 tons of sulphur, 1230 barrels of propane, 1300 barrels of butane, 1020 barrels of natural gasoline and 7810 barrels of condensate.

During the first year's operation prior to completion of the pipeline the residue gas will be recycled back into the Pincher Creek field. Later, residue dry gas will be sold to Trans Canada at 1 million cubic feet daily for the first year and 1.7 million feet daily in subsequent years.

Bar Harbour — Yarmouth Ferry

The "Bluenose", the new car and passenger ferry operating between Bar Harbour, Maine, and Yarmouth, Nova Scotia, made her way up Yarmouth Harbour on June 9, completing the first official run and inaugurating the year-round ferry service.

Built by the Davie Shipbuilding Company of Lauzon, Que., the five million dollar vessel can carry 500 passengers and 150 cars and trucks. Some of the specifications are: service speed, 18½ knots; gross tonnage, 6,419 tons; registered tonnage, 3,341 tons; service draft, 16 ft. 7 in.; engines, six 2000-hp. diesel, developing 200 r.p.m.; total shp. 11,160; six decks to bridge, welded structure with super-structure of welded aluminum; over-all length, 345 feet; moulded breadth, 65 feet; moulded depth to promenade deck, 45½ feet.

The "Bluenose"

Ripple Rock, B.C.

An unusual project of great interest to British Columbians and to shipping interests is under way in the Strait of Georgia, some 100 miles north of Vancouver, where a tremendous explosion will be set off some time late in 1957 or early in 1958, to remove the hazardous Ripple Rock from the navigation channel.

This obstacle to navigation, located in Seymour Narrows, between the craggy shores of Vancouver Island and Quadra and Maud Islands, has always been a menace to ships plying the 'Inner Passage' which separates Vancouver Island from the B.C. mainland. Here over the past 80 years fourteen ships and more than 100 smaller vessels have been wrecked, while the loss of 114 lives has been recorded.

Right in the middle of the Seymour Narrows where the channel is reduced to a width of half a mile from its usual two-mile width, stands Ripple Rock, 3000 feet in length and 1500 feet wide at the base, tapering off to a ridge more than 300 feet in height with pinnacles nine to twenty feet below low tide level. Currents at the speed of 10 knots and sometimes 15 knots an hour past the rock, make passage extremely dangerous for shipping, excepting during the 20 to 40 minutes at slack tide twice a day.

Governments have been besieged with demands for years to have the rock removed. In 1942 the federal government, fearing for the fate of ammunition and supply ships bound for Alaska and the Aleutians during the war insisted something must be done.

In 1943 and again in 1945 attempts to drill holes in the rock from an anchored barge failed. The Department of Public Works offered $1.8 million to anyone who would guarantee a completed job. Suggestions were even made for blowing it away with an atom bomb. Then a fourth year physics student at U.B.C. conceived the plan for tunnelling under the water from nearby Maud Island and blowing it up from below.

The tunnelling scheme was handed to Dr. Steacie, director of the National Research Council, for a report on its feasibility. The underwater rock was examined for possible fissures and dangerous faults, and a TV camera was lowered to examine the underwater rock bed. Boyles Bros., internationally known diamond drilling contractors, were engaged to drill from Maud Island during the winter of 1953/54 and no dangerous faults were disclosed.

Early in 1955 Dr. Victor Dolmage, an eminent British Columbia geologist, was given charge of the project, estimated to cost some 2½ to 3 million dollars, for sinking a 500-foot shaft from a point 50 feet above water level on Maud Island and for driving a tunnel some 2400 feet in length under the channel to a position under the rock, with branches upwards 300 feet to points under each of the two pinnacles. When completed, the tunnel will be loaded with 550 tons of nitrone, a new and powerful explosive. Ten pounds per cubic yard will be used compared with the normal loading of ½-lb. per yard. The objective is to entirely remove the rock pinnacles to a depth of some 40 feet below low tide water level.

In order to furnish electric power for the tunnelling work, British Columbia Power Commission engineers this year undertook the difficult operation of spanning the Seymour Narrows with an aerial power line.

Now power is being supplied over a 3000-foot span for rock drills and for removing the blasted rock from the tunnel and raising it through the shaft to the surface. Before the blast is set off all residents of the area within 25 miles of the operation will be moved out for safety.

The people of Victoria and other cities and towns on Vancouver Island, who have been dreaming for years of a highway to connect the Island with the mainland, fear this means an end to their hopes for spanning the narrows with a highway bridge. But shipping interests in Vancouver, Seattle, San Francisco, whose boats travel the Inner Passage on their way north to Prince Rupert, Skagway and other ports in Alaska, will be indeed happy to see this hazard to navigation removed. So will lumber and paper mills along the B.C. coast, as well as the Aluminum Co. of Canada, whose ore boats use the channel for bringing Jamaica bauxite concentrates to Kitimat.

St. Lawrence Seaway and Power Project

Progress by Ontario Hydro

With favourable weather, construction work forged ahead at an accelerated pace during June. Noticeable progress was made in the power-house section, where a total of 135,000 cubic yards of concrete had been placed at month end in the "U" abutment, wing wall, ice sluices, and for generating units one, two and three. The wing wall was completed during the month and some of the concrete blocks in the "U" abutment have been finished to full height. At unit No. 1, assembling of the draught tube form got underway and it was expected that first concrete would be placed around this form early in July. The work force for the month reached a total of 3,600 persons.

The new access tunnel under the diversion canal was ready for use at the end of the month. The concrete roadway in the tunnel was completed, and the banks of the canal over the tunnel had been built up.

At the diversion canal closure structure, a total of 15,000 cubic yards of concrete had been placed in the wing walls and in the center block. The contractor also was progressing with excavation work in the west end section of the canal towards lock 20.

Dike work got underway on a major scale during June, and the work program accelerated in section three of Cornwall dike between No. 2 highway and Toll Gate Road. Here the contractor was placing and compacting material. In sections one and two of the dike, stripping was in progress to take the dike to the present Mille Roches area where it will terminate.

Railway relocation work was resumed and all three contractors had been busy on grading operations. Track laying and ballasting were proceeding rapidly from the west end in the vicinity of Iroquois. At the east end, track laying had been going on in Cornwall area on the new right-of-way out toward Nine Mile Road.

During the month, channel improvement work progressed, with rock excavation being carried out by the contractor at Galop Island, the rock being used to build cofferdams at the west end of the island enclosing the channel as far as Tick Island. Earth that was being excavated was being placed on the south side of the island. Near Chimney Island, four dredges were working on channel excavation work.

House moving operations commenced in Morrisburg during June. Seven houses were moved to make way for the new shopping center and were placed on new foundations in Morrisburg.

At Iroquois, a total of 138 houses had been moved at month end, which is almost the completion of house moving operations in that village. Steel was being erected for the new modern shopping center for Iroquois. Construction of the town's elevated steel water tank was well advanced, and work had also progressed well on the pump-house and sewage disposal plant.

In new town No. 2, building of permanent roads, sewers, and water mains had been completed in one section. Power distribution and phone lines also had been installed. Work was beginning to be accelerated in new town No. 1 where laying of sewers and water mains was progressing favourably.

Progress by NYSPA:

During June construction was accelerated as the unusually wet spring weather gave way to much dryer, improved working conditions. Concrete in place at end of June exceeded 410,000 cubic yards; excavation had reached 19 million cubic yards and employment averaged 5,600 for the month.

Gate guides and sills were being placed at Long Sault dam, piers were at an impressive height and concrete was being placed in apron blocks. Concrete in the structure totalled 145,000 cubic yards. Earth excavation in the main section of Cut "F" between the upstream and downstream plugs was complete and overall excavation was more than 75 per cent completed. The cofferdam "E" cableway was nearly ready for cable stringing.

Concrete placement in the Barnhart power-house had reached 103,000 cubic yards as drilling, grouting and excavation operations continued. Excavation for the switchyard had been started and construction of the south forebay dike had been resumed as dryer conditions permitted placing of filter material and embankment.

Eight piers at Iroquois dam had reached their height to the top of the dam. Concrete in one section of Massena intake was as high as the canal water surface, as 51,000 cubic yards had been placed to date. Construction of a temporary bridge for construction traffic and for supporting water lines had been started downstream. A detour of route 37B around the west end of the dike was being built. Pipe laying for Massena and Alcoa water supply had resulted in 1,000 feet of 48-inch and 4,400 feet of 30-inch line in place to date. About half of the concrete in the valve house had been placed.

Excavation on the main channel side of Lotus and Lalond Islands had been completed and was continuing in the south channel. An additional dredge added downstream from Chimney Island had increased production in that area. At Sparrowhawk Point, a rim dike had been built around the point and excavation was proceeding in the main section. On the Ogden Island contract, clearing was in progress, construction facilities were being built up and construction of the Waddington sewage treatment plant was continuing. Excavation under the five major channel improvement contracts was 25 per cent completed.

Production of construction drawings and specifications continued on schedule. Specifications were issued during the month for reservoir clearing between Point Three Points and Red Mills Point.

Progress by SLSDC:

A third contracting firm has defaulted on the American side of the St. Lawrence navigation channel construction. Dutcher Construction Corporation of Maryland, gave up its $2.2 million excavation contract for the Grass River lock last April with some 91 per cent of the job completed. The firm then took a sub-contract for the joint venture group known as Grass River Constructors, which undertook to complete the excavation without alteration of its $26.7 million contract for lock construction. Now Dutcher has stopped work on this sub-contract.

Progress by SLSA

A contract amounting to $1,508,520 has been awarded to Canadian Vickers Limited, Montreal, for the supply and installation of operating machines for lock gates at locks of the St. Lawrence Seaway. A second contract has been awarded to Bridge and Tank Company of Canada Limited, Hamilton, Ontario, the lowest bidder for the supply and erection of Cote Ste. Catherine lock bridge, and Iroquois lock bridge, (rolling lift type bridges). The value of the contract is $873,421.

The award of a contract was announced on June 29, for the supply of stop logs, pick-up booms, etc., for locks of the seaway to Montreal Locomotive Works, Ltd., Montreal, valued at $2,210,400. Also announced was the award of a contract for the supply and installation of unwatering pumps and sump pumps at locks of the St. Lawrence Seaway to Canadian Ingersoll-Rand Company Ltd., of Montreal, valued at $387,516. This firm was the only tenderer.

Miron et Frères, Ltee., of Montreal and Mannibec Construction Company Limited, in joint venture, have been awarded a contract for excavation of some two miles of overland channel and a dyke from the South Shore end of the Honoré Mercier Bridge to Lake St. Louis, in the Lachine section, at a total estimated cost of $5,843,750. The work will extend upstream from the Honoré Mercier Bridge through part of the Caughnawaga Indian Reserve to the dredged channel in Lake St. Louis.

The work consists of 1,200,000 cubic yards of common excavation, 1,980,000 cubic yards of rock excavation, and approximately 10,000 linear feet of dike construction. All the work must be completed by August 31, 1958.

Awards of the two largest contracts to date by the St. Lawrence Seaway Authority were announced on June 15, for two locks on the Beauharnois canal. United Waterways Constructors, Limited, was lowest bidder for construction of the Upper Beauharnois lock and approaches, at a price of $14,440,000. Canit Construction, Limited, was the successful bidder for construction of the Lower Beauharnois lock and approaches, at a price of $11,199,925. Atlas Winston Limited was second lowest bidder on each of the contracts at $14,860,200 and $12,879,800 respectively.

The two locks will raise or lower ships some 85 feet between Lake St. Louis and the Beauharnois canal, at a point near Melocheville. Thus contracts for all of the five locks to be built by Canada's Seaway Authority have now been awarded. Work on the upper Beauharnois lock must be completed by November 30, 1958 and for the Lower Beauharnois lock by October 31, 1958.

Award of these two contracts brings to some forty the number of contracts awarded by SLSA, for a total value of approximately $120 million.

Changes To Montreal Bridge

Federal Minister of Transport George Marler announced on June 15 that $30 million would be spent on construction of the Nuns Island highway bridge between Montreal and the South Shore. A plan to connect the City and St. Lambert by either a tunnel or a high level bridge had been ruled out by federal authorities because of excessive costs, and because of the disruption either would cause in St. Lambert. The National Harbours Board plans to build modern approaches with separation grades at the south end, at a cost of $1½ million, he stated. There would be underpasses and overpasses of the most modern nature, designed to eliminate traffic congestion and to accelerate movement of traffic entering or leaving the bridge.

Mr. Marler also announced that Victoria bridge would be modified by building lift spans over each end of the seaway lock. Eight million dollars would also be spent on the Honoré Mercier bridge, for a ramp at the south end rising to a height of 120 feet over the seaway channel and descending by a complex but modern system of approach roads, to provide a junction with existing highways and a separation from the railway facilities of the C.P.R. The Seaway Authority's contribution here would amount to $6,750,000.

No part of the Jacques Cartier bridge would be demolished, he reported. The south end would be raised to provide 120-foot clearance but the present spans would be lifted or jacked up to a higher level. A new span would be built over the channel itself on false work, opposite the old span. Then the old span would be rolled out of place and the new one rolled in. The operation would involve only a short interruption to traffic across the bridge.

Other Seaway News

Federal Transport Minister George Marler, speaking at Quebec City on June 6, said the United States would benefit by a larger increase of overseas traffic than Canada, once the seaway is built. Canada could also expect an increase in traffic, but the U.S. rise would be greater because of its larger population. One reason an increase in U.S. traffic through the seaway could be anticipated was the recent declaration by the U.S. Maritime Commission that the inland waterway is essential to the American trade and economy. This would enable ships of U.S. registry to collect operating subsidies, making American shipping competitive with other shipping now operating at lower costs. No vessels of Canadian registry were operating on the route at the present time, he said.

Piers of the Jacques Cartier Bridge are being enlarged.

Lake Ontario Level

The International Joint Commission made public recommendations on July 3 involving regulations of the water level of Lake Ontario. The proposals were released simultaneously in Washington and Ottawa after a meeting of the IJC in Montreal. They have been accepted by the Canadian and United States governments.

Highlights of the recommendations concern maintenance of Lake Ontario level between 244 and 248 feet during the navigation season. They also prescribe regulation of the outflow from the lake and flow through the International Rapids section of the St. Lawrence. An eventual plan of water regulation is envisaged which will take place under the international St. Lawrence River Board of Control.

Microwave Radio Project of the Trans Canada Telephone System

(Continued from page 1009)

vices to obtain the very flat frequency response required for a satisfactory picture signal. Colour television introduces particularly severe requirements in these facilities. At television service points across the country, television operating centres will be established, equipped with picture monitors, oscilloscopes and other devices that will allow continuous monitoring of the quality of transmission. At main points on the network, comprehensive switching arrangements are provided so that the network may be reversed or rearranged to meet the program requirements of the broadcaster.

Conclusion

The section of the transcontinental network extending from Buffalo, through Toronto, Ottawa and Montreal to Quebec City has been in service for some time. The long section between Toronto and Winnipeg is scheduled for service in October 1956, to be followed a few months later by service between Saint John, Halifax and Sydney. Westward extension to Regina and Saskatoon will be completed about the middle of 1957 followed in September by the extension to Calgary, Edmonton and Lethbridge. The Maritime Provinces will be connected into the central part of the network by completion of the section between Quebec City and Saint John about the end of 1957, and the entire transcontinental system will be available with the completion of the difficult section between Lethbridge and Vancouver in the second quarter of 1958.

Upon completion of this undertaking, Canada will have as modern a communication network as any country in the world and one that will have the inherent capacity for expansion to meet future increasing telecommunications requirements.

MOVING-BED PROCESSES

(Continued from page 1030)

many of us, enlarges our knowledge of moving-bed solid-fluid processes. The members, I am sure, will find the author expertly capable of answering any additional questions on the principles or application of the process.

It is of interest to note in the paper the high degree of proficiency and engineering skill that the petroleum industry has utilized in this process. This is not only a challenge to other industries but an indication to the engineer of the opportunities that may lie in further application of the principles and knowledge in kilning, drying, ion exchange and solid-fluid chemical reactions.

My interest in the moving-bed process has been with respect to the field of metallurgy: I was privileged to be associated with the author in pilot plant work on ore roasting in moving-bed units. What has intrigued us most in this application is the mechanical simplicity of operation of a moving-bed unit, the large capacities, high thermal efficiency, and the reaction control that is possible.

The Author

I would like to thank the discussers for their comments and questions. With reference to the question by T. W. Hoffman, I would like to amplify my remarks on heat and mass transfer rates. When heat is transferred between the solids and the gas or liquid flowing through the bed, higher transfer coefficients are achieved in fluid-bed units. The main reason for this is that the solid phase resistance is lower for fine particles than for coarse.

However, other factors besides transfer coefficients must be considered. As an illustration, let us assume that a solid is to be calcined at 1000° F. If this is done in a single-stage fluidized system, the calcining gas will leave the bed at a temperature close to 1000°F. because of the very nature of that system. If this same operation is performed countercurrently in a moving-bed system, the gas will transfer almost all of its heat to the solids and leave the bed only slightly hotter than the entering cold solids. Here is a case where thermal efficiency is of much greater importance than heat transfer coefficients.

Automating the Engineer's Task

(Continued from page 1019)

high. This was the gambler's first estimate but he noted that in arriving at this estimate he had used random numbers exceeding 854. He therefore improved his estimate by averaging the first guess with the first estimate and he obtained a second estimate of 927 blocks. Now the gambler proceeded to check this estimate by averaging only those random numbers below 927. These resulted in a new average of 438 and a new estimate of

400,000/438 = 913 blocks

This estimate was within 2 per cent of the exact answer and so the gambler had proven his claim. Those were the beginnings of modern statistics and since the gambler's method is based on chance, or random sampling, this technique was dubbed the Monte Carlo method.

The Gambler's Set of Random Numbers

448	98	224	534	40	256	918	719	925	877
708	894	931	837	417	376	364	811	4	201
958	58	413	18	339	570	369	195	889	649
616	17	520	39	409	210	179	334	396	412
22	65	557	294	659	656	269	319	902	74
306	958	358	40	571	236	939	867	420	402
163	927	755	858	938	254	499	365	4	359
770	445	482	397	120	40	826	14	592	444
657	693	885	531	366	447	219	711	156	554
6	204	868	822	819	876	912	285	117	360

Month to Month

News of the Institute and the Profession

COMMENT AND CORRESPONDENCE
ELECTIONS AND TRANSFERS

Education Conference

In the Month to Month section of the June *Journal* reference was made to the Conference on Engineering Education which was held as part of the annual meeting of the Institute in Montreal on May 22 and 23.

Since that short report was made a resolution has been presented to Council which was prepared by the Education Conference. It reads as follows:

Conference Resolutions

RESOLVED: that this E.I.C. Conference on Engineering Education (1956) express to the Council of The Engineering Institute of Canada its deepest appreciation for making the conference possible. We wish to say that we consider that the Institute is to be very sincerely commended for its vision in sponsoring the conference and for its generous assistance and cooperation in making it an accomplished fact.

The beneficial results will perhaps be intangible and will not lend themselves well to being set forth on paper for all to see. But we are convinced that this valued meeting of the minds of those in whose hands lie very largely the responsibilities for meeting and solving our Canadian problems in the training of our future engineers, cannot help but exert an important and beneficial influence on our collective and individual thinking.

AND RESOLVED that this resolution be transmitted to the Council of The Engineering Institute of Canada.

When this resolution was presented, Council considered future action and after considerable discussion approved the following resolution — "That Council go on record and so inform the special committee of the Education Conference that the Institute is planning for a further conference a year hence. If the committee feels that the conference should not be held until two years hence Council would agree to it". This motion was approved unanimously and has since been transmitted to the special committee.

There can be no exaggeration of the importance of the conference. With approximately sixty people in attendance representing with but few exceptions the leading people in engineering education in Canada, something good was bound to result. The president and other officers of the Institute were congratulated by almost every delegate attending the conference, and without exception they spoke in glowing terms of the opportunities they had had to discuss the important problems that were facing them.

R. E. Jamieson is Chairman

The conference was opened informally by a dinner held at the University Club at which the president presided. This gave the delegates an opportunity to meet with each other and with some of the senior officers of the Institute. During this dinner the delegates elected Dean R. E. Jamieson of McGill as chairman for the conference.

The stenotypist who attended throughout the conference reported that it was one of the biggest tasks she had ever undertaken. Just recently her transcription has been received at headquarters and is approximately 1 inch in thickness. There is a Herculean task ahead of the special committee in digesting this into some form of minutes and into a program for an agenda for the next conference.

In view of the great bulk of material to be reviewed by the committee it will not be possible to send minutes to those who participated in the conference for some time yet. However, the committee has the task in hand and proposes to send the minutes as soon as possible.

Following is a list of those who were in attendance:

University of British Columbia

J. F. Muir, civil; W. O. Richmond, mechanical; Frank Noakes, electrical; L. W. Shemilt, chemical; L. G. R. Crouch, mining.

University of Alberta

Dean R. M. Hardy; J. A. Harle, electrical; G. W. Govier, chemical and petroleum; R. N. McManus, civil; L. E. Gads, civil, and secretary of the faculty.

University of Saskatchewan

Dean I. M. Fraser; W. E. Lovell, electrical; A. H. Douglas, civil; J. B. Mantle, mechanical.

Cover Picture

One of several special jigs developed for fabricating post sections of radar towers for the DEW Line in the Arctic. The accuracy achieved eliminated pre-assembling, reaming, and match-marking in the shops. The methods used also permitted interchangeability on all the towers, which ranged in height from 100 to 400 feet.

(Photo courtesy of Dominion Bridge Co. Ltd. and Western Electric Company, Inc.)

University of Manitoba
J. Hoogstraten, civil; J. P. C. McMath, electrical; N. M. Hall and R. E. Chant, mechanical.

University of Toronto
Dean R. R. McLaughlin; G. F. Tracy, electrical; C. F. Morrison and W. M. Huggins, civil.

Queen's University
Dean H. G. Conn; D. M. Jemmett, electrical; J. S. Campbell, mechanical; S. D. Lash, civil; A. C. Corlett, mining.

University of Ottawa
Dean Pierre R. Gendron; L. A. Madonna and E. A. Levergne, chemical; L. A. Beauchesne, electrical.

McGill University
Dean R. E. Jamieson; D. L. Mordell and J. B. Phillips, mechanical; J. U. MacEwan, metallurgical; R. A. Chipman, electrical; J. L. deStein, civil.

Ecole Polytechnique
Dean Henri Gaudefroy; J. C. Bernier, electrical; Raymond Boucher, hydraulic; Roger Brais, mechanical; Jacques Laurence, electrical, and executive secretary.

Laval University
Dean Adrien Pouliot; Lionel Boulet, electrical; L. P. Bonneau, mechanical.

University of New Brunswick
Dean Earle O. Turner; Ira M. Beattie, civil; E. E. Wheatley, mechanical; J. O. Dineen, electrical.

Nova Scotia Technical College
M. L. Baker, mechanical; G. H. Burchill, electrical; G. G. Meyerhof, civil; E. Lee Cameron, mining.

Expansion at Western University

A full four-year engineering course will be in effect at the University of Western Ontario in 1957. The first and second years of the program are already being given. The third year will be offered this fall and the fourth year will be available the following year. At present the freshman intake into engineering at Western is limited to 25, but this will be increased in September to 50, and by the fall of 1958 to 150.

Western is preparing now to provide facilities and staff for a doubling of its student enrolment by 1960, Dr. Edward Hall, president and vice-chancellor of the university has announced.

It was explained that the course in engineering is not the traditional type with major specialization in one of the fields of engineering. A program has been worked out which is believed to be a realistic approach to the education of engineers in today's and tomorrow's Canadian economy. Dr. Hall has commented, "We believe that it is both educationally and philosophically sound. Economically it is, additionally extremely attractive." The plan is as follows:

Some 20 per cent of the time, 5 hours per week for four years, will be devoted to the humanities and social sciences; the course includes a three-year program in mathematics, a three-year program in physics and a two-year program in chemistry. The first and second years are common program years. A common core runs through the third and fourth years.

Dr. Hall acknowledges the help of industries in London and Western Ontario which permit the use of their facilities for major laboratory work. He cites the activities of the Ontario Government in assistance to the universities.

The enlargement of the engineering faculty is part of a larger development throughout the university in academic and physical capacity.

An engineering science building, accommodating 500 engineering students, will be ready for occupancy in the fall of 1958. A new geological and biological science building will house several departments, allowing expansion of other departments in the natural science building.

A new arts college is in the plan; it will be called Middlesex College. Thames Hall, Stevenson Hall, and Somerville House, built during the past few years provide gymnasium and swimming pool, library expansion, and the great hall of 500 seating capacity. Another new building will be ready for 1957, the Richard Ivey School of Business Aministration.

With the completion of the long-term program only very briefly summarized here, Western will be able to provide university educational opportunities for some 5000 full-time intramural students in keeping with the great demands with which it will be faced, Dr. Hall has said.

Delegates to the E.I.C. Conference on Engineering Education, Montreal, May, 1956

Three people familiar to members of the Institute. They have been key figures in the E.I.C. activities for some time. Photographed with Colonel H. G. Thompson (left) at a farewell party, were Miss May McLaren of Headquarters, and Dr. L. Austin Wright, master of ceremonies for the occasion.

H. G. Thompson Retires

Colonel H. G. Thompson who since September 1951 has been assistant general secretary of the Institute, retired from this position on June 30, because of ill health.

During these five years Colonel Thompson has done a magnificent piece of work for the Institute and for the profession. No one could have been more loyal, industrious, or intelligent in the execution of his work than was he.

Colonel Thompson possesses to an unusual degree a happy combination of determination and good humour. He manages to get things done in spite of the evident difficulties, and yet he antagonizes no one in the process. To anyone familiar with society affairs it will be readily evident how useful this qualification is in work of this kind.

Around the office he endeared himself to everyone. It was to him that members of the staff went for counsel and advice on issues both large and small, personal and professional.

H. G. Thompson, and gift painting from the staff.

Indicative of the esteem in which he is held, was the "party" given by the staff on the eve of his departure. The Institute staff is always holding "get togethers" of one kind or another but never before was there one like this. There were presentations from the staff, from Council, and from officers of the Institute who during the course of their office learned something of the sterling qualities of this man. Above all it was a tribute to a fellow worker, a friend and a gentleman.

Colonel Thompson for almost all his life has been known affectionately as "Spike". It is doubtful if any engineer in Canada is more widely or more favourably known. Now on the occasion of his retirement he inherits the respect and affection which he has earned for himself all these years in his many capacities. His friends and associates will wish him the best of health and happiness in the long holiday which he has so fully merited.

What's New in Aviation?

All the things that were seen and discussed at the 18th annual meeting of the Aviation Writers Association (A.W.A.) in San Francisco recently were not necessarily the newest, but they were still new and some of them were even the newest. In the July *Journal* there was a short general account of the meeting, and it is the purpose of this article to fill in some details.

On Monday, May 28, after a 7.45 A.M. breakfast at which officers of Lear Inc. told of their products, the party went by bus to Palo Alto to see the plant of Hiller Helicopters. It was a beautiful day and sitting comfortably in the temporary grandstand, bathed in the lovely California sunshine, it was not difficult to persuade oneself that the speakers were not talking of war and the machines were purely for peace time purposes.

There is a lot of interesting work going on here. The company has specialized from its beginning in 1941, on rotorcraft, and today they rank third in unit production on a world wide basis. Demonstration flights were made to show three different models.

It was at Hillers that the sensational "flying platform" or "flying manhole cover" was developed and flown. This is indeed a switch in aviation development although history shows that the idea of wingless flight has been around for a long time. In fact the British flew a similar machine dubbed "the flying bedstead" in 1954, before the Hiller machine hit the front pages.

There are two vital differences between the United States and British machines. The United States platform is powered by two horizontally placed ducted fans which rotate in opposite directions at the base of the structure. The British effort is powered by jet engines. Direction is maintained in the United States machine by the operator tipping the platform by shifting his weight. In the British, the outlet from the jet engines can be changed in position to alter or maintain direction.

The platform was not flown for the visitors but it was there on the ground for inspection. It is an extremely simple affair with two relatively small air cooled piston engines mounted so that their shafts are vertical. This permitted a single V belt drive system to be used, with one engine for each propeller.

The company officials were not very talkative on details of the design. However that was not surprising in view of the fact that this is purely an experimental model. While the development work has been done for the Office of Naval Research, the machine has great possibilities for the Army. The company is now working on a new contract with ONR for the development of a "rotorcycle" or a one-man portable helicopter. The specifications call for a machine that can be collapsed into a small package for easy transport or a parachute drop for use by the Marine Corps.

By the way, the company is now in production on a small model of this platform. It is about 8 ins. in diameter, made of plastic, and it really flies. We saw it. The engine weighs one ounce. It is now being distributed to retail stores to be sold to the young inquiring minds of the nation at about $12.00.

The engineers in this company seem to be full of imagination. While it was only a model that was shown, there seems to be an interesting future for vertical take-off and landing (VTOL) designs. Hiller has a new idea or two in this field. For instance they are proposing a plane in which the wings tilt to the vertical for take off and landing, and move to the horizontal for forward flight. It looked very reasonable in the models which showed planes with two engines and with six. Perhaps this is the answer to VTOL.

The "Flying Platform" (left) of Hiller Helicopters, which uses ducted fan for lift and propulsion.

New concept of flight on the horizon. Artist's drawing shows a design using the principle of tilting wings and propeller units to eliminate need for long runways.

The company is working also on a helicopter with wing tip jet engines. Already they have a ram jet engine certified by the Civil Aeronautics Administration. It is a surprisingly small affair about 24 ins. long and 10 ins. outside diameter. A small number of helicopters so equipped are being manufactured for the Army and the Navy, purely for field evaluation purposes. Apparently the tip powered "egg beater" has many advantages.

National Advisory Committee for Aeronautics

After a delightful luncheon at the Moffett Field Naval Officers club, Hal Hibbard vice-president of the Lockheed Company spoke on what the future holds for air travel. His picture showed supersonic airliners, highly useful earth satellites and earth spanning automatic mail services, faster than the present telephone service.

He envisaged commercial transport planes travelling at almost 700 m.p.h. at altitudes of over 35,000 feet. Also he made public reference for the first time, to a rocket "we have been flying for some time". He thought "we will see mail rockets that will cross the country or travel around the world quicker than today's long distance telephone call".

Also he spoke of rockets for quick express service that, working with an automatic pilot could deliver almost anywhere in a matter of minutes. In conclusion he prophesied that shortly we would have watch pocket television, instant communication with almost any place you may wish, robots doing house work and possibly "new sources of power, new sources of knowledge of man and his behaviour, a new lease on life itself".

Later a fly past of all the latest aircraft used by the Navy was presented, and a briefing in this was given by Rear Admiral John B. Pearson, Jr. of the Navy Bureau of Aeronautics.

Research and Development

Then the group moved to the Ames Aeronautical Laboratory adjacent to Moffett Field. To this writer the most interesting thing here was the story of high speed, up to 10,000 miles per hour. This fantastic rate of travel was achieved by a sphere in a new high velocity lightgas gun developed in the NACA laboratory. The set up is arranged in such a way that photographs at one ten millionth of a second can be taken of the projectile at different positions in its flight, lighted by its own incandescence.

This almost meteoric speed is reported as the greatest ever achieved. Studies such as this aid in the collection of much needed information on high temperature associated with flight at very high speeds. It is understood that NACA proposes to build soon another gun that will develop speeds up to 16,000 m.p.h.

Picture of 10,000 miles per hour. The sphere was shot from a new high velocity Light-Gas Gun developed at NACA Ames Aeronautical Laboratory. Shadowgraph picture, made at one ten millionth of a second, shows the strong shock waves formed by the speeding model.

A Day with the Commercial Airlines

Tuesday, May 29, was taken over by the commercial air transport people. Breakfast was followed by a talk from the Hughes Aircraft Company. Then the group enbussed for the United Air Lines maintenance base to see and hear about their jet air age projects. In the afternoon there was a tour of the new San Francisco airport, which is said to be the last word. However, there is no last word in aviation and while the facilities of the airport were impressive, better ones will be built shortly. Let us hope that some of them find their way into Canada before long.

Dinner was sponsored by the Air Transport Association, and its president Stuart Tipton talked about the industry and its relationship to government and government controls. It was evident that the companies and the authorities do not agree on every issue. Here are some extracts from Mr. Tipton's address to illustrate this point.

"My thesis tonight is a very simple one. It is this: There need never be any debate on the subject of American civil airpower as represented by the scheduled airlines of the United States: there need never be any question as to whether American civil airpower is paramount and will remain paramount — unless our own government somehow manages to undermine our own air transport system. This country can continue to have the greatest airline system in the world if only our own government, which has life-and-death powers over the industry, recognizes the great public issues with which it is dealing — recognizes the disaster that can come from errors, the national benefits that can flow from sound policy.

"This is not the time, if there ever was or will be a time, when the government should be arrayed against the industry or the industry against the government. Nor is this a time when the government should be required to apologize for sympathetic or realistic consideration of the industry's problems. The airlines have too much to do, and great issues hang on their ability to do it.

"The Civil Aeronautics Board and members of the industry have greatly exasperated one another from time to time, and we have every reason to believe that they will do so again. But, by, and large, a record has been written in which the airlines, the government and the country can take pride.

The B-52 Stratofortress and the KC-135 Jet Stratotanker.

"It is enough to observe that compared to 1946, speeds of airlines have doubled, and the number of persons using air travel has more than tripled. Volume of available air service has more than quadrupled. And with all of this, the average fare level stands today just about where it was in 1938, despite such increases in costs as reflected in a rise of 235 per cent in airline wage levels and an increase of over 90 per cent in consumer's prices.

"Service to the postal service is also provable through an array of statistics. Here is the one of which we are the proudest. The post office department, which did so much to get air transportation off the ground, today gets more than 5 cents of every six-cent airmail stamp. For handling the mail we get less than 1 cent. In addition to the carriage of priority airmail, the industry and the post office department are today conducting an experiment in moving first-class mail by air in order to expedite delivery. That experiment will expand because the public will demand it. (Canada has had this for years. Editor).

"Let me simplify the story at the outset. After a lot of lean years we finally made a profit. The first thing that happens is that the government moves in and takes 52 per cent of it. Then we sit down and figure out how little of the remainder we can give our stockholders, and still maintain our credit. We give it to them, and then we take the rest and buy airplanes. When we get the airplanes we call the military department and contribute them to the Civil Reserve Air Fleet to be called up on 48-hour notice. Scheduled air transport is the biggest bargain the government or the public ever had.

"And over the next ten years the scheduled airlines are expected to spend some three billion dollars for new airliners and related equipment."

The Satellite Program

The breakfast speaker on Wednesday was Captain A. B. Metsger, deputy chief, Office of Naval Research, and his topic was the Vanguard Satellite Program. He did an awfully good job of it, but a paper quite similar to it on the same subject was presented to the annual meeting of the Institute by F. R. Furth, Rear Admiral U.S. Navy, so no further reference will be made to it here.

Luncheon and the afternoon were devoted to the "Convair Project", with particular reference to rockets and guided missiles. Some interesting exhibits helped round out the program.

That night the whole delegation were entertained at dinner in Chinatown as guests of the Douglas Aircraft Company.

A Day with USAF

Thursday was Air Force Day. After a 7.15 breakfast as guests of the Boeing Airplane Company, the busses were on their way by 8.30 *en route* to San Francisco's International Airport where two Convairs and two Globemasters of the USAF waited to convey the group to Castle Air Force Base in Merced County.

Here there was a great static display. Most attention was paid to the new Boeing B-52 bomber which is now the pride of the Air Force. Great things are claimed for it and it has been in service long enough for a thorough test. It is powered by eight jet engines in the 10,000-lb. thrust class. Its wing span is 185 feet, length 156 feet and height 48 feet. Its gross weight is over 350,000 lb. Its ceiling is over 50,000 feet and its range over 6000 miles, and its speed is better than 650 m.p.h.

Also on display both on the ground and in the air was what the USAF call "the most powerful fighter in the world". It is the McDonnell F-101 A, now dubbed the Voodoo. It is powered by two Pratt & Whitney J-57 engines each developing 10,000 lb. thrust. Incidentally this is the only two engine supersonic fighter in production in the United States.

The luncheon speaker was General Curtis E. Le May, commander in chief, Strategic Air Command (SAC). He had a lot to say about the troubles of trying to maintain an adequate supply of manpower, particularly in view of some of the things being done by the top authorities in Washington. It was interesting for a Canadian to hear so straightforward an account of the trouble and problem of an arm of the service. It was interesting also to hear a top officer lay the blame for these things at the feet of the mighty. Here are some abstracts from the address:

"The personnel situation in SAC is critical, reenlistment will fall 50 per cent short of what is needed to maintain a first-class nuclear striking force. The first need is for a realistic pay structure. The Armed Forces are still operating under an antiquated idea that one man in uniform is worth as much as another. This simply is not true today, when highly technical skills are required by modern military equipment. Practically all our Air Force technicians have civilian counterparts who are being paid at rates well above those we now pay. We decidedly are not in competition with other branches of the military service for man power—we are in direct competition with industry and we are losing out."

Cost of Living

"An airman cannot use his patriotism to pay his bills. It is not negotiable," he remarked, and added, "it is time that we started placing the proper premium instead of increasing penalties, on the patriotism of the people who defend this country of ours."

Pays Tribute

SAC cannot go on providing a potent striking force without a solution to its manpower problem. From January 1953, to January of this year, his command had a 35 per cent increase in combat wings and a 77 per cent increase in air bases — with a 20 per cent boost in man-power.

General Le May emphasized that with a realistic program costs would be reduced greatly, stating as a possible saving the amount of $2,500,-000,000.

It was something to hear!

The afternoon was given over principally to a fly-by. In the show were the B-52 heavy bomber, the Voodoo, the B-47 medium bomber, the Thunderbird strategic fighter, and the B-36 bomber. There was a demonstration of refuelling in flight when the giant KC-92 tanker refuelled a Voodoo fighter using the "flying boom" system.

Once again into the "air lift" and back to the airport at San Francisco, for a reception in the plant of the Rick Helicopter Company. A feature of this function was that two helicopters were on hand to give a short ride to anyone wanting it. We did.

Luncheon on Friday was sponsored by General Electric Company and at its conclusion one of their metallurgists, Dr. Herbert Halloman, spoke of the so-called "wonder metal" molybdenum. The tremendous strength at red-hot temperatures makes this metal one of the important materials for tomorrow's jet engines.

A peculiar quality of the metal is that it simply goes up in smoke when it gets hot and is in the vicinity of air or oxygen in any form. However, the research laboratories of General Electric are working on a special protective coating that will survive the rough handling "moly" would get in actual service.

Dr. Halloman said, "Molybdenum with a proper coating may be the key to the door through that horrible bogey called the 'heat barrier' ". He also suggested that eventually jet engine parts including the critical buckets may be made of "cermets" — a metal-ceramic combination or even ceramics themselves. He thought that an age of forgeable pottery was a possibility, explaining that non-brittle ceramics would go a long way towards answering the problem of finding materials for use beyond 2500 degrees Fahrenheit.

Dr. Halloman concluded his talk by telling of work General Electric has done on producing perfect iron. Already they have produced tiny whiskers of iron with tensile strength up to 1,900,000 pounds per square inch, which appear to be a world's record for strength of metals. Theoretically metals are ordinarily from 10 to 1000 times weaker than they should be because of imperfection in the crystals that constitute their basic structure. If metal crystals can be produced without imperfection, then metals will achieve strengths approaching those indicated by theory. It is something to ponder.

(Part three of the report will appear in the September issue).

E.I.C.

ANNUAL MEETINGS

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1957

Banff

Banff, Springs Hotel

June 12, 13, 14

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1958

Quebec

Chateau Frontenac

May 21, 22, 23

James Newby Visits Us Again

The Cunard liner "Carinthia", on her maiden voyage to Montreal, July 3, brought to Canada a large party of about thirty British engineering students for summer employment under the current exchange plan. It is known as IAESTE, which is the short form of International Association for the Exchange of Students for Technical Experience. The Institute acts as the Canadian agency for all arrangements under this organization.

Taking advantage of this occasion to visit us again was James Newby, of Imperial College, London, England, who travelled with the party. He remained long enough to renew several old acquaintances, and see something of our industrial and university life. Mr. Newby is the British secretary for IAESTE and, prior to this year, was general secretary for the whole international plan. It was in this capacity that he was here four years ago when Canadian participation in the exchange was being set up. He was particularly interested, while in Canada this time, in starting action to establish some industrial bursaries to help Canadian IAESTE students with their travelling expenses. Initial response to this proposal has been good.

The illustration shows the group of young British engineers on the boat deck of the "Carinthia" while she was docking at Montreal. Mr. Newby is kneeling in front centre.

More information about the 1956 activities of IAESTE, in Canada and abroad, will be found in the September issue of the *Journal.*

E.I.C. Awards of Merit for Photography

The photography display which was a feature of the annual meeting this year was an outstanding success. The industries contributed views of their engineering operations which graphically portrayed their work in the development of Canada.

The members attending the meeting received the exhibit with enthusiasm and by ballot indicated a wide diversity of interest and opinion as to the quality of the 150 entries.

Six photographs have brought Awards of Merit to the following organizations:

- Avro Aircraft Limited, for the entry titled, "Flight Testing Avro CF-100's";
- Shawinigan Water and Power Company, "Testing Penstock Welds at Trenche Development, June, 1955";
- Dominion Steel and Coal Corporation, "End Hardening Rails";
- Dominion Engineering Co. Ltd., "Ball and Rod Mills";
- The Fluor Corporation of Canada Ltd. "Fluid Catalytic Cracking Unit".
- Department of Highways, Province of British Columbia, "Southern Trans-Provincial Highway on Anarchist Mountain".

The collection will receive further attention when it is sent across Canada for public display, particularly in the universities where engineering is taught.

Many of these pictures will be presented in future issues of *The Engineering Journal.*

THIRTY-FIVE YEARS AGO

Comment on the Journal of August, 1921

It is always interesting, sometimes instructive and frequently amusing to reread something one wrote in the days of one's flaming youth. And sensations are sharpened if one's authorship has been entirely forgotten.

The writer of these reminiscences finds himself this month, not in the position of the forgotten author, but of the author of a forgotten paper. The *Journal* for August, 1921, published an effort of his called "What about Western Coal?", a subject which he would now say he never dared to touch. Yet there is the evidence; he not only wrote four pages of text, suitably embellished with maps and diagrams, but he had the temerity to make some rather novel suggestions as to the means which might perhaps be used to extend the market for western coal and reduce importations of the United States product.

When first he spotted this paper in the *Journal,* he felt much as anybody does who thinks he has made a fool of himself, but his equanimity was pretty well re-established by the opening paragraph — "All the statements made here and figures quoted are . . . from sources available to anyone and the conclusions are . . . only . . . such as might be arrived at by anyone . . ." Be nothing if not cautious.

The writer has decided not to be ashamed of his brain child nor of the illustrations, which he obviously drew himself. The subject, a live one at the time, has lost most of its importance in these last thirty-five years. The west is no longer so vitally interested as it was in its coal—oil and gas are in the limelight there now—but sometime coal will come into its own again, unless it is put completely out of the running for ever as a source of power by the atom, by the sun or by something else of which we are ignorant today.

Prairie Provinces Water Power

C. H. Attwood, A.M.E.I.C., discussed the water powers of the prairie provinces. It must have come as a bit of a shock to some in the east that there were any. To the average Torontonian, say, the prairie provinces were treeless and as flat as a billiard table, blistered by heat in the summer, with an occasional hail storm or tornado by way of accent, and frozen by terrible blizzards in the winter. Their only business was to produce the wheat for his daily bread and some of his beef. How surprising, then, to find that these three provinces contained undeveloped water power estimated at some 4,200,000 hp. as a minimum and at over 7,000,000 hp. as a maximum. The developed power in the area amounted to 141,465 hp. in 1921, mostly on the Winnipeg River.

The potential power was largely in the north and its development would have to await a market; this is still true. Some, of course, has been developed, but most of it is as yet just water falling over the rocks. However, it is an asset that the provinces rightly cherish.

Western Highways

The western provinces were beginning to worry about their highways. As for mileage, they had too much —384 miles for each nine-mile square township. As described by C. W. Dill, M.E.I.C., in this *Journal,* Saskatchewan had divided its system into three classes — main, interurban and trunk — and one gathers that if a road did not fall into one of these three it was sent to limbo so far as provincial interest in improving it was concerned.

Mr. Dill believed in strict control of highway use by the 77,000 motor vehicles then registered in the province—nearly all passenger automobiles; the roads were too poor for trucks—and quoted with approval the then recent New Brunswick regulations.

Northern Development

Dr. R. C. Wallace, the Commissioner for Northern Manitoba and later the principal of Queen's University, told the Saskatoon meeting something about what was needed to develop the Canadian North, with the usual good sense and Scottish caution characteristic of him. In only one minor way did he fail to foresee what has actually happened: "As far as passenger traffic is concerned, the hydroplane . . . (may) replace the canoe in the north, (but) it does not seem probable . . . that air service will be in a position to quote a freight rate for many long years which will compete with . . . motor trucks."

Strictly speaking, Dr. Wallace was probably quite right; air transport in the north does not compete with trucks. Its advantage is that it is not so dependent on ground conditions as are tractor trains and that it can reach some areas that they cannot. Imagine trying to build DEW without air service. We owe more than we know to the bush pilot and his machine.

Notes on Brazil

The whole correspondence section of this *Journal* was filled by a long and delightful letter from H. K. Wicksteed, M.E.I.C., the father of the Mount Royal tunnel and of the Canadian Northern Railway terminal development in Montreal, whom many members will remember with respect and affection.

Mr. Wicksteed had just returned from four and a half months in Brazil on a "railway assignment". He didn't say what it was, but one may suspect that it might have had something to do with an attempt to untangle the confusion of railway gauges there. The nearest approach to a "standard" gauge seems to have been 5 ft. 3 ins., but there was also a lot of metre-gauge track and quite an assortment of other gauges. Newfoundlanders may appreciate better than most of us the handicap such a condition imposes on business.

Although Mr. Wicksteed apparently did not speak Portuguese, he managed to meet and talk with a good many Brazilian business men and officials. And he kept his eyes open; much of his letter is that of an extra-observant traveller. But he was glad to sight the snow on Chebucto Head on his return via England.

The Branches

A good many of the Montreal Branch members had attended a complimentary dinner tendered by the local branch of the University of Toronto Alumni Association, the "Toike Oikes", to Drs. T. Kennard Thompson, G. H. Duggan, R. A. Ross and J. M. R. Fairbairn. These gentlemen had only just received their honourary degrees from their alma mater and it was said that they were the only engineers so honoured by her. Dr. Fairbairn was the sitting president of the Institute, Drs. Duggan and Ross were ex-presidents and Dr. Thompson was deeply interested in engineering society affairs in the United States.

R. DeL. F.

NEWS OF THE

Associations and Corporation

Information received through co-operation of the provincial organizations.

NOVA SCOTIA

Recently a committee of senior members of the Association was set up to study and report to Council on the " . . . desirability of instituting an annual award for which members of this Association who have contributed outstandingly to the welfare of this province would be eligible. This contribution having been made possible by virtue of the recipients technical knowledge . . .".

It has been suggested that the award be named the "F. H. Sexton Award", in memory of the late Dr. F. H. Sexton, first president of the Nova Scotia Technical College and an outstanding engineer who contributed much to the welfare of his adopted province. The award would be made once annually, but not necessarily each year.

Changes in Council Representatives

Professor M. L. Baker, a past-president of the Association has been appointed the Association's representative on the E.I.C. Council to complete the unexpired term of the late A. E. Flynn.

J. D. Dexter of Bridgewater has been for Queen's County to replace **G. S.** named chairman of the zone committee Sherman who found it necessary to resign due to ill health.

C. N. Murray, president of the Association, has been appointed Dominion Councillor for the Nova Scotia Association replacing **J. E. Clarke.**

J. D. Fraser,, a past-president of the Association, has been appointed a member of the Council, and of the executive committee, to complete the unexpired term of **R. F. Titus** who has recently been transferred to Ontario.

Councillor R. F. Titus Resigns

Mr. R. F. (Tiny) Titus has been appointed manager of Standard Paving Limited, Toronto, Ontario, and recently resigned as councillor of the Association and as a member of the executive committee of Council.

Mr. Titus was born in Moncton, New Brunswick, and received his engineering education at Mount Allison University and the Nova Scota Technical College. He graduated from "Tech" as a civil engineer in 1950.

His education was interrupted by his naval service during World War II, when he specialized as a "frogman". His activity in this work proved useful in civilian life especially at the time of the 1950 Winnipeg flood when he assisted in rehabilitation work.

Since graduation Tiny has been construction engineer with Standard Paving Maritime Limited. He was vice-president of the Nova Scotia Road Builders Association and very active in accident prevention work in the highway construction industry.

In his new position as manager of Standard Paving Limited, he will supervise his company's activities in Ontario.

Life Membership Awarded R. J. Bethune

R. J. Bethune, president of the Association in 1930, a councillor for seven years and an active supporter of both the Association and the Engineering Institute was recently honoured with the award of life membership in the Association. Mr. Bethune has recently retired from active engineering practice.

R. J. Bethune, M.E.I.C.

Mr. Bethune was born in Baddeck, Nova Scotia, and graduated from Dalhousie University in 1907 with the degree of Bachelor of Engineering (civil).

During the next eight years Mr. Bethune was engaged in railroad construction. He started as an instrumentman with the Transcontinental Railway in New Brunswick, advancing quickly to resident engineer on the Edmonton high level bridge, the Jasper Avenue subway and other construction work in this area. In May 1913 he was resident engineer for the C.P.R., on the construction of the Kootenay Central Railway in B.C.

Mr. Bethune returned to Nova Scotia in 1915, being employed by the Nova Scotia Provincial Roads Department in various counties, as county road superintendent. In 1920 he became divisional highway engineer and during the next nine years held this position in various divisions throughout the province.

From 1929 to 1931 Mr. Bethune returned to railway engineering with the Guysboro Railway in Nova Scotia, on location and construction work. In 1932 and 1933 he was associated with a gypsum company in Cape Breton.

Mr. Bethune returned to highway work toward the close of 1933 as divisional engineer with the provincial Department of Highways. He resigned this position on his retirement.

A member of the Engineering Institute of Canada, he joined as a student in 1910.

BRITISH COLUMBIA

Engineers in the News

W. H. Smith, assistant chief engineer of B.C. Electric's engineering division for the past nine years, has been appointed assistant general manager of the company's subsidiary firm, B.C. Engineering Company Limited.

E. A. Sears, of the Packard Electric Company Ltd. has recently been transferred from the head sales office in Toronto to their Vancouver office as sales engineer. Mr. Sears graduated from the University of New Brunswick in 1950 in electrical engineering. He was with Hollinger Consolidated Gold Mines, Timmns, Ont., and Spruce Falls Power and Paper Company at Kapuskasing, before joining Packard in 1954.

F. T. Brown, of Calgary has been appointed chief engineer for the B.C. highways department. Mr. Brown has been chief estimator for Mannix Limited, and was previously chief engineer with Brown and Root Limited in Edmonton. Other appointments he has held include: —chief construction engineer at Goose Bay for the federal department of transport; construction and maintenance engineer for Imperial Oil Limited at Montreal; resident engineer for the Aluminum Company of Canada Ltd. at Arvida, Que.; structural engineer in charge of construction and contracts for the Toronto subway.

Geoffrey Leach recently entered into the partnership of Carlberg, Jackson and Leach, architects and engineers, with offices at 774 Columbia St., New Westminster. Mr. Leach, had been in private practice and was previously employed with Marwell Construction Co. Ltd. which he joined after coming to Canada from England in 1950.

E. D. **Sutcliffe** has been appointed executive assistant to W. C. Mainwaring, president of B.C. Power Corporation's new subsidiary, Western Development and Power Ltd. Prior to his appointment, Mr. Sutcliffe was executive assistant to the general manager of B.C. Electric's transportation division.

F. B. Baker, of American Fabricators Limited, was recently appointed vice-president, engineering, and elected to the board of directors.

J. C. Timmer of H. A. Simons Ltd. has left for an extended vacation in Holland. He will return to Vancouver next fall.

M. H. Campbell, has accepted the position of municipal engineer for the corporation of the district of Powell River. Mr. Campbell was formerly with the engineering department, city of Vancouver.

A. T. Wason, a 1951 civil engineering graduate of the University British Columbia has been appointed executive engineer, Public Works Department, Barbados, British West Indies, and is presently concerned with the construction of a new 300-bed hospital. Mr. Wason had previously held the position of assistant engineer in the same department.

C. G. Walley, formerly with Marwell Construction Company is now general superintendent for Barker Construction Company, Limited and will be working on the suspension bridges for the gas pipe line at Shelley, Quesnel and Savona.

M. H. French has accepted a position with Canadian General Electric in their Atomic Energy Division in Peterborough, Ont. Mr. French had been in Vancouver for the past year with H. A. Simons Limited.

P. A. Boving, who has been associated with the agricultural engineering division of the Swift Current, Sask., experimental farm, recently accepted a research position with the California Experimental Station drainage department, Davis, Calif.

B. C. Finerty of B. D. Bohna and Company, Limited, has left for Fort St. John, B.C. He will work for Marwell Construction in connection with a plant on the natural gas line.

R. E. Sinke, who is with Sprostons (Jamaica) Limited, has been transferred to Kingston, Jamaica in the capacity of assistant construction manager.

Ralph Sultan, 1956 mechanical graduate of the University British Columbia and past president of the EUS — has sent word that he is now with Linde Air Products Company in their new products division at Toronto. He expects to spend some time in the development laboratories in Tonawanda, New York and then return to the Toronto area in sales.

H. H. Fickel is in Revelstoke, B.C. where he is resident engineer with the Department of Highways.

J. A. Cowlin, on the engineering staff of the Corporation of the District of Saanich, is now assistant engineer.

B. R. MacFarlane, has accepted a position with C. D. Schultz and Co. Ltd. He was previously with MacMillan and Bloedel.

W. F. Miles, of the B. C. Electric was appointed assistant chief engineer (operations) division. Mr. Miles has been with the B.C. Electric since 1946 and until recently was acting supervisor, protection and communication engineering.

G. F. Green, formerly superintendent of protection and communication engineering, B.C. Electric, is now executive assistant to the chief engineer.

E. G. Oldham, is now in Mexico as woods manager of the Tuxtepec Pulp and Paper Co. Ltd. Mr. Oldham had been with the B.C. Forest Service in Victoria.

H. D. Currey, is now with the A .P. Green Firebrick Company in Vancouver. He had been with General Appraisal Company until recently.

P. T. Christoffersen, of Read, Read, Jones and Christoffersen conducted a seminar on "Model Analysis in Concrete" before the annual assembly of the Royal Architectural Institute of Canada at Banff this month.

G. A. van Exel has left the B.C. Telephone Company to take up a new position with B.C. Engineering.

E. G. Craigen has retired from the position of electrical superintendent, Powell River Co. Ltd., Powell River, B.C.

H. E. Harlos, has announced that he has set up at 1398 West 73rd Ave., Vancouver, B.C., as consulting engineer for machine design. Mr. Harlos has been with Canadian Ingersoll-Rand Company and will continue to serve them on a consulting basis.

F. H. Chapman, of the Anglo American Corporation of South Africa, Northern Rhodesia, passed through Vancouver recently on a business trip, travelling in Canada and the United States. Mr. Chapman was executive-secretary of the Association in 1949 and dropped into the office to discuss the changing times.

A. C. Mullen, of the Powell River Company, formerly project engineer on the number nine paper machine and finishing room is now assistant plant engineer.

J. S. Goulding, also with the Powell River Company has been appointed project engineer, sulphite mill.

J. S. Ball, chief engineer of Shell Oil Company of British Columbia Limited has been promoted to the position of chief engineer of Shell Oil's refinery at Montreal, taking up his new work in July.

H. D. Dawson, municipal engineer of Saanich will retire at the end of this year.

E. L. Bartlett, assistant plant engineer, Columbia Cellulose Company, Prince Rupert, B.C. has been promoted to the position of mill engineer.

Allan Gall, recently joined Monarch Forge and Machine Works, Portland, Oregon, on leaving Letson and Burpee Limited of Vancouver.

R. G. Harvey, highway engineer, Nanaimo, has been appointed regional maintenance engineer for the department.

ONTARIO

Engineers in the News

Lieutenant Colonel William Alton of Ottawa, has been given the new appointment of Technical Staff Officer, Grade 1, in the Army's directorate of electrical and communications development at army headquarters in Ottawa. His earlier appointment was with the directorate of signals at the same headquarters.

D. E. Peatfield, of Montreal, has recently accepted the position of civil engineer for the newly formed project engineering group of Noranda Mines Limited. The first project of the group is the construction of a new tube mill for Noranda Copper and Brass Limited, at its plant in Montreal East.

J. A. Hansford, has been appointed supervising engineer on the Mid Canada Line of Bell Telephone Company of Canada, headquarters at Ft. McMurray, Alta.

Ronald C. Getty, is employed by B. Perini and Sons (Canada) Ltd., and is at present a project engineer for Can-Met Explorations Ltd., at Uranium Mine, near Blind River, Ont.

Joseph Dennis, of DuPont Company of Canada Limited, has been transferred from Kingston to the company's plant at Maitland, Ont., where he is technical development supervisor.

Robert E. Austin, field engineer for The Denison Engineering Company, Columbus, Ohio, is now the company's direct representative in Canada and is located at 70 Leisure Lane, Richmond Hill, Ont.

Mr. Austin, who is a Toronto graduate in mechanical engineering of 1944, joined The Denison Engineerng Company in 1954 and replaces the previous Canadian sales representatives for the company's line of multipresses.

W. R. Cantelon, is at Arvida, Que., with the Aluminum Company of Canada Limited. It is located at the company's ore plant No. 1. Prior to this move Mr. Cantelon was in Toronto and employed by Dominion Tar and Chemical Company as a project engineer.

W. M. Metcalfe, has been appointed town engineer of Brockville, Ont. He is located in the Victoria Building, Brockville. He graduated in civil engineering from the University of Toronto in 1949 and previous to undertaking his new responsibilities with the Corporation of Brockville, was on the engineering staff of the City of Peterborough.

G. O. Saunders, vice-president in charge of manufacturing, with the Canadian Locomotive Company Limited, Kingston, Ont., has been elected to the organization's board of directors. A graduate in mechanical engineering of Queen's University, Kingston, Mr. Saunders has been with the Canadian Locomotive Company since 1942 when he joined as assistant plant engineer.

Roy J. Brown. Announcement has been made of the appointment of Roy J. Brown, as vice-president in charge of engineering Moloney Electric Company of Canada Ltd., Toronto.

Mr. Brown took the test course of Canadian Westinghouse Company Ltd. He subsequently was on the staff of the department of electrical engineering at the University of Toronto and in 1941 was appointed an assistant professor. During the Second World War he was with the Canadian General Electric Company at its Davenport Works in Toronto. In 1944 he joined the Maloney Electric Company as chief engineer.

Eric A. Brown, of Polyfiber Limited, Renfrew, Ont., ahs been appointed vice-president in charge of sales and engineering.

Mr. Brown has been with Polyfiber Limited since its folmation in 1950.

Bernard W. Wittig, is works manager of B and W Precision Heat Treating Company, Kitchener, Ont.

Mr. Wittig graduated in metallurgy from Queen's University in 1944 and has been with the Morrow Screw & Nut Company of Ingersoll, Ont., for some time, latterly as metallurgical engineer.

S. A. M. Robertson has recently been appointed sales manager for the central district and the province of Ontario with Canadian General Electric Company Limited's motor and control department. His office will be at 1350 Castlefield Avenue, Toronto.

R. C. Satchell, has severed his employment with the Goodyear Tire and Rubber Co. of Canada Ltd. and has joined Hinde and Dauch Paper Company of Canada Ltd., 43 Hanna Ave., Toronto, where he is material handling engineer.

John A. Howard, has retired from Frost Steel and Wire Company Limited of Hamilton, where he was works engineer. Mr. Howard joined the company in 1918 and has been with it ever since.

W. Frank Sutherland. At the end of May 1956, W. Frank Sutherland, retired from the Toronto Hydro-Electric System, where he was director of industrial relations for the Commission, and is engaging in private professional practice.

Mr. Sutherland entered his engineering carreer in 1913 with Toronto Hydro and for a time was employed with the MacLean-Hunter Publishing Company on their technical trade papers as editor of "Power House", and with the Deloro Smelting and Refining Company as assistant chief engineer. He later returned to Toronto Hydro as chief designing engineer of the station construction department. During the thirties he engaged in economic research having to do with electricity supply and utilization, and in 1942 was assigned to industrial relations work of the system.

Mr. Sutherland has been a member of the Association since 1923 and for many years has been active in the affairs of the Association, particularly in respect to remuneration of the salaried engineer.

Leonard H. Harper, of Defence Construction (1951) Limited, has moved from Algoma Uranium Mines at Algoma Mills, Ont., to the RCAF Station at Uplands, Ont., where he is employed as assistant project engineer.

E. A. Sears, of Package Electric Company Limited, has been transferred from the company's Toronto office to the Vancouver office, 709 Dunsmuir St., Vancouver, B.C.

Gordon D. Campbell, has received the degree of Doctor of Philosophy from Purdue University, at LaFayette, Indiana, and is employed by the Canadian Good Roads Association, Ottawa, Ont. In this position he will act as Canadian observer on the $12 million test road to be constructed at Ottawa, Illinois; by the American Association of State Highway Officials and the Highways Research Board.

Mr. Campbell graduated in civil engineering from the University of Manitoba in 1951 and the following year obtained his Master's degree from Purdue University. Prior to proceeding on his doctorate work he was with the Trans-Canada Highway Division of the Resources and Development, Ottawa.

A. H. R. Smith, has been appointed a professor of engineering on the staff of the University of California, Los Angeles.

Prof. Smith is a graduate of the University of Toronto and following his graduation spent several years in the United States. From 1940 to 1942 he was with the National Research Council, spending much of this time in London, Eng., as a scientific liaison officer. On his return to Canada he became associate professor of electronics in the engineering faculty of Rutgers University at New Brunswick, N.J. and in 1943 began private consulting work in Ottawa.

H. F. Pragnell, has recently been appointed project engineer with the Eddy Match Company Limited, Pembroke, Ont.

Mr. Pragnell graduated from the Royal Military College, Kingston, Ont., in 1942 and in 1949 obtained his degree in civil engineering from McGill University. Since graduation he has been employed in construction and design work with the Foundation Company of Canada Limited, in Montreal, and in Chalk River, Ont.

K. C. Cox, of Toronto, has been elected to the board of directors of Dravo of Canada Limited, 159 Bay St., Toronto. Mr. Cox has been chief engineer of Dravo of Canada Limited since 1953 and previously had served with the company at Pittsburgh, Pa., for more than thirteen years in various capacities.

Mr. Cox graduated in civil engineering from Iowa State University in 1937 and two years later obtained his Master's degree at Lehigh University.

ALBERTA

Officers for 1956

President of the Association of Professional Engineers of Alberta for the term 1956-57, is J. G. Dale, of Northwestern Utilities Edmonton. Mr. Dale succeeds T. D. Stanley of Calgary Power Limited.

The office of vice-president is held by Dr. J. C. Sproule, Calgary.

Councillors whose terms expire in 1957 are E. H. Davis, Calgary, J. C. Neufeld, Lethbridge, and L. Schofield, Edmonton.

Holding office for two years are E. K. Cumming, Edmonton, K. F. Huff, Edmonton, Dr. D. R. Stanley, Edmonton, and L. C. Stevens, Calgary.

Terms expiring in 1959 are those of councillors J. W. Gregg Prof., of the University of Alberta, Edmonton, J. E. Poole, Edmonton, K. W. Mitchell, Calgary, and G. H. Sissons, of Medicine Hat, Alta.

Named Dominion Councillor was J. J. Hanna, Calgary; E.I.C. councillor, P. M. Sauder; and Faculty council representative, J. G. Dale, who will hold the two offices jointly.

Elected deputy registrar was L. Schofield of Edmonton while the office of registrar was accorded J. F. McDougall, of Edmonton.

A. E. McDonald is the 1956 choice of the Association as executive-secretary.

NEW BRUNSWICK

Election of Officers

Members of the Association of Professional Engineers of New Brunswick, for the session 1956-57 named D. R. Webb, Saint John, as their president, replacing D. J. Brewer, retiring from office. W. D. G. Stratton of Moncton will serve the Association in the capacity of vice-president, while the duties of secretary-registrar went to J. H. McKinney, resident of Saint John.

Chosen councillors for the district of Saint John were K. V. Cox, Lancaster, and L. O. Cass, Saint John.

Frederiction district representatives as councillors are R. E. Tweeddale, Bathurst, and C. E. Weyman, Fredericton.

F. K. Leighton and R. L. Parsons of Moncton were elected to serve that district, while P. G. Robinson was the Association's choice for Chatham district.

OBITUARIES

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Tom Percival Strickland, M.E.I.C., of Melbourne, Australia, died in March, 1955. He was a former chief engineer of the Melbourne Tramways Board and one as an S.E.C. commissioner.

Mr. Strickland was born in Sydney, and on winning a science research scholarship, came to Canada for further study at McGill University. There he was awarded an M.Sc. degree in 1899.

Remaining in this country briefly, he was known in connection with the Charlottetown Sewerage Construction and the Dominion Iron and Steel Company. In 1902, once again in Australia, Mr. Strickland practiced engineering with the New South Wales Railways & Tramways. He remained in this work until 1921.

In 1938, Mr. Strickland went into private practice as a consultant, covering a wide range of engineering fields. He served in an honorary capacity on the council for Scientific and Industrial Research, and later, during the war, was a member of the Board of Business Administration.

He served as an S.E.C. Commissioner for a four-year period extending through the war years and into the post-war era and was concerned with plans for more extensive utilization of coal resources.

Mr. Strickland joined the Institute as a Student Member in 1898, transferred to Member in 1910, and was granted Life Membership in 1942.

C. W. Boast, M.E.I.C., chief engineer with the Spruce Falls Power and Paper Company Limited, at Kapuskasing, Ont., died May 23, 1956, at Sherbrooke, Que.

Mr. Boast was born at Richmond, Que., on December 25, 1893, and in 1917 attained a B.Sc. degree in civil engineering. For the next few years, he was concerned with varied civil and mechanical engineering projects in Canada and the United States, principally in design and construction of industrial buildings, concrete storage and power dams and materials handling equipment.

In 1921, first associated with the pulp and paper industry, he joined Orbison and Orbison, consultants of Wisconsin, to work on projects for Kimberley-Clark Corporation. In 1924 he joined the latter organization, at Neenah Wis. Two years later he was transferred to Spruce Falls Power and Paper Company Limited, at Kapuskasing, Ont. Appointed chief engineer early in 1945, he had been plant engineer for some time.

Mr. Boast was a member of the Board of the Sensenbrenner Hospital, having served in this capacity since 1929.

He was a member of the Association of Professional Engineers of Ontario.

On the Council of the Institute during 1954 and 1955, Mr. Boast joined the Institute as a student in 1917, transferred to Associate Member in 1922, and in 1940 was named a Member.

Jerzy Stanislaw Korwin-Gosiewski, M.E.I.C., former vice-president of Devoe Electric Switch Company Limited of Montreal, founder and first president of the Association of Polish Engineers in Canada, died on May 20, 1956, in Montreal.

Born in Poland, on October 5, 1886 he took a degree in mechanical and electrical engineering at the University of Mittweida, Saxony, Germany, in 1909.

His first work was the designing of small power stations and electrical installations.

From 1909 to 1915 he gained experience with the Siemens - Schuckert Werkes, a Warsaw firm, in the same type of work, having supervision over most of the important power projects built during that time in Poland.

J. S. Korwin-Gosiewski, M.E.I.C.

Concerned with electrification and modernization in the Donetz Basin, from 1915 to 1919, Mr. Korwin-Gosiewski was technical manager of a coal mine.

Later, forming an alliance with a French firm, represented in Warsaw, he was for an additional eight years, engaged in power installation work.

Joining the Swiss firm of Brown Boveri Limited, in Warsaw, he was appointed manager of two factories, and responsible for the manufacture of electrical machines and devices. Extensive technical studies marked this phase of his career with Brown Boveri in Switzerland, Italy, Germany and France. He remained with the firm until 1936.

In the brief years remaining before World War II, he held the office of president and general manager of the Zaklady Elektro Co. in Upper Silesia.

Among those evacuated by the Polish government to France in 1939, Mr. Korwin-Gosiewski worked there briefly until at the fall of France. He was moved to England, where in 1940 he became Adviser to the Polish government exiled in London.

In 1941, by that time located in Canada, he was employed with the Aluminum Company of Canada, at Montreal, in connection with the Shipshaw Development Project. Other appointments held within the next few years were those of works expert and supervisory engineer in the field of industrial engineering with George S. May Company, in 1943; chief industrial engineer with Fairchild Aircraft Limited Longueuil, Que., in 1944, and with H. V. Lea, consulting engineer in Ottawa.

Finally joining Devoe Electric Switch Company Limited, in Montreal, the firm with which he was to remain until the end of his career, he was in 1952 named general manager of the organization. Appointed vice-president in 1954 he held this position until illness forced him to relinquish it.

A member of the Corporation of Professional Engineers of Quebec and the Association of Professional Engineers of Ontario, he became a Member of the Institute in 1945.

William L. Waters, M.E.I.C., retired consulting engineer of Montreal and New York, N.Y., died on March 13, 1956.

Born in London, Eng., on September 7, 1877, Mr. Waters obtained his engineering training there. He attended London University, graduating in mechanical and civil engineering in 1898.

Embarking on his graduate career, Mr. Waters' first appointment was with the L. and S. Railway, London, Eng., from 1898 to 1901. At that time he moved to the United States where he gained employment with the National Brake and Electric Company, Milwaukee, as chief engineer. This association was of four years duration. In 1905 he left this work to become a consulting engineer with Westinghouse Air Brake, Canadian Westinghouse and Westinghouse Electric Manufacturing companies, at Pittsburgh.

However, in 1913, Mr. Waters entered private practice as a consulting engineer, which field he continued to serve throughout his career. He became known as a partner in the firm of Bury and Waters, consulting engineers of New York and London, England, with Sir George Bury, formerly a senior vice-president with the C.P.R.

Mr. Waters was a member of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and the American Society of Civil Engineers.

A Member of the Institute since 1918, he was elected a Life Member in 1949.

James Thomson Turnbull, M.E.I.C., retired district highway engineer for St. John Country, N.B., died at Red Head, N.B., on June 20, 1956.

Born in Paris, Ont., on April 22, 1884, he began his career with a period of railway service. Rodman and transitman with the Canadian Pacific Railway, he took part in location and construction revision, and the survey work done in the early days around North Bay, Sudbury, Cap Rouge, Grand'Mere and other eastern districts, and was for a time attached to the old Canadian Northern Railway.

From 1914 to 1926 he gained experience in various fields. In private practice with David R. Smith, surveyors and engineers, St. John, N.B., he was later associated with the St. John Drydock Company and from 1920 to 1926 worked with the City of St. John on a survey concerning the sewerage system. He also embarked on highway construction engineering with the St. John firm of G. G. Murdoch, workng on the Lancaster highway.

Appointed district provincial highway engineer in 1926, he continued to carry on his work in this capacity until his retirement in 1954, after twenty-eight years of service.

Mr. Turnbull accepted a temporary position as parish engineer with Simonds Parish, on a part-time basis in 1955.

A great supporter of the sport of curling, throughout his life, Mr. Turnbull was, as chairman of the building committee, instrumental in the erection of the Thistle Club curling rink in Portland Place, completed n 1947.

A charter member of the Association of Professional Engineers of New Brunswick, he was president of that body in 1939.

Mr. Turnbull joined the Institute in 1927 as an Associate Member, being transferred to Member in 1940.

George Bromley, M.E.I.C., consulting engineer in the firm of Kearns and Bromley, of Montreal and Wolfville, N.S., died on May 25, 1956.

Mr. Bromley, who was born in Petrograd, Russia, on March 1, 1916, received his early schooling both at King's School, Canterbury, Eng., and in rural Manitoba. In 1932 he entered the University of Manitoba, obtaining in 1936, a degree in electrical engineering.

Between that date and the beginning of his service with the R.C.N.V.R., in 1942, Mr. Bromley was associated with the Canadian General Electric Company test department at Peterborough, Ont., and Toronto, 1936 to 1938, the Aluminum Company of Canada, at Arvida, Que., from 1938 to 1940, and the Canadian Comstock Company, at Montreal and Halifax.

After the war, in 1945, Mr. Bromley joined A. D. Ross and Company, an electrical construction firm in Montreal, as a consulting engineer. The following year saw the formation of the firm of Kearns and Bromley, consulting engineers, in Montreal. By 1949 a branch office was in operation in Wolfville, N.S., where, for some time, Mr. Bromley had been carrying on his work.

He joined the Institute as a Member in 1946.

Lawrence Frederick Train, M.E.I.C., former sales engineer with Canadian Johns-Manville Company Limited in Toronto, died in June, 1955.

A native of Orillia, Ont., Mr. Train was born there on June 19, 1916. He attended the University of Toronto, graduating with a B.A.Sc. in metallurgical engineering in 1939.

With Canada Electric Casting Company Limited at Orillia, Ont., as a chemist, during part of his student days, he later joined the firm for a short time, on graduation, working as a metallurgist and sales engineer. In 1941 he was associated with John Bertram and Sons, and Pratt Whitney of Canada, Dundas, Ont., as a metallurgical engineer.

Named manager of the research department of Craig Bit Company, at North Bay, Ont., that year, he remained with the organization until 1948 when he became superintendent of the Toronto firm of Engineering Castings Limited.

In 1949, on joining the staff of Canadian Johns-Manville company limited, he was commodity manager, electrical refractory products. Later, as sales engineer in 1954 he held responsibility for industrial products sales within the Sarnia, London and Windsor area of Ontario.

Mr. Train became a member of the Institute in 1954.

Paul S. Cheese, JR.E.I.C., a member of the engineering staff of Molson's Brewery Limited in Montreal, died on May 18, 1956, in that city, following an accident.

Mr. Cheese was born in Montreal on October 14, 1921. He received his education at Westmount High School, Montreal, then served as a flying officer with the Royal Canadian Air Force during the second World War. He later attended McGill University, and in 1950 obtained a B.Eng. degree in chemistry.

For the past six years Mr. Cheese had been associated with Molson's Brewery Limited and at the time of his death held the position of assistant brewmaster with the company.

He became a Student Member of the Institute in 1948 and was transferred to Junior member in 1952.

Leonard Jasechko, JR.E.I.C., formerly special projects manager with Rogers Majestic Electronics Limited, Toronto, died on April 20, 1956, in that city, following a lengthy illness.

Born in Poland on April 13, 1920, and brought to Canada at an early age, he had his schooling at Kelowna, B.C., and at Hepburn, Sask. He attended normal school and then became a student of engineering at the University of Saskatchewan; in 1950 graduating with a B.Eng. degree in electrical engineering.

Within a short time Mr. Jasechko joined the staff of Rogers Majestic Electronics Limited, communication division, and in 1952 served in that position which he held when his untimely death occurred.

Mr. Jasechko joined the Institute as a Student in 1949. He was transferred to the status of Junior Member in 1952.

John J. Gorkoff, S.E.I.C., a University of British Columbia student who had completed two years study toward a degree in engineering, died in an accident on July 13, 1955, at Nelson, B.C.

Born at Brilliant, B.C., on Jan. 16, 1933, Mr. Gorkoff attended school at Blewett and Nelson, B.C., and then went on to further education at the university.

J. J. Gorkoff, S.E.I.C.

Combining engineering studies with an interest in diverse subjects, he was known also for his philatelic endeavors, and for his collection of material, in English and Russian, on a number of topics.

Mr. Gorkoff joined the Institute in 1952.

Minutes of the 70th Annual General Meeting

The seventieth annual general meeting of The Engineering Institute of Canada was convened in the Champlain Room of the Sheraton-Mount Royal Hotel, Montreal, on Wednesday, May 23, 1956, at ten thirty a.m. with President R. E. Heartz in the chair.

The president presented two communications, one a telegram extending best wishes from the president and council of The Royal Architectural Institute of Canada, and an air mail letter from Councillor-Elect R. F. Legget, of Ottawa, expressing his regrets at being unable to attend the meeting and conveying greetings and best wishes from the Institutions of Engineers in Australia and India and from the Institution of Civil Engineers of Great Britain.

The minutes of the sixty-ninth annual general meeting, as published on pages 964 and 965 of the July 1955 *Journal* were taken as read and approved.

Nominating Committee

The membership of the Nominating Committee of the Institute for the year 1956 is as follows:

Chairman ..... J. F. Harris, Toronto

Branch	*Representative*
Amherst	J. N. Ritchie
Belleville	C. R. Whittemore
Border Cities	C. G. R. Armstrong
Brockville	J. S. Waddington
Calgary	K. W. Mitchell
Cape Breton	G. W. Ross
Cent. Br. Columbia	R. L. Bigg
Corner Brook	H. B. Carter
Cornwall	B. T. Yates
Eastern Townships	Marcel Bourque
Edmonton	N. J. Allison
Fredericton	D. J. Brewer
Halifax	A. R. Harrington
Hamilton	N. A. Eager
Huronia	B. C. Lamble
Kingston	S. H. Rochester
Kitchener	A. J. Girdwood
Kootenay	W. K. Gwyer
Lakehead	W. Donald MacKinnon
Lethbridge	E. A. Lawrence
London	D. M. Jenkins
Lower St. Lawrence	Marcel Lanouette
Moncton	G. E. Franklin
Montreal	R. F. Shaw
Newfoundland	G. E. Knight
Niagara Peninsula	C. G. Cline
Nipissing and Upper Ottawa	J. Millar
North Nova Scotia	R. S. Morrow
North Eastern Ontario	C. R. McIntyre
Northern New Brunswick	G. P. Milton
Ottawa	T. Foulkes
Peterborough	B. Ottewell
Port Hope	W. S. Raynor
Prince Edward Island	
Quebec	Jean St. Jacques
Saguenay	O. Gislason
Saint John	H. P. Lingley
St. Maurice Valley	A. H. Watier
Sarnia	J. W. Graeb
Saskatchewan	Allan Tubby
Sault Ste. Marie	R. A. Campbell
Sudbury	R. L. Snitch
Toronto	C. D. Carruthers
Vancouver	W. O. Richmond
Vancouver Island	Jack Alton
Winnipeg	T. E. Storey
Yukon	H. L. Meuser

Honorary Memberships

The general secretary reported that the following had been elected to honorary membership in the Institute and that certificates would be presented at the annual banquet of the Institute on May 25:

Clarence Ebenezer Davies, M.E., D.Eng., Secretary, American Society of Mechanical Engineers, New York, N.Y.

Albert R. Decary, M.B.E., D.Sc., formerly Superintending Engineer, Province of Quebec, Department of Public Works, Quebec, Que.

Francis William Gray, LL.D., formerly Assistant General Manager, Dominion Steel and Coal Corporation, Victoria, B.C.

James Alexander McCrory, B.Sc., (Mech.), D.Sc., Engineering Consultant, Shawinigan Engineering Company, Montreal, Que.

Harold Wilson McKiel, B.Sc., LL.D., Vice-President, Mount Allison University, Sackville, N.B.

Awards of Medals and Prizes

The general secretary announced the various awards of the Institute as follows stating that the formal presentation of these would be made at the annual banquet on May 25th.

Julian C. Smith Medals—"For achievement in the development of Canada"; to Howard Kennedy, M.E.I.C., consulting engineer, Ottawa, Ont.; and to Adrien Pouliot, M.E.I.C., dean of the Faculty of Science, Laval University, Quebec, Que.

Duggan Medal and Prize—"For papers dealing with the use of metals for structural or mechanical purposes"; to joint authors Georges F. Welter, M.E.I.C., professor, and Julien Dubuc, JR.E.I.C., associate professor, Ecole Polytechnique, and Thomas A. Monti, M.E.I.C., consulting engineer, Montreal, for their paper "Fatigue Life of Steel I-Beams at Normal and Sub-Zero Temperatures".

Leonard Medal—"For papers on mining subjects"; to Franc R. Joubin, consulting engineer, Toronto, Ont., for his paper "Uranium Deposits of the Algoma District".

Plummer Medal—"For papers on chemical or metallurgical subjects"; to Morris Katz, M.E.I.C., consultant, atmospheric pollution, Occupational Health Division, Department of National Health and Welfare, Ottawa, Ont., for his paper "The Nature, Distribution and Dispersion of Contaminants in the Urban Environment."

Ross Medal—"For papers on electrical engineering subjects"; to George William Holbrook, M.E.I.C., head of the Department of Electrical Engineering, Royal Military College of Canada, Kingston. Ont., for his paper "Design of a Wide Audio Band".

John Galbraith Prize—"For the best paper by a Junior in the Province of Ontario"; to Hendrik Jan Saaltink, JR.E.I.C., engineer, hydraulic dept., H. G. Acres and Company, Niagara Falls, Ont., for his paper "In the Wake of Hurricane Hazel".

Phelps Johnson Prize—"For the best paper by an English Junior in the Province of Quebec"; to Roderick Roy Real, JR.E.I.C., post-graduate student at McGill University, Montreal, Que., for his paper "Over the Hill and Line of Sight".

Report of Council, Report of Finance Committee, Financial Statement and Treasurer's Report

Mr. Dunsmore, vice-president, and chairman of the Finance Committee, pointed out that the complete report and financial statement were in the annual report of Council, copies of which had been distributed at this meeting.

These reports were complete in themselves but he pointed out that substantial amounts had been put into reserves during the year. These reserves have been invested conservatively and the Institute was in an excellent position.

On the motion of W. B. Pennock, seconded by H. C. Bates, it was resolved that the report of Council, the report of the Finance Committee, the financial statement and the treasurer's report be accepted and approved.

Reports of Committees

Speaking on the matter of committee reports, the president stated that he wanted to thank the members of every committee for the splendid work they had done throughout the year. Some of the most important work done by the Institute was done through the committees, and Council was greatly indebted to them.

On the motion of R. E. Hayes, seconded by T. Foulkes, it was resolved that the reports of the following committees be taken as read and accepted: Admissions, Board of Examiners, Life Members' Committee, Professional Interests, the Young Engineer, Employment Service, Prairie Water Problems, Library Report, Library and House, Papers, Publication, Legislation, Membership, Report of Field Secretary, Ontario Division, Canadian Chamber of Commerce and the Canadian Standards Association.

Branch Reports

On the motion of C. D. Carruthers, seconded by Norman Ursel, it was resolved that the reports of the various branches be taken as read and approved.

Committee on Confederation

At the president's request, Dr. I. R. Tait, chairman of the Institute's Committee on Confederation, presented a summary of his report. He explained that the same report had been presented the day previously to the meeting of Council and to the branch officers conference, and had been approved unanimously by both groups.

Dr. Tait explained further that a copy of the complete report had been sent in advance of the meeting to every member of Council so that he would be familiar with it when it came up for discussion at the annual meeting of the Council.

Dr. Tait inquired as to whether or not there were any questions from the audience. The president explained that before any final form of agreement would be agreed upon it is likely there would be several changes and adjustments.

Mr. Johnston of the Saguenay Branch inquired about branch fees. Dr. Tait replied that that angle of the subject would have to be given further study before a fixed recommendation could be made.

Mr. Paterson of Toronto, proposed that the meeting should express an opinion either for or against the report so that Dr. Tait's committee would know where they stood.

Mr. Ross of Sydney, stated that he felt the meeting had full confidence in the committee and in the Council of the Institute. He thought excellent progress had been made considering how difficult the issues were.

Mr. Paterson moved that this annual general meeting endorse the action taken by Council with regard to confederation. This was seconded by Mr. J. W. Macdonald of Halifax, and approved unanimously.

Election of Officers

The general secretary presented the list of the newly elected officers of the Institute as follows:

President

V. A. McKillop, London, Ont.

Vice-Presidents

H. R. Sills, Peterborough, Ont.
G. M. Dick, Sherbrooke, Que.
H. W. L. Doane, Halifax, N.S.

Councillors

Vancouver Branch	E. L. Hartley
Edmonton Branch	H. L. Roblin
Lethbridge Branch	James M. Campbell
Calgary Branch	W. A. Smith
Saskatchewan Br.	J. B. Mantle
Winnipeg Branch	R. T. Harland
Sault Ste. Marie Branch	D. C. Holgate
North Eastern Ontario	G. G. M. Eastwood
Huronia Branch	H. C. Bates
Hamilton Branch	L. C. Sentance
Kitchener Branch	Wm. R. Roberts
Niagara Peninsula Branch	Paul E. Buss
Toronto Branch	W. M. Huggins
Peterborough Br.	A. J. Bonney
Ottawa Branch	R. F. Legget
Cornwall Branch	John M. Hawkes
Montreal Branch	Roger Brais
	C. E. Frost
	H. A. Mullins
Quebec Branch	C. H. Boisvert
Northern New Brunswick Br.	R. C. Eddy
Moncton Branch	M. F. K. Leighton
North Nova Scotia Branch	D. J. MacNeil
Halifax Branch	O. Nelson Mann
Cape Breton Br.	J. R. Wallace
Sarnia Branch	R. A. McGeachy

The president congratulated the newly elected officers and wished them every success in their arduous duties during the coming year.

Dr. Ira P. Macnab took much pleasure in expressing the thanks not only of this meeting but of all the members of the Institute all over Canada for the work which has been done by the president, vice-presidents and councillors during the past year. He had some knowledge of the magnitude of the work that had been accomplished and he moved a hearty vote of thanks to Dr. R. E. Heartz, the retiring president, to the retiring vice-presidents and councillors and to all other members of the Institute for the work which had been done. Dr. D. M. Stephens seconded the motion which was carried unanimously.

Having some idea of the enormous amount of work involved, particularly in view of the tremendous growth of the Institute in the past few years, Dr. H. W. McKiel wished to add his own personal appreciation and thanks for the contribution which the retiring Council has made. He felt that he could speak also for all members of the Institute.

Dr. Heartz thanked them all for their kind remarks, not only personally but on behalf of the retiring officers without whose strong support it would have been impossible for him to have carried on with what had turned out to be a strenuous year. It had been a pleasure and an honour to serve the Institute and he hoped that those who carry on will have the same enthusiastic and loyal support which he had had.

The meeting adjourned at eleven forty-five a.m.

Presentation at McGill University

"What's the matter with old McGill!" The president calls on the principal. Left to right: R. E. Jamieson, dean of engineering, R. E. Heartz (president 1955-56), and Dr. Cyril F. James, principal of McGill.

The Institute's prize was won this year by Robert L. Wright, S.E.I.C., who is shown receiving it from the past president while Dean Jamieson (left) and John J. Gillman, S.E.I.C., (right) look on.

Personals

News of the Personal Activities of Members of the Institute.

D. E. Blair, M.E.I.C. Retired recently as consulting engineer with Montreal Transportation Commission is D. E. Blair, long-time transit worker, and one-time president and general manager of the Montreal Tramways.

Mr. Blair has worked a total of fifty-three years with Montreal Street Railway, Montreal Tramway Company and the Montreal Transportation Commission.

A native of the province of Quebec, he completed studies at McGill University and then spent six years in the service of the Quebec District Railway and the Quebec Railway, Light, Heat and Power Company.

In 1903 the Montreal Street Railway named him assistant general superintendent. Other appointments which followed were those of superintendent of rolling stock, general superintendent and general manager.

In 1942, remaining as general manager, he became vice-president of the Montreal Tramways Company. Seven years later, in 1949, he retired from these positions but remained with Montreal Tramways Company in a consulting capacity, when the Montreal tramways Company property was acquired by the Montreal Transportation Commission.

In the earlier days of the city's growth, in 1928, Mr. Blair was active in the organization of and work of the Montreal Metropolitan Planning Board.

A past president of the Canadian Railway Club and the Canadian Transit Association, he holds life membership in the Corportion of Professional Engineers of Quebec, and the Engineering Institute. Mr. Blair joined the Institute in 1904 as an Associate Member, in 1927 transferred to Member.

D. E. Blair, M.E.I.C.

Charles E. Garnett, M.E.I.C., has been re-elected to office as chairman of the Board of Great Northern Gas Utilities Limited, and Plains Western Gas Utilities Limited. He is also president and managing director of Gormans Limited and the Edmonton Elevator Service Limited.

Mr. Garnett has been prominent in activities of the Canadian Chamber of Commerce in Alberta. He is a past-president of the Association of Professional Engineers of Alberta, a past-chairman of the Edmonton Branch of the Engineering Institute and a past vice-president of the Canadian Institute of Mining and Metallurgy.

R. F. Legget, M.E.I.C., director of the Division of Building research of the National Research Council of Canada, has been named a Fellow of the Royal Society of Canada.

Mr. Legget graduated from the University of Liverpool in 1925 and in 1927 he received the degree of master of engineering from the same institution.

He came to Canada in 1929, and was engaged in heavy construction engineering until 1936, when he joined the staff of Queen's University. He went to the University of Toronto in 1938, remaining there as associate professor and consultant on soil and foundation problems until 1947. He was then invited by the National Research Council to start the new Division of Building Research, of which he has been director since that time.

R. F. Legget, M.E.I.C.

Mr. Legget was elected an Honorary Fellow of the Royal Architectural Institute of Canada in 1953 and is a Fellow and Councillor of the Geological Society of America. He is a member of the Institution of Civil Engineers and the American Society of Civil Engineers.

J. M. M. LaForest, M.E.I.C., assistant engineer recently retired from the National Harbour Board, after forty-three years' work at the Port of Montreal.

Shortly after graduation in civil engineering from Queen's University in 1913, Mr. LaForest joined the Harbour Commission of Montreal as an engineer's assistant.

Assigned to the Department of Munitions, Ottawa, during the first World War, he was deputy inspector for the manufacture of fuses and cartridges in Canada. He also saw a term of duty as

J. M. M. LaForest, M.E.I.C.

liaison officer in London between the British War Mission and the inspection department of the Ministry of Munitions. This duty kept him in London until after the war.

Returning to Monreal in 1920 he immediately took charge of the construction of the cold storage warehouse at the port, which was finished two years later. In 1922 he became resident engineer, taking part in the major development of the waterfront. The appointment of assistant was conferred in 1947.

Mr. LaForest's work at the Port of Montreal brought him into contact with

various agencies such as the Shipping Federation, the railways and navigation companies, the City of Montreal, and adjoining municipalities.

M. McMurray, M.E.I.C., previously sales manager of Dominion Bridge Company Limited's Ontario Division in Toronto, has been given the head office appointment of assistant to the vice-president and managing director.

Mr. McMurray is a metallurgical engineering graduate of the University of Toronto. At the beginning of his career, a demonstrator in mining engineering, he joined Dominion Bridge in 1940, shortly after graduation, and spent the next five years as a metallurgist and chief inspector of munitions. Since then he has held a number of positions in the fields of engineering, production and sales.

In 1954 Mr. McMurray received a Master of Commerce degree in Business Administration from the University of Toronto.

He is a member of the council of the Engineering Institute and a past-chairman of the Toronto Branch.

H. F. Finnemore, M.E.I.C., chief electrical engineer since 1945, with the Canadian National Railways in Montreal, has recently retired.

On recieving a bachelor of science degree at the beginning of World War I, he joined the Canadian Engineers.

Demobilized in 1918, he spent the next five years with the Canadian Government Railways. It was in 1923 that he went to the Canadian National Railways mechanical department in Montreal. He eventually became chief electrical engineer.

Mr. Finnemore has been actively engaged in the development of electric motive power and installations, and the introduction of air-conditioning on the Canadian National passenger euqipment.

He served the Engineering Institute for several years on the Library and House Committee, and was a member of the Council from 1948 to 1950.

H. R. Finnemore, M.E.I.C.

M. McMurray, M.E.I.C.

Dominion Bridge Appointments

P. E. Savage, M.E.I.C., formerly erection manager of Dominion Bridge Company Limited's eastern division has received the head office appointment of assistant to the vice-president and managing director.

Mr. Savage graduated from McGill University in 1934, with a M.Eng. degree in civil engineering. Awarded a Strathcona Memorial Fellowship he also carried out advance studies at Yale University. He was employed with Dominion Bridge Company while still a student, and in 1934 joined the structural design department of the organization at Lachine. Since then he has been associated mainly with the engineering and erection departments.

Robert Chambers, M.E.I.C., for nineteen years a member of the staff of Shawinigan Engineering Company Limited in Montreal, has transferred his services to the B.C. Engineering Company Limited in Vancouver. His position is that of assistant superintendent of construction.

Mr. Chambers was last year named superintendent of power developments in the construction division of the eastern company. He has over the years done extensive work in surveying and in the design and construction of transmission lines.

He is a University of Alberta graduate.

Dr. D. B. Steinman, M.E.I.C. The famous Brooklyn Bridge, built in 1869-1883 by Roebling in the days of "horse and buggy" traffic and reconstructed 1950-1953, by Dr. D. B. Steinman, with wider roadways for modern highway traffic, has been honoured by the American Institute of Steel Construction with a special artistic bridge award as "A pre-eminent example of the adaptability of the steel bridge" to expanding traffic needs.

An international authority on design and construction of long-span bridges, Dr. Steinman has been identified with 300 bridges on five continents. He has received international honours and decorations from 12 countries.

P. E. Savage, M.E.I.C.

E. A. Ford, M.E.I.C.

E. A. Ford, M.E.I.C., whose name appeared in a recent list of head office appointments in the Dominion Bridge Company Limited, at Lachine, Que., has been named assistant to the vice-president and managing director.

Mr. Ford has, since 1952, been engaged as a contract eng'neer with the Western Division of the firm in Winnipeg.

Following a 1927 graduation from the University of Manitoba, he joined Dominion Bridge as draughtsman. He has spent most of his business life with the company's western division, in manufacturing and sales.

W. C. Wilkinson, M.E.I.C., resident of Australia for the last five years, has accepted a position with the Amalgamated Television Services Party Limited, in Sydney, Australia. He will undertake the duties of senior television engineer.

Mr. Wilkinson, who studied at the University of New Brunswick gained a degree in electrical engineering and then spent more than ten years in the communications field in Canada. He held the position of transmitter development engineer with the Canadian Marconi Company in Montreal for four years. During the war, he was with the National Research Council in Ottawa as research en-

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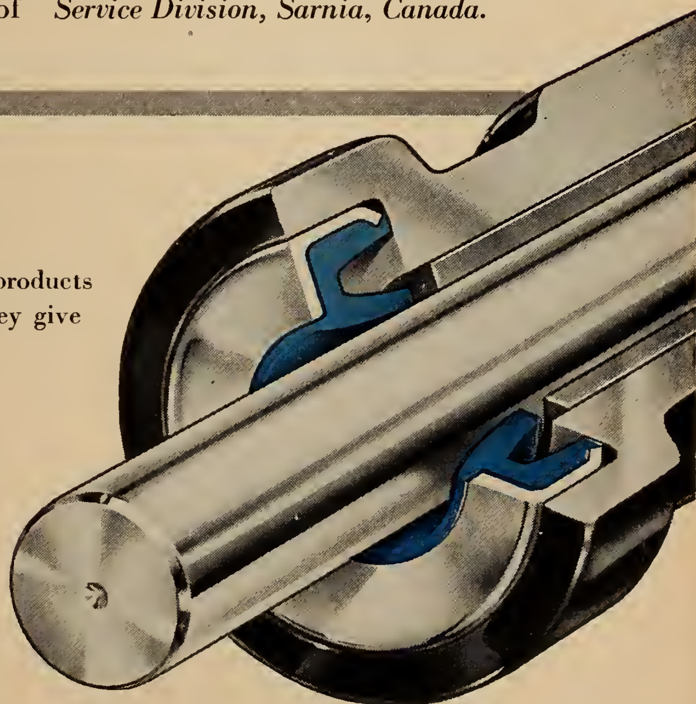

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gineer. He was named vice-president and chief engineer of the Wired Radio Company of Canada Limited, from which company he resigned in 1946.

Mr. Wilkinson has also been associated with the Department of Transport in Ottawa, working in conjunction with the Radio Interferences Section. He was with the Snowy Mountain Hydro Electric Authority in Australia in 1950.

L. Pallas, M.E.I.C., now residing in Bermuda, is resident engineer of Castle Harbour Hotel, Bermuda, B.W.1.

In 1953 he was general superintendent of the North York and York Incinerator in Toronto.

He is a member of the Institution of Electrical Engineers of Britain.

A. J. Nowakowski, M.E.I.C., has been at work for some time in the experimental department of Canadair Limited, Montreal. He was formerly associated with the Dominion Engineering Works Limited, at Lachine, Que.

Mr. Nowakowski is from the Polish University College of London, Eng., class of 1950.

John Bathurst, M.E.I.C., a University of London, Eng., graduate, class of 1947 who has been living in Victoria, B.C. for some time, has left his position with the Department of Public Works, Province of British Columbia. He has joined the federal Department of Transport in that city.

K. C. Martin, M.E.I.C., has joined the staff of the Canadian British Aluminum Company Limited at Baie Comeau, Que., where his position will be that of divisional engineer.

A McGill University graduate, class of 1950, he was formerly associated with the Department of Public Works of Canada in Charlottetown, P.E.I.

W. A. Marshall, M.E.I.C., has been elected a director of Canada Iron Foundries, Limited. Mr. Marshall is president of Dominion Structural Steel Limited.

A graduate of Queen's University class of 1937, in civil engineering, he was with the Dominion Structural Steel Limited at an early date, employed as designing and detailing engineer and estimator. Apart from five years service with the R.C.E.M.E., during World War II, he has been continually associated with the company.

W. A. Marshall, M.E.I.C.

A. B. Yates, M.E.I.C., was elected chairman of the Yukon Branch of the Institute for the year 1956-57.

A. B. Yates, M.E.I.C.

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AGENTS THROUGHOUT THE WORLD

TS13-56

Mr. Yates, whose home is England, first went to the North West Territories in 1950, as a regular officer of the Royal Engineers, British Army, on exchange to the Canadian Army. He was posted as assistant highway superintendent, Whitehorse.

In 1953 he obtained a discharge from the service and took up residence in the Yukon as a technical officer, works department, with H.Q., N.W.H.S., at Whitehorse.

With the Royal Engineers from 1942 to 1953 he saw extensive war service, then later enrolled in engineering studies at London University. In 1950 he received a B.Sc. degree.

Frank A. Ross, M.E.I.C., has accepted a position as assistant to the manager, power equipment sales department, with the Amalgamated Electric Corporation Limited, in Toronto.

Former professional associations held in Canada by Mr. Ross include those with BepCo Canada Limited, in Montreal, where he was assistant chief estimator, and with the British Elecrical Company of Canada Limited, also in that city.

J. G. Dale, M.E.I.C., has been elected president of the Association of Professional Engineers of Alberta.

Mr. Dale, a native of British Columbia, received his engineering degree from the University of Alberta in 1934. He immediately joined North-western Utilities Limited and has remained with the firm to the present time. Among his various appointments with the firm are those of combustion engineer in 1946, and utilization engineer and chief salesman, the following year. In 1953 he was named to his present position of manager of sales and service.

Mr. Dale first joined the Association of Professional Engineers of Alberta in 1941. Two years later he was named registrar and served the organization in this capacity until 1947. The following year he was chosen as Councillor which office he filled for four consecutive years. In 1952 he became the Association representative at the Faculty of Engineering Council, University of Alberta, and continues as such. Previous to his

J. G. Dale, M.E.I.C.

election as president this spring, he was the 1955 choice as vice-president.

Stuart S. Lefeaux, M.E.I.C., was elected chairman of the Vancouver branch of

S. S. Lefeaux, M.E.I.C.

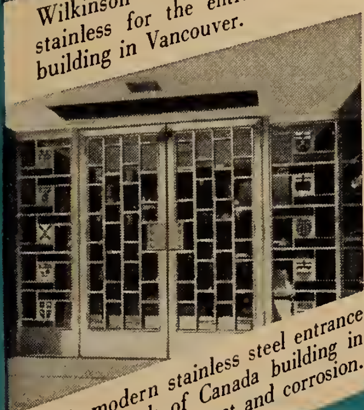
the Institute for the term 1956-57.

Born at Victoria, B.C., he attended

Entrance to the Fairbanks-Morse building in Winnipeg.

The rich, neutral luster of the metal contributes to handsome architectural effects as illustrated in the Albert G. Baker Limited building in Quebec City.

Wilkinson Company Limited chose stainless for the entrance to their building in Vancouver.



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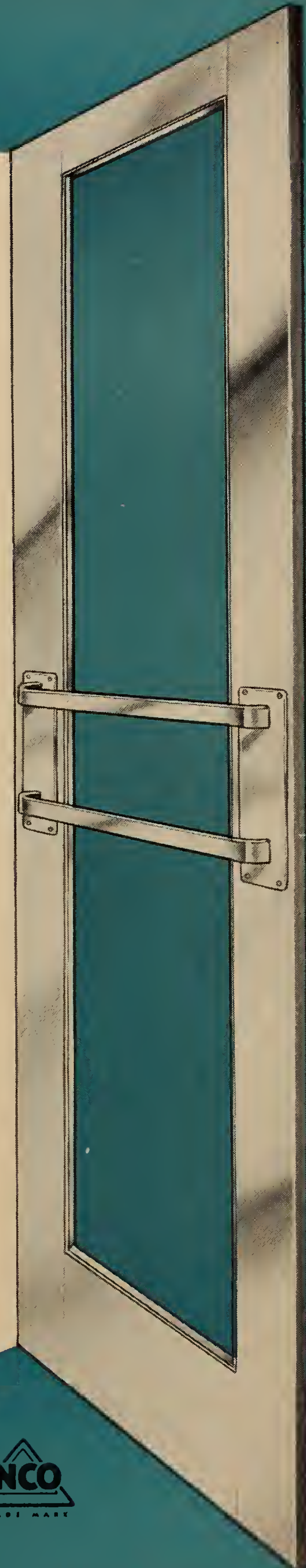

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25 KING ST. W., TORONTO, ONT.

South Burnaby High School in Vancouver, and went on to the University of British Columbia where he graduated with a B.A.Sc. in civil engineering in 1945.

A short career with the Royal Canadian Engineers followed. Prior to this Mr. Lefeaux had spent his summers with the Department of National Defence on airport construction in British Columbia.

He joined the Board of Park Commissioners, Vancouver, in October 1945 as assistant superintendent of parks and has continued in this work to the present time. He has, since then been named deputy superintendent and engineer.

Mr. Lefeaux is a Fellow in the American Society of Park Executives and a member of the Association of Professional Engineers of British Columbia.

With the Vancouver Branch of the Institute he was for two years Branch News Editor and also served as Secretary to the organization for two years.

E. W. R. Butler, M.E.I.C. The appointment of vice-president of the Bailey Meter Company, Montreal has gone to E. W. R. Butler, formerly assistant manager with the firm.

E. W. R. Butler, M.E.I.C.

Mr. Butler joined the organization in 1924, shortly after graduating from McGill University, and held the position of manager of the firm's Winnipeg office from 1928 to 1952.

A. L. Stewart, M.E.I.C., has been named president of the Bailey Meter Company Limited in Montreal following recent elections within the company.

A. L. Stewart, M.E.I.C.

With the firm since 1921, Mr. Stewart has held the position of vice-president and manager since 1928.

He is a graduate of the University of Toronto and a member of the Corporation of Professional Engineers of Quebec.

Lt.-Col. W. Alton, M.E.I.C., who has spent five years with the Directorate of Signals, Army Headquarters, Ottawa, was

"My reputation is at stake"

"...just can't afford slip-ups"

"...it's my job to choose the right subcontractors"

Another engineer realizes there is no substitute for know-how. So—like many others these days—he plays safe and calls in Eastern Steel. Whenever a blueprint indicates a piece of equipment that needs to be custom-fabricated in sheet metal or steel plate, it is only natural to insist on complete assurance that any sub-contractor selected is fully equipped to do a satisfactory job. Accuracy is vital, of course, but you also require delivery on the appointed date—and a *competitive price*. Eastern Steel can satisfy you on all three counts.

We have recently completed orders for such diversified products as transformer casings, steel breechings, and smoke stacks, tote boxes, underground storage tanks, bins and hoppers, and oil loading racks.

5510

CUSTOM PRODUCTS DIVISION

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EASTERN STEEL ESP PRODUCTS LIMITED

recently appointed technical staff officer, grade I (TSOI) in the Army's Directorate of Electrical and Communications development, D.E. and C.D.

He is a graduate of Queen's University, Kingston.

P. L. Strigner, M.E.I.C., holds the position of assistant research officer with the National Research Council, Ottawa.

Last year Mr. Strigner was refinery chemist with Trinidad Leaseholds (Canada) Limited, at Port Credit, Ont.

He is a 1949 graduate of Queen's University.

Milton MacRitchie Uloth, M.E.I.C., has been elected chairman of the Peterborough Branch of the Institute.

Originally from Nova Scotia he was born in New Harbour and had his schooling there and at St. Mary's College, Halifax. Proceeding on to the Nova Scotia Technical College he was in 1942 awarded a B.Eng. in electrical engineering.

Immediately joining the Canadian General Electric Company in Peterborough, Ont., he attended the test course. Afer a year in design engineering he saw service with the Directorate of Electrical Engineering, R.C.N.V.R.

He returned to design engineering at the end of the war, and held several engineering assignments in Peterborough and Quebec City. Mr. Uloth is supervising engineer in the motor and generator division of Canadian General Electric Company, Peterborough.

M. M. Uloth, M.E.I.C.

C. S. Phelps, M.E.I.C.

C. S. Phelps, M.E.I.C., of Sarnia, Ont., is chairman of that Branch of the Institute for the term 1956-57.

Born in Sarnia, educated there and at the University of Toronto, he obtained a Bachelor of Science degree in 1934.

Following graduation he joined the Canadian General Electric Company Limited on a students test course and served the company in various head office divisions until 1942. At that time he became associated with the Canadian Kellog Company Limited on construction of the Polymer Corporation Limited.

• PERSONALS

He was for some time assistant electrical engineer at the steam and power plant, and was later promoted to electrical engineer of the Polymer plant.

In 1949 Mr. Phelps joined the Sarnia Hydro Electric System as assistant manager. His present appointment as manager dates to 1952.

A. M. H. Norris, M.E.I.C., is service contract engineer with the Central Mortgage and Housing Corporation, Camp Gagetown Project at Oromocto, N.B.

A native of London, England, and former student of the London Polytechnic class of 1949, he came to Canada in 1953, and was for a time engaged as senior engineer with Jaques Price, consulting civil engineer, in Windsor, N.S. He also held a position with Central Mortgage and Housing Corporation in Fredericton, N.B.

Ralph M. Ferguson, M.E.I.C., latterly of Trail, B.C., where he was employed in the design office of the Consolidated Mining and Smelting Company, is now in Lethbridge, Alta. He is associated with the firm of Meech, Mitchell, Robins and Associates, architects and engineers and is engaged in structural engineering.

Mr. Ferguson was also known in Calgary where he was on the staff of Dominion Bridge in 1955.

He is a graduate of the University of Alberta, class of 1946.

S. A. Milner, JR.E.I.C., has left the Inland Natural Gas Company Limited in British Columbia to take on the duties of executive vice-president of the Canadian Chieftain Petroleums Limited in Edmonton.

Mr. Milner, a graduate of the University of Alberta, class of 1951, was with Perforating Guns of Canada, shortly after receiving his degree. He was with the Inland Natural Gas Company in Vancouver in 1953, and later became construction field superintendent with the organization.

James Anderson Aitken, JR.E.I.C., has been taken on the staff of the National Steel Car Corporation Limited at Hamilton, Ont.

He is a graduate of the University of Manitoba, class of 1950, in mechanical engineering.

Mr. Aitken is known in Montreal where he was associated with Combustion Engineering Corporation Limted, which firm he joined in 1951.

John Kurelek, JR.E.I.C., is employed with Standard Tube and T. I. Limited, Woodstock, Ont.

He is a graduate of the University of Manitoba, class of 1951, and has been associated with the Northern Engineering and Supply Company Limited in Fort William, Ont., at an earlier date.

Roland Collins, JR.E.I.C. has accepted employment as construction engineer with Canadian Petrofina Limited in Montreal.

He has been associated with the Defence Research Board at Valcartier, Que., in 1952, in the year following his graduation from Laval University in chemical engineering, and later, in 1953 was design engineer with the Board in Carde, Que.

W. W. Serrick, JR.E.I.C., a 1952 graduate of McGill University in civil engineering, has taken on the duties if Public Health engineer with the Province of Newfoundland, at St. John's, Nfld.

Mr. Serrick was previously employed with the Water and Sewerage Corporation of Greater Corner Brook, at Corner Brook, Nfld.

G. W. Easter, JR.E.I.C., has moved from Shawinigan Falls, Que., to North Bay,

Ont. He has joined Du Pont Company of Canada Limited in works concerned with the production of commercial explosives. His position is that of process control and development supervisor.

Mr. Easter was formerly with Canadian Industries Limited. He is a graduate of the University of Toronto, class of 1949.

J. Raymond Roy, JR.E.I.C., who was appointed assistant Trade Commissioner, Department of Trade and Commerce, Ottawa, in October 1955, he received a posting to Brussels where he will serve as assistant commercial secretary with the Department's Foreign Trade Service.

A graduate of the University of New Brunswick in electrical engineering, class of 1952, Mr. Roy has since then, as winner of a Rhodes scholarship, been engaged in studies at Oxford University.

In 1955 he was awarded a B.A. degree in the Honour School of Philosophy, Politics and Economics.

Before leaving Canada for his position abroad, Mr. Roy carried out an in-

J. R. Roy, JR.E.I.C.

tensive three month cross-Canada tour of industry.

J. M. Watson, JR.E.I.C., has been appointed sales representative for the Montreal office of the Permutit Company of Canada Ltd. Mr. Watson is a graduate of McGill University where he received his degree in chemical engineering. After

J. M. Watson, JR.E.I.C.

graduation in 1950 he joined the Permutit Company, working out of their Montreal office in an assistant capacity.

He is a member of the Corporation of Professional Engineers of the Province of Quebec.

Jean C. Garneau, JR.E.I.C., with A. Janin Company Limited in Montreal in 1955,

we'll soon be bagging 'em with both barrels!

QUEBEC
TORONTO

January first, 1957, the St. Lawrence Cement Company's new plant at Clarkson, near Toronto, will start production.
Annual Portland Cement output of the new plant will be 12,000,000 bags, for a total of 18,000,000 bags when tallied with the Quebec plant's output.

ST. LAWRENCE CEMENT CO.

CLARKSON, TORONTO

HEAD OFFICE: Villeneuve, Quebec, Tel: Montcalm 3-7831

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ANTHONY HOPE

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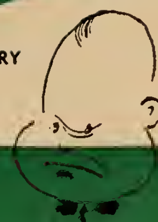
"HARD-BOILED" HARRY
(the demon Purchasing Agent)



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ED56

now serves the company in Kenogami, Que., where a hydro-power development is underway for Price Brothers.

Mr. Garneau's professional experience has included work with the Quebec Department of Roads, and with the firm of A. Jolill Company Limited, in Montreal.

He is a McGill University graduate, class of 1953.

C. Rex Burke, JR.E.I.C., a 1953 graduate of the Nova Scota Technical College is working with Defence Construction (1951) Ltd., as zone engineer at Camp Gagetown, N.B.

He was formerly with the civil service at H.M.C. Dockyard, Halifax, N.S., employed as a civil engineer.

David A. Foster, JR.E.I.C., has been transferred by the Canadian National Railways from Norwood, Man., to Moncton, N.B., where he will fill the position of mechanical engineer for the Atlantic Region. He is a 1951 graduate of the University of British Columbia.

L. H. Harper, JR.E.I.C., in 1955 associated with the Algoma Uranium Mines, at Algoma Mills, Ont., has accepted the position of assistant project engineer with Defence Construction (1951) Limited at the R.C.A.F. Station, Uplands, Ont.

He is a Queen's University graduate in civil engineering, class of 1951. Shortly after obtaining his degree he was associated with Gore and Storrie, consultng engineers, in Toronto.

D. W. Murray, JR.E.I.C., works in the capacity of design engineer with the Montreal Engineering Company Limited, Montreal. He has recently been located in Edmonton.

Winner of a fellowship for study abroad, he gained an M.S. degree in civil engineering at the University of London, Eng. in 1954.

Mr. Murray obtained his first degree in engineering from the University of Alberta, class of 1952.

L. H. Fransen, JR.E.I.C., who graduated with the class of 1952 in civil engineering from the University of British Columbia, is at work in the North West Territories. He holds the responsibility of assistant branch superintendent of maintenance at Con Mine in that locality.

J. B. Woods, JR.E.I.C., is with Canada Iron Foundries Limited at Oakville, Ont.

Formerly at Lynden, Ont., he was also known in engineering circles in Hamilton, Ont. in 1953, where he was employed as a sales engineer with Gartshore, Thomson Pipe and Foundry Company.

A civil engineering graduate from Queen's University, he obtained his degree in 1951.

W. E. Boresky, JR.E.I.C., has joined the staff of Swan, Wooster and Partners in Vancouver. He was formerly structural draftsman with H. A. Simons Limited in that city, and earlier was junior engineer with the Int. Pacific Salmon Fisheries in New Westminster.

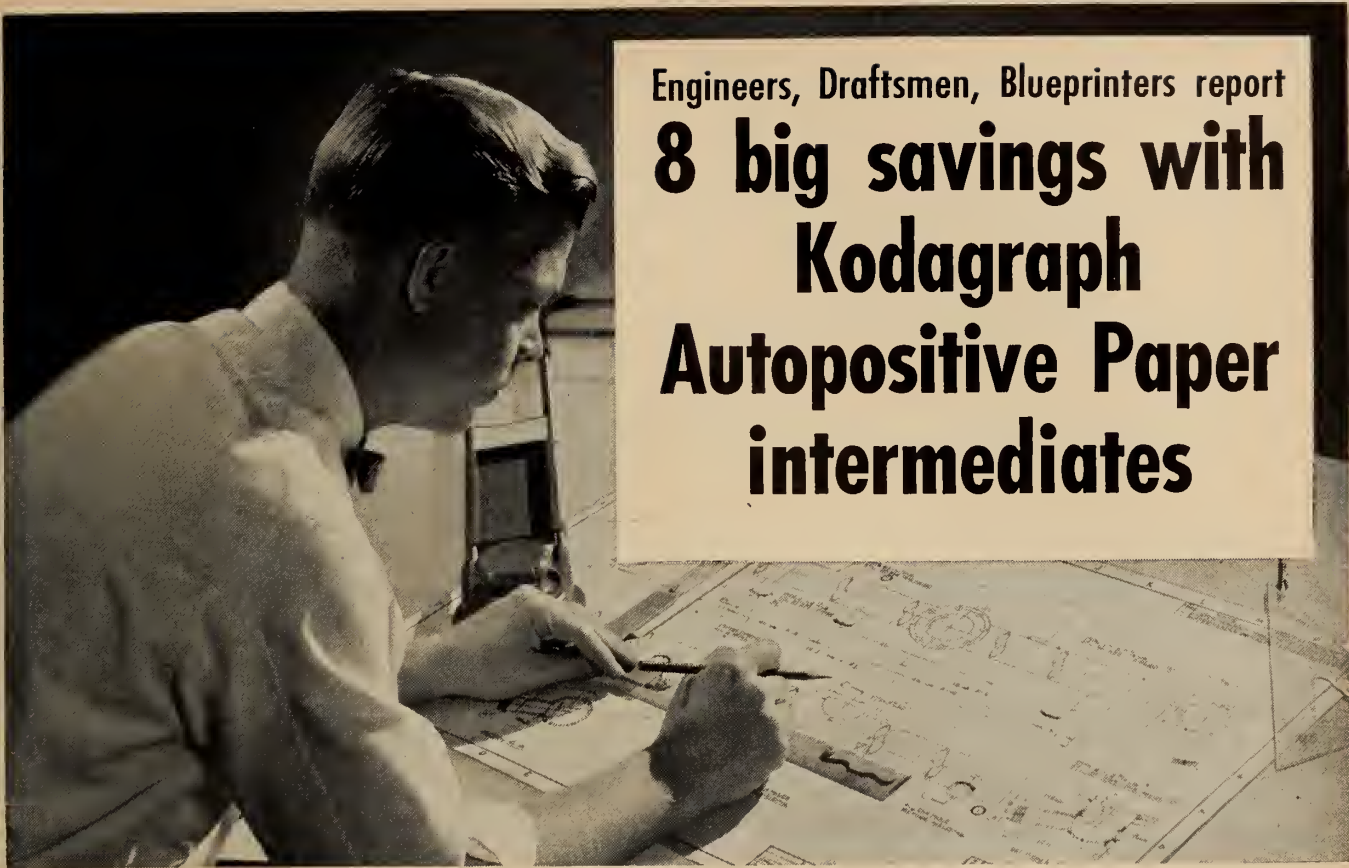
He is a 1953 graduate of the University of British Columbia in civil engineering.

A. M. Ibrahim, JR.E.I.C., a 1953 graduate of the University of Alberta, employed with the Department of Highways in Picture Butte, Medicine Hat and Edmonton in 1955, has been transferred to the town of Olds, Alta.

Colin B. Fairn, JR.E.I.C., formerly at Port Hastings, N.S., in connection with his work as engineer on the Strait of Canso lock, has accepted a position with Pentagon Construction Company Limited a Iroquois, Ont. He will be project engineer on the lock and canal.

Mr. Fairn is a Nova Scotia Technical College graduate of 1952.

William Bobbie, JR.E.I.C. Resigned recently from his position as plant engi-



Engineers, Draftsmen, Blueprinters report

8 big savings with Kodagraph Autopositive Paper intermediates

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- **Kadagraph Contact Paper Translucent** for fast-printing durable, very high-quality intermediates.
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• PERSONALS

neer with Dunlop Canada Limited in Whitby Ont. He has accepted an appointment as industrial engineer with B. F. Goodrich Canada Limited, at Kitchener, Ont.

Mr. Bobbie, a University of Toronto graduate, was at one time associated with Plibrico Jointless Firebrick Limited, at New Toronto and with the Goodyear Tire and Rubber Company of Canada Limited, at that address also.

W. E. Currie, JR.E.I.C., has been transferred by the DuPont Company of Canada from the Kingston works to Montreal. In his new appointment he holds the position of equipment buyer in the purchasing and traffic department.

He is a mechanical engineering graduate of Queen's University, class of 1952.

B. J. Ferries, S.E.I.C., a University of Manitoba graduate in mechanical engineering, class of 1955, joined the staff of the Amalgamated Electric Corporation Limited, in Winnipeg early in 1956.

D. E. Eby, S.E.I.C., who was among the electrical engineering graduates of the University of Manitoba, class of 1955, has gained employment in Toronto. He is a junior engineer-in-training with the Ontario Hydro-Electric Power Commission.

John D. Brunt, S.E.I.C., is employed as a management trainee with the American Can Company of Canada Limited in Simcoe.

He received a B.Sc. degree in mechanical engineering at Queen's University this spring.

Garland Laliberte, S.E.I.C., a 1956 graduate in agricultural engineering from the University of Saskatchewan is with P.F.R.A., at Vauxhall, Alta. His work is in connection with the drainage division.

A. R. Black, S.E.I.C., a 1955 engineering graduate from the University of Toronto, has accepted an appointment with B. Perini and Sons Canada Limited, at Spragge, Ont. He is at work on the Consolidated Denison Mine Project.

Keith S. Preston, S.E.I.C., a University of New Brunswick graduate in mechanical and civil engineering, class of 1954 and 1955, has been taken on the staff of the Montreal Engineering Company Limited. He holds the position of power plant engineer.

Claude Hotte, S.E.I.C., a 1955 graduate of the Ecole Polytechnique is with Lachute Lumber and Millwork Limited, Lachute, Que.

Gerald C. Burtt, S.E.I.C., who was among the graduates of the University of New Brunswick, class of 1955, in civil engineering, has accepted a position with the Corporation of the City of Ottawa. His duties are those of assistant roadways engineer with the department of planning and works.

Bernard Roy, S.E.I.C., of Laval University, class of 1956, in civil engineering, is with Perini Quebec Inc., in Montreal.

Mr. Roy is employed in the capacity of training engineer.

K. Linn MacDonald, S.E.I.C., a 1956 graduate from the University of Manitoba, and winner of the University Gold Medal, has found employment with the Ontario-Minnesota Pulp and Paper Company. He is located at Fort Francis, Ont.

W. L. Sharpe, S.E.I.C., a 1955 graduate in engineering and business from the University of Toronto, joined the staff of the Aluminum Company of Canada, at Arvida, Que., early this year working at the caustic-magnesium plant.

In the June issue, personals section, it was wrongly stated that **H. Frymann**, M.E.I.C., had been appointed chief electrical engineer with the St. Lawrence Cement Company in Quebec City. The Journal wishes to make it clear that Mr. Frymann is, instead, chief mechanical engineer and head of the mechanical department at the company's new headquarters, Clarkson, Ont.


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"TURNALL" Trafford Tile is the one asbestos-cement sheet to give you *both* pleasing appearance *and* structural strength.
The wide valleys and graceful corrugations combine architectural beauty with structural strength.
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Activities of the Forty-Seven Branches of the Institute and abstracts of the papers presented at their meetings

KINGSTON

D. I. OUROM, JR.E.I.C.
Secretary

Prof. S. D. Lash

Preservation of scenic beauty along Highway 33 from Collins Bay to Adolphustown was the subject of a brief presented by Prof. S. D. Lash at the annual meeting of the Kingston Branch.

The affair which took the form of a dinner and dance was held at the Royal Electric and Mechanical Engineers Officers' mess. More than one hundred persons were in attendance.

Guests, visitors and wives were welcomed by chairman Professor A. V. Corlett, who also gave a brief account of the activities of the organization throughout the past year.

Annual Report

E. C. Reid presented the annual report, stating that membership now totalling 217 members had given rise to eight well attended meetings during the year. The sum of $200.00, to be received by the branch is to be used in furthering the interests of the E.I.C. among the undergraduates of the Royal Military College and Queen's University.

I. H. Jenks, of Aluminium Laboratories, winner of the Plummer Medal for the best paper in metallurgical and chemical subjects published in the Engineering Journal, accepted the award from Col. L. F. Grant.

Officers elected for the forthcoming year were: Chairman, Col. C. W. Jones; vice-chairman, E. C. Reid; executive, J. W. Dolphin, W. B. Rice, S. D. Lash; secretary-treasurer, D. I. Ourom.

VANCOUVER

A. D. CRONK, JR.E.I.C.,
Secretary
T. F. HADWIN, M.E.I.C.,
Branch News Editor

Field Trip

A very successful field trip to the manufacturing plant of Boyles Bros. Drilling Company in Vancouver was attended by about 40 members and friends of the Vancouver Branch on June 20, 1956.

Mr. P. Bland, vice-president of the Branch, made all arrangements with plant manager J. W. Booth, of the company and all phases of bit and drilling machine manufacture were seen by the visitors.

Diamonds

Ungraded industrial diamonds in large quantities are sorted, weighed and positioned in carbon molds. A copper alloy is melted in the mold to fix the diamonds in position and for the diamond bit. An interesting feature was that bits worn in service are returned to the plant, the diamonds dissolved out and again sorted and reused. The bit customer only pays for the labour and diamond wear.

Drilling

Drilling machines are made in all sizes to suit all purposes and an extensive machine shop shapes the required gears and other parts. The complete assemblies are shipped to all parts of the world.

The procedures in core drilling were described with the various devices used to determine and change the direction of the drilling at depths up to a mile. A drill can be directed over almost any route.

Diamond drills are used only for core drilling whereas the majority of drilling is done for blasting and for this purpose Throw-Away-Bits are used. The Boyles Company manufactures these bits and the process was observed from the stock

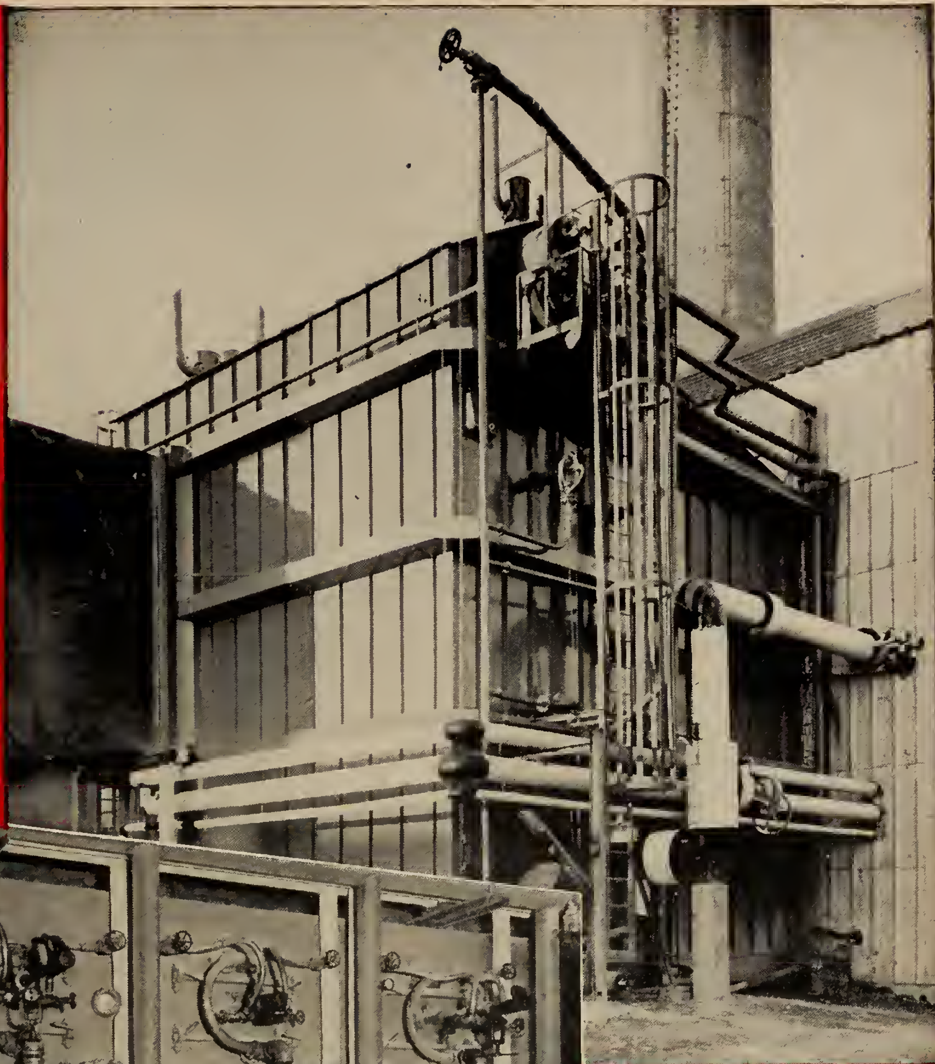
Colonel L. F. Grant is shown presenting the Plummer Medal to I. H. Jenks.

Kingston Branch Executive—front row; Colonel L. F. Grant, field secretary, Colonel C. W. Jones, chairman; Professor A. V. Corlett, immediate past president; back row; Professor J. W. Dolphin, Dr. S. D. Lash, E. C. Reid, vice-chairman, and D. I. Ourom, secretary-treasurer. W. B. Rice is not shown.

at

CLARKSON, ONTARIO

NEW Outdoor High-Pressure BABCOCK BOILER



The above view shows position of outside boiler adjoining main boiler house.

Left: View of burner wall taken from the inside of boiler house.

The recently installed Babcock Type G "INTEGRAL-FURNACE" Boiler, at the British American Oil Co. Ltd., Clarkson, Ontario, has a capacity of 120,000 lbs. of steam per hour and is designed for 875 psi pressure.

The Boiler is fired by six Babcock Oil and Gas Burners.

STEAM FOR PROCESS
BABCOCK
STEAM FOR POWER

BABCOCK-WILCOX AND GOLDIE-McCULLOCH LIMITED. GALT, ONTARIO

MONTREAL · TORONTO · CALGARY · VANCOUVER to the finished bit. These bits are shipped by the thousand to all parts of the world, since their efficient manufacture in Vancouver makes them competitive in all markets.

For engineers not dealing with drilling problems, the field trip was an eye-opener and will permit the more intelligent reading of mining reports. The Boyles Company, including Mr. P. B. Hall, its president, were thanked for their courtesy and tour organization.

Inspection of the Duwamish bascule bridge at Seattle by Vancouver Branch members. This visit was reported in the July issue. In this group: Ed. Greathouse and Hanford Thayer, Seattle. Frank Culp, project engineer, with Hubert Lillie, A. eebles, and T. F. Hadwin of the Vancouver Branch.

WINNIPEG

Electrical Section

W. H. DICKINS, M.E.I.C., *Reporter*

Final Spring Meeting—May, 1956

For the final spring meeting, the Electrical section, Winnipeg, inaugurated what it is hoped will become an annual event. An informal social evening and smorgasbord for engineers and their ladies was held at the Assiniboine Hotel on May 30th. An invitation was extended to all members of the E.I.C., A.I.E.E. and I.E.E. In spite of the lateness of the season, approximately 100 people were present, half of whom were ladies.

W. K. Brasher—Guest Speaker

A distinguished guest, W. K. Brasher, secretary of the Institution of Electrical Engineers of Britain, was present. Mr. Brasher gave an informal but very informative talk on the shortage of engineers and an account of what steps are being taken in Britain to remedy the shortage. A film, "The Enquiring Mind," was produced by the Institution of Electrical Engineers, with the express purpose of attracting youth to electrical engineering. The film outlines the progress of electrical engineering through the centuries and gives an excellent presentation of the careers and opportunities available in the industry.

• BRANCH NEWS

Engineering Education

A discussion period followed, in which Mr. Brasher gave an outline of methods of engineering education in Britain, where two means of arriving at professional engineering status are employed.

a) 3 or 4 years university and following graduation, 2 years of practical and/or specialized training in industry.

b) A new scheme, whereby a youth graduating from high school may spend 6 months in practical factory training alternated with 6 months in college, for a total of 5 years.

This latter scheme is a development of the Higher National Certificate courses, which Mr. Brasher indicated had served a useful purpose in the past, but which offered limited study hours.

Mr. Brasher was in possession of up-to-date factual information on engineering education methods in Soviet Russia, a number of his colleagues having recently returned from that country. Mr. Brasher said that it must be admitted that the Russians were oudistancing the western nations in numbers of technical men and that he was afraid they were surpassing the western nations in quality also. While there was no outright direction of Soviet youth into engineering, the inducements offered were considerable. An engineer in Russia enjoyed an outstanding financial and social position and for this reason the most promising young people tended to gravitate towards engineering. Mr. Brasher hoped to visit Russia later this year.

The ladies present were intrigued at the sight of a number of women engineering students shown in the film. Mr. Brasher regretted to tell them that out of the total institution membership of some 40,000 only 70 were women. However, their training schemes were open equally to girls and boys.

Mr. Brasher was a most accomplished speaker and was obviously thoroughly familiar with his subject. The discussion period was lively and had in fact to be halted for lack of time.

Following Mr. Brasher's talk, the film "Power and Passage," produced by the Canadian General Electric Company Limited, was shown. This was an interesting and most informative film on the St. Lawrence Seaway.

ANNUAL GOLF TOURNAMENT
MONTREAL BRANCH

Saturday, 8 September, 1956
St. Hyacinthe Golf Club,
St. Hyacinthe, Que.

Enquiries welcomed by—
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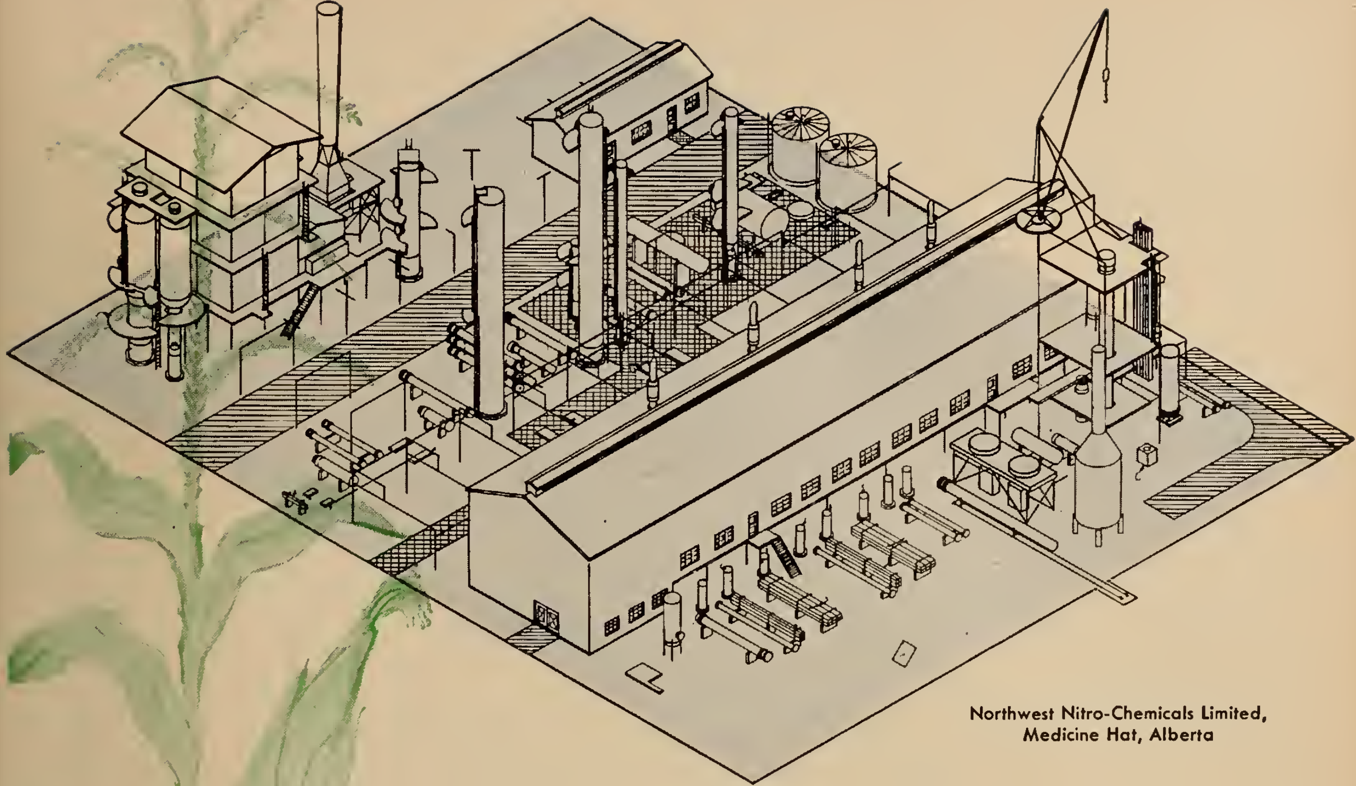

Northwest Nitro-Chemicals Limited,
Medicine Hat, Alberta

New fertilizer plant to meet growing needs

These are a few of the companies with whom Canadian Kellogg has worked—

British American Oil Company Ltd.
Canadian Oil Companies Limited
Canadian General Electric Co. Ltd.
McColl-Frontenac Oil Company Limited
Nova Scotia Light & Power Company
Babcock-Wilcox & Goldie-McCulloch

Even the rich Canadian prairie lands must be fertilized to be farmed efficiently and to produce the maximum yields per acre. Soon the new Northwest Nitro-Chemicals Limited fertilizer plant will take natural gas from the prairies of Western Canada and manufacture it into fertilizers for our Western farmers. Canadian Kellogg has been assigned the responsibility of designing, engineering and constructing the ammonia plant and other important sections of this large facility.

Based on its vast experience and background in the petro-chemical industry, Kellogg can now offer four basic processes for producing ammonia, the starting point for manufacturing most nitrogen bearing fertilizers. These four basic processes can utilize a variety of gas, refinery off gas, crude oil, coke oven gas and other hydrogen bearing materials. A booklet on these processes will be sent on request. Your inquiries on ammonia and other petro-chemical or petroleum projects are invited.

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News of Other Societies

Uniform Traffic Control

At the request of the Institute, W. D. Hurst, M.E.I.C., attend the special meeting of the Joint Committee on Uniform Traffic Control Devices for Canada, sponsored by the Canadian Good Roads Association and the Canadian Section of the Institute of Traffic Engineers, held at the Royal Alexandra Hotel in Winnipeg on May 7, 1956. This is his report of the proceedings. Editor.

Philippe Ewart, traffic engineer, Department of Highways, Province of Quebec, was the chairman pro-tem of the meeting and Jacques Barriere, JR.E.I.C., was the secretary pro-tem.

Between 30 and 40 persons attended the meeting, representing various levels of government, industry, and various technical associations.

The chairman explained that the meeting had been called under the sponsorship of the referenced bodies to discuss the possibilities of the joint sponsoring of a manual for uniform traffic control devices for Canada, similar to the one in existence in the United States. For this purpose a joint committee was to be set up consisting of not more than 40 persons from the following groups:

Provincial Governments (one representative each)
Federal Department of Public Works (one representative)
Cities of Vancouver, Ottawa, Hamilton, Toronto, Winnipeg, Regina, Edmonton, Calgary, Montreal, Quebec and Halifax (one representative each)
Canadian Good Roads Association (five representatives)
Canadian Section of the Institute of Traffic Engineers (five representatives)
Engineering Institute of Canada (one representative)
Canadian Highway Safety Conference (one representative)
Canadian Standards Association (one representative)
Conference of Commissioners of Uniform Legislation in Canada (one representative)
Royal Canadian Mounted Police (one representative)
Association of Chiefs of Police (one representative)
Board of Transport Commissioners (one representative)
American Association of Motor Vehicle Administrators (one representative).

The next question arising was, who would set the necessary machinery in motion: Should it be a federal body like the Canadian Standards Association, or, should the CGRA, together with the Institute of Traffic Engineers (Canadian Section) be the sponsoring bodies? In any event it was very important to have this work commenced at once because the Province of Ontario had just finished a manual on traffic control devices. This manual, followed generally the U.S. manual, but departed from it in some respects, and before the manual had received complete acceptance it was desirable to have a uniform policy across Canada.

It was ascertained from the meeting that generally speaking the United States manual was widely used in British Columbia, Alberta, Saskatchewan and Manitoba and the Maritime Provinces; but it had not come into general acceptance either in Ontario or Quebec. After some extended discussion it was decided that the CGRA and the ITE (Canadian Section) should sponsor the manual.

It was decided that the Joint Committee as constituted should remain but that an executive committee should be set up with the responsibility of preparing the manual in the next 18 months.

The following were selected for the executive committee:

Co-chairman: W. Q. Macnee, Ontario Department of Highways, and Philippe Ewart; Editor: H. F. Bruns, JR.E.I.C., A. D. Margison and Associates Limited, Toronto; Associate Editor: Jacques M. Barriere, JR.E.I.C., city traffic engineer, Montreal; Secretary, R. A. Draper.

At this point the joint meeting went into executive committee session and Mr. Macnee assumed the chair.

The appointment of sub-committees was discussed, and it was suggested that the following working subcommittees be set up: Signs, Markings, Signals, Islands, Research (a continuing sub-committee), Translation, Editing.

Chairmen and secretaries for these committees were to be selected preferably from central Canada in order to facilitate the work. The chairmen asked that regional representatives supply lists of suitable technical personnel for membership in the various subcommitees. The subcommittees would then be selected by the executive committee.

Following is a list of chairmen and secretaries:

Signs. chairman, R. B. Campbell, Ontario Department of Highways; vice-chairman, J. O. Martineau, M.E.I.C., Department of Roads, Quebec; secretary, Lucien Delisle, Dept. of Roads, Quebec.

Markings: chairman, J. R. Walker, Toronto Parking Authority; secretary, Larry Forrester, Ontario Dept. of Highways.

Signals: chairman, Samuel Cass, Metropolitan Toronto; secretary, W. W. Rankin, traffic engineer, Ottawa.

Islands: chairman, John Connolly, Department of Roads, Quebec; secretary, W. Biddel.

Research: chairman, Allan K. Hay, M.E.I.C., Canadian Good Roads Association; secretary, H. M. Edwards, M.E.I.C., Queen's University.

French Language: chairman, Jacques Barriere, JR.E.I.C., traffic engineer, Montreal; secretary, Lucien Delisle.

Editing: Chairman, H. F. Burns, M.E.I.C., A. D. Margison and Associates Ltd., Toronto; secretary, E. F. Gillies, M.E.I.C., Minnesota Mining and Manufacturing Company, Toronto.

It was decided that the next meeting of the Joint Committee would be held on Friday, October 5, 1956, in Quebec City at the time of the annual meeting of the Canadian Good Roads Association.

CEA Meets at Murray Bay

The annual convention of the Canadian Electrical Association was held at the Manoir Richelieu, Murray Bay, Que., June 18-20, 1956 with a total attendance of 616. A. C. Abbott, vice-president, distribution, Shawinigan Water and Power Co., Montreal, was elected president of the Association for the year 1956-57. V. A. Ainsworth, of Newfoundland and J. C. Dale of Edmonton were re-elected vice-presidents. N. T. Smith of Halifax was also elected a vice-president.

CEA President J. A. Pagé told delegates Canadians used more power last year than ever before. Generating capacity at 13.9 billion kilowatts, was 41 per cent more than in 1951. The estimated percentage change from 1955 to 1959 is 39 per cent and from 1951 to 1959, 96 per cent. Firm energy requirements in 1955 were 72.633 billion kilowatt hours, which, it is forecast, will reach 101.508 billion kilowatt hours by 1959, an increase of nearly 40 per cent.

Current planning of new projects still centered largely on hydro, he stated, with central electric stations expecting to spend some $634 million on capital growth this year.

The solid base for Canada's competitive position would always be hydro


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• NEWS OF OTHER SOCIETIES

power, he predicted. No 'breakthrough' was expected by nuclear scientists that would make obsolete any efficient hydro development. The big question mark was the role atomic energy would play. Nuclear fired plants would not cut the cost of electricity in half; it would replace the boiler end, but investment in that kind of equipment was only 13 per cent of the total.

While industrial Canada might have to pause to catch up with proposed plant expansion in late 1956 and in 1957, Canada's future growth would always depend on the ability of its electric utilities to provide the power and energy needed in sufficient quantities at the right time and place, he concluded.

A. C. Abbott, M.E.I.C., President

Enough Hydro Power for Next Fifteen Years

Addressing delegates at the first afternoon session, McNeely DuBose, M.E.I.C., president, Saguenay Power Co. Ltd., speaking of Our Heritage of Water Power, pointed out that this heritage was a great one, but it was largely behind us. Remaining sites would be more expensive to develop. Today coal burning plants use one pound or less of coal per kilowatt hour compared with three pounds thirty years ago. Coal at the mine was now cheaper than it was seven years ago, due to increased output with improved machinery.

If Canada's present rate of increase in energy production continued, another ten years would see half of our undeveloped water potential used up, provided it could still undersell steam power, he pointed out. A further five years would bring us almost to the end of our hydraulic resources.

We must therefore give consideration to atomic fuel and atomic boiler plants. Those in the newsprint, metal reduction or heavy chemicals industries may continue to advantage to follow elusive water power to more remote sites, but even these would be keeping their eye on steam, he added. "Let us not be caught napping, lulled by the complacency we cannot help but feel as a result of our heritage of water power."

New Farval spray panel lubricates gearing automatically, efficiently, inexpensively

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No. 183

HERE'S how to do a better job of greasing gears and save a lot of lubricant and labor besides. Just install Farval Spray Valves. They can reduce oil and grease consumption and oiling labor as much as 95%. Then you can throw away the oil can and grease bucket, and put your oilers on other constructive work.

Shown at right is a new Farval Spray Valve System developed for large-diameter wide-faced gears. Installed on a panel mounted on the gear housing are Dualine valves, spray valves and reversing valve. An automatic air-operated barrel pump supplies the lubricant.

Farval Spray Valves are completely flexible as to arrangement and operation. They can be used alone or as part of a Dualine System—wherever a supply of compressed air is available. As with standard Dualine valves, the spray can be operated as often or as infrequently as needed to deliver any desired amount of oil or grease, on gears, sliding bearing surfaces or other areas needing lubrication. There is no waste or mess. Quantity of air used is limited to the exact amount required to spray each delivery of oil or grease.

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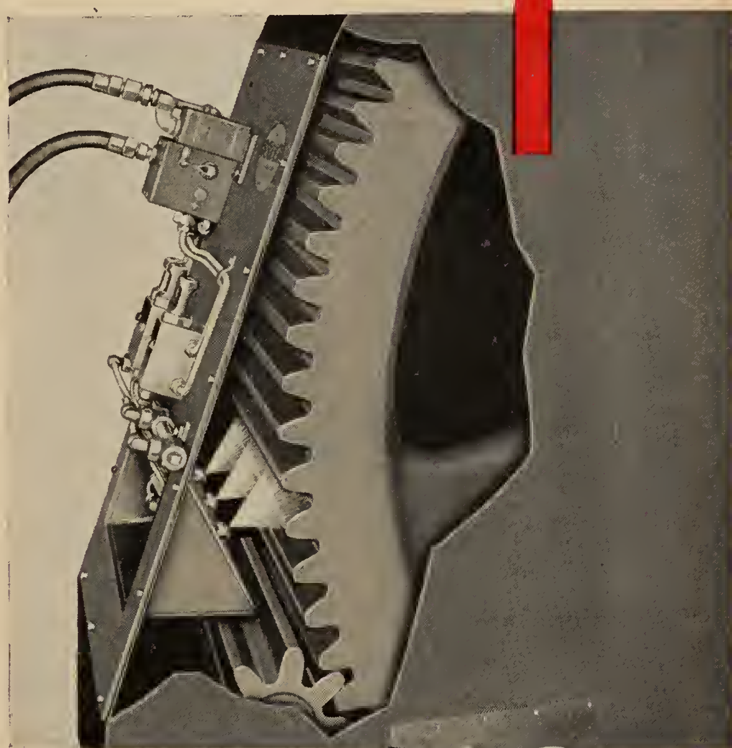

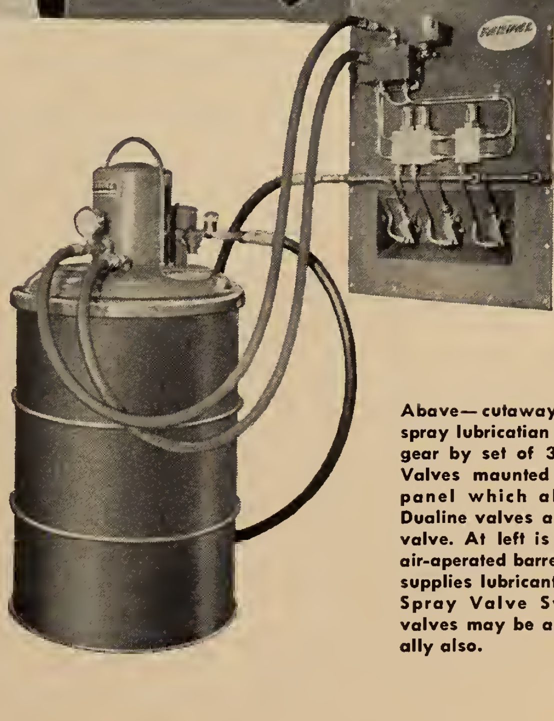

Above—cutaway view shows spray lubrication of wide-faced gear by set of 3 Farval Spray Valves mounted on a special panel which also carries 3 Dualine valves and a reversing valve. At left is the automatic air-operated barrel pump which supplies lubricant to the Farval Spray Valve System. Spray valves may be operated manually also.

• NEWS OF OTHER SOCIETIES

During a CEMA panel discussion chaired by CEMA president H. M. Turner at the morning session the third day, John J. Deutsch, secretary to the Treasury Board, Department of Finance, Ottawa, spoke on The Position of the Electrical Manufacturing Industry in the Canadian Economy. Describing recent developments in Canada with a view to indicating the extent of the opportunities available and the progress achieved, he pointed out that gross value of output of electrical manufacturing industry had increased fourfold over that period, compared with two and a half times for the manufacturing industry as a whole.

Turning to the future, he predicted the role of electrical manufacturing would be one of the most vital in our economy. Its products were both producer equipment and consumer appliances, through which our huge resource of energy is put to use. Thus the industry held the key to the increasing productivity of the economy. Canada, he warned, must remain fully abreast of developments and changes in the technique of production, through a more general application of automatic and electronic devices, in order to maintain our competitive position.

Mr. Deutsch was followed by Walter Gilson, president, Eastern Power Devices, and O. W. Titus, vice-president and general manager Canada Wire and Cable Company.

While utilities usually operate by franchise, the manufacturing business did not lend itself so readily to any broad monopoly type of operation, Mr. Gilson pointed out. During the past two years Canadian electrical manufacturers had made an average net profit after taxes of 3.1 per cent on total sales.

During the past decade the industry had been meeting a 17 per cent per annum increase in demand production but had been running into steadily lowering net profits. An average net profit not less than 4½ per cent on production must be achieved to maintain a favourable financial climate for adequate growth. In this case, the utilities undoubtedly should have an enlightened self interest in the financial welfare of the manufacturers. The utilities and the electrical manufacturers were partners in the electrical business in Canada, he said, and as such had many mutual responsibilities.

That Canada must decide whether the nation's trading policy should be based on disposal of primary products and products of extractive industries, or upon a closer internal balance between manufactured and non-manufactured products, and between manufactured imports and exports, was declared by Mr. Titus. Manufacturing, he pointed out, was the area into which the greatest amount of population growth must move for a livelihood.

While early U.S. expansion was materially aided by foreign capital, this was mainly by debt financing, so that the ownership remained in the U.S. To a much greater extent present Canadian policies were resulting in equity financing by foreign capital, so that ownership would remain permanently outside of Canada. He suggested Canadian companies should be permitted to make such profits as would enable them to retain control of their equities in Canadian industry while expanding their facilities.

National Forestry Conference

The National Forestry Conference to be held in Winnipeg, September 17-19, 1956, will be sponsored by the Canadian Chamber of Commerce, the Canadian Institute of Forestry, the Canadian Forestry Association, and The Engineering Institute of Canada.

Some of the highlights of the program are as follows:

Welcome by the Lieutenant Governor of Manitoba, J. S. McDiarmid.

Theme address: Forestry in Canada's Economy, by Chairman Walter L. Gordon of the Royal Commission on Canada's Economic Prospects.

Address by The Hon. Jean Lesage, minister, Department of Northern Affairs and National Resources.

Discussion: The Outlook by the Forest Industry, by R. M. Fowler, L. R. Andrews, W. J. Leclair.

Discussion: Forest Protection (stressing Public Education); The Provincial Forest Protection Outlook, presented by speakers from Newfoundland to British Columbia; a panel and open forum on How Can Forest Conservation be Most Clearly Shown to the Canadian Public?

Papers: Youth Education, by W. F. Myring, Alan Beaven, W. G. Mackie, and J. A. Breton; Tree Farmers, by Gordon Godwin.

Royal Commission Forestry Summaries, statements and briefs.

Banquet. The speaker, Rt. Hon. Louis St. Laurent.

Secretary of the program committee is J. L. Van Camp, secretary, Canadian Forestry Association, 4795 St. Catherine St. West, Montreal 6, Que.

Calendar

The Federation of Sewage and Industrial Wastes Associations (4435 Wisconsin Ave., N.W., Washington 16, D.C.) have arrangements complete for the 29th annual meeting at Los Angeles, California, October 8-11, 1956.

The third International Technical and Industrial Exhibition will take place in Charleroi, Belgium, Setpember 20 to 30, 1956.

The American Public Health Association (1790 Broadway, New York City) will hold the 84th annual meeting, and meetings of 40 related organizations at Convention Hall, Atlantic City, N.J., November 12 to 16, 1956.

The Chemical Institute of Canada (18 Rideau Street, Ottawa 2) will hold two meetings in September 1956: s symposium of the organic chemistry division, a Guelph, Ont., Sept. 6-7; and the third western regional conference, Edmonton, Alta., Sept. 13-15.

The Community Planning Association of Canada (77 Maclaren Street, Ottawa 4) announces the 1956 national planning conference for October 29-31, 1956, at the Chateau Laurier, Ottawa.

There will be a Canadian convention of the Institute of Radio Engineers in Toronto, on October 1,2,3, 1956.

Information can be obtained from the convention manager, 745 Mount Pleasant Rd., Toronto 12, Canada.

The Institution of Electrical Engineers (Savoy Place, London W.C. 2) has announced a convention on ferrites to be arranged by the committees of the Radio and Telecommunication and Measurement and Control Sections of the Institution during the week beginning October 29, 1956.

Six sessions will deal with such subjects as: theory preparation and properties of ferrites, microwave applications, square loop applications, radio and television applications and carrier frequency applications.

The tenth session of the International Geological Congress, will be held in Mexico from September 4 to 11, 1956.

Information can be obtained from the general secretary of the executive committee, Balderas 36-302 A, Mexico 1, D.F.

There will be a meeting of the American Institute of Chemical Engineers (25 West 45th Street, New York 36) in Baltimore, Maryland, Lord Baltimore Hotel, September 15-18, 1957.

The Institution of Engineers, Australia, (Gloucester Street, Sydney) has extended to E.I.C. members an invitation as follows:

"As you are aware, the 1956 Olympic Games will be held in Melbourne in November.

"It seems quite possible that some of your members may be attending as competitors, officials or visitors, and the members of this Institution would be very glad of the opportunity to extend hospitality to them. Should any such visitors desire to inspect engineering works or industries in the state of Victoria, we will be very pleased to make the necessary arrangements to enable them to do so."

Information can be obtained from the Hospitality Officer, The Institution of Engineers, Australia, Kelvin Hall, 55 Collins Place, Melbourne.

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Oily machine-shop floors have little effect on the sturdy Du Pont neoprene hose cover. Lubricating oil in the air stream won't crumble the Du Pont neoprene tube.

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Out at a dam site, jagged rocks tear into the hose cover under a blistering sun—but rugged Du Pont neoprene refuses to chip, crack or soften.

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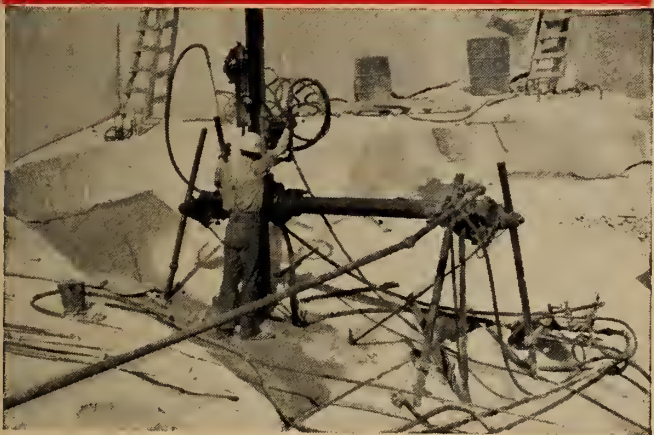

Reflected sunlight bakes the hose in a quarry, yet the sturdy Du Pont neoprene cover remains firm, free from cracks. The smooth Du Pont neoprene tube keeps air stream clean.

TO RESIST FLEX CRACKING . . .

An impact-wrench operator in a shipyard yanks and tugs air hose as he works. Rough duty for any hose except a flexible Du Pont neoprene hose—it stays smooth.

No wonder you have fewer replacements of air hose made with cover and tube of neoprene, Du Pont's chemical rubber. Du Pont neoprene resists oil, grease, abrasion, heat and weathering—the very things that shorten the service life of ordinary hose.

Ask your rubber-goods supplier about air hose made with Du Pont neoprene. Whatever you need, you can count on hose with neoprene cover and tube for dependable performance and lower maintenance costs from the first day it's installed.

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Library Notes

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Reviews, Book Notes
Standards

BOOK REVIEW

Proceedings of the International conference on the peaceful uses of atomic energy.

New York, United Nations, Toronto, Ryerson; 1956.

The publication of the proceedings of the first truly international conference on atomic energy is probably one of the most important events of the century in the field of scientific literature. The sixteen volumes contain the thousand and more papers submitted at the conference, the text of the oral presentations, and the verbatim record of discussions. Bibliographical references accompany most papers, adding to their value.

This series forms the most comprehensive work available on the peaceful uses of atomic energy.

Volume I, The world's requirements for energy: the role of nuclear energy.

The main topics covered by this first volume of the series are the world's estimated power needs over the next fifty years, and the possible ways in which nuclear power can be used to overcome energy shortages.

The papers presented at the first session discussed world energy requirements in general, conventional and unconventional sources of power, and the need for a new source of energy.

At the next session the estimated requirements of individual countries and potential sources of power were discussed. The final sessions considered the role nuclear power will play in the next half-century, the capital expenditure involved, and international co-operation. (479p., $8.00)

Volume 7, Nuclear chemistry and effects of irradiation.

The problems of the effects of neutron and gamma radiation on the properties of structural and fuel materials used in nuclear reactors are discussed in this volume. The problems of handling radioactive materials are considered, as is the fundamental chemistry of the various materials associated with nuclear energy. (691p., $10.00).

Volume 8, Production technology of the materials used for nuclear energy.

This volume deals with the chemical and metallurgical processes involved in the preparation and processing of such fundamental materials of nuclear energy as uranium, thorium, beryllium, zirconium and heavy water. Production techniques are described as well as many such basic physical facts as phase digrams of materials, their alloying chemical characteristics, etc.

Because many of these materials are comparatively unknown, both chemically and metallurgically, the information in this volume in many cases corrects errors in previous literature. (627p., $10.00)

Volume 9, Reactor technology and chemical processing.

We find here collected all the papers and discussions on the fabrication of fuel elements, the chemical reprocessing of spent fuels, the chemical recovery of new fuel produced in a breeder reactor, the separation and isolation of fission products, etc.

The thirteen sections, made up of papers given by scientists from many nations, also include such subjects as waste disposal in the ground, the sea and air, the metallurgy of thorium, uranium and their alloys, handling liquid metals, liquid metal heat transfer, and corrosion in liquid metal systems.

This is one of the most important books in the series. (771p., $10.00)

Volume 15, Applications of radioactive isotopes and fission products in research and industry.

The papers in this volume will be of particular interest to engineers in industry, presenting as they do the uses of radioactive isotopes in research, and in control and technology. These include tracers, thickness guages, radiography and inspection, etc.

Fission products can be used to promote chemical reactions, to sterilize food, and to convert radiation into electricity. (326p., $7.50)

Other volumes in the series will cover reactors, uranium and thorium, medical uses of radioactive isotopes, the biological effects of radiation, and legal and safety aspects of the large scale use of atomic energy. S. C.

BOOK NOTES

Prepared by the Library The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

ASME handbook: Engineering tables.

Jesse Huckert, ed. Toronto, McGraw-Hill, 1956. Various pagings, $14.40.

This valuable collection of tables of recognized design standards, which are not usually found in handbooks, is a companion volume to the ASME publications on the design function in metals engineering and on metals properties. They are meant to save the engineer time and to make design calculations easier.

There are fifteen sections in the handbook, grouping together tables which apply to the design of such specific machine elements as bearings, various types of gears, keys, bolts, serrations and splines, nuts, springs, tubing, and gaskets. A single source is usually given for a table although identical data is sometimes available from several sources. Each section is preceded by an index.

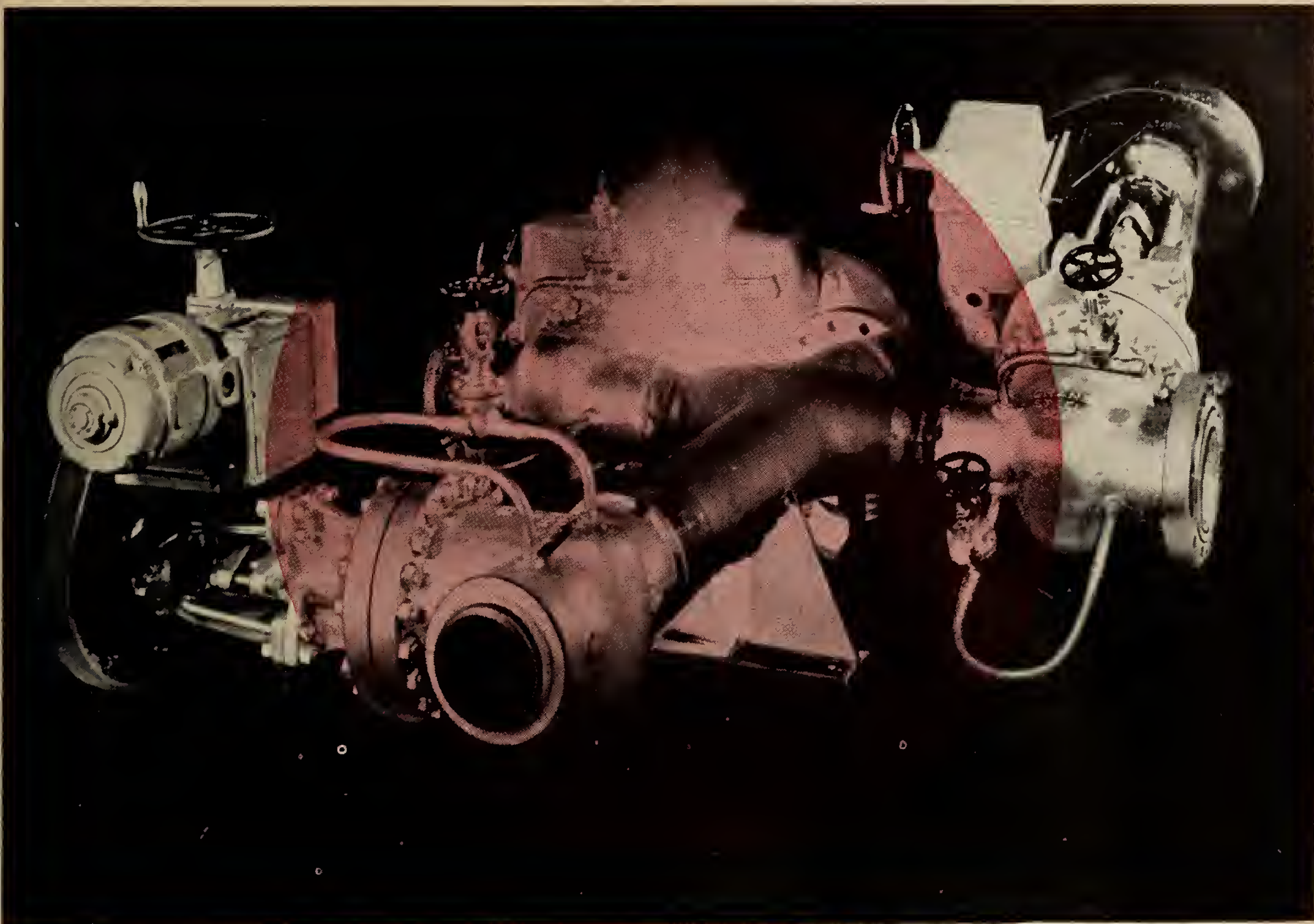
Some of the tables, which were previously hard to locate, cover involute functions, methods for finding the loads in ball bearings, and data on bars and tubes suitable for reworking into gears, levers, shafts, or screws.

Aircraft production methods.

G. B. Ashmead. Philadelphia, Chilton, 1956. 293p., illus., $7.50 (U.S.)

This book on developing aircraft designs into production is in the nature of an illustrated tour through the plants of many of the largest producers in the United States.

DURING THE SUMMER MONTHS THE LIBRARY IS OPEN FROM 9 TO 5, MONDAY TO FRIDAY



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• LIBRARY NOTES

Commencing with the master plaster pattern, successive chapters consider sheet metal preparation and forming, tooling, welding, machining, plastics, etc. As the aircraft industry does not operate on a mass production basis, techniques vary from one manufacturer to another. These different methods are compared, although the majority of the examples are drawn from the Douglas Aircraft Company with whom the author is presently associated.

The analysis of structures.
N. J. Hoff. New York, Wiley, 1956. 493p., $9.50.

The aim of this book is the presentation of structural analysis as a logical and unified theory based on a small number of first assumptions, rather than as a series of unrelated formulae, rules and procedures. Although prepared from lectures used in a graduate course, any mathematics used beyond the level of elementary calculus are explained in detail so that recourse to other texts is not necessary.

The four sections of the book cover the principles of virtual displacements; the minimum of the total potential; the calculation of buckling loads and complementary energy and least-work methods. Bibliographical references are collected in an appendix to which there is an author index.

Applied automation.
J. R. Custer, ed. Philadelphia, Chilton, 1956. 236p., illus., $7.50 (U.S.)

The seventy-five articles comprising this book all appeared in the periodical "Automotive industries" during the last four years. Unfortunately in this reprinting they are not dated.

The object in preparing this compilation was to present a review of the applications of automation in automotive and aircraft production. Many illustrations are included in the articles which cover such topics as car assembly, engine assembly and manufacture, painting, plating, transmission and welding.

This is a useful review of a subject which is today attracting a great deal of attention.

Automatic data processing conference. Proceedings.
R. N. Anthony, ed. Boston, Harvard university, Graduate school of business administration, 1956. 194p., $3.50 (U.S.)

In September 1955 a conference was held at Harvard on automatic data processing as one way of attempting to overcome the language barrier between scientists or engineers and businessmen.

The proceedings are divided into five parts, the first of which is an introduction to the subject. Part two considered the merits of centralized or decentralized data processing for multiplant companies. The remaining sections discuss developments in equipment, the selection of applications for automatic data processing and the relations between operations research and data processing.

Bibliography of monolingual scientific and technical glossaries, v.I. National standards.
Eugen Wuster. Paris, UNESCO, Toronto Ryerson, 1955. 219 p., $2.50.

A companion volume to the "Bibliography of interlingual scientific and technical dictionaries" this bibliography lists standardized technical glossaries issued by standards associations in various countries.

The entries are arranged according to the Universal decimal classification, and for each entry is given in addition to author, publisher, etc., language, whether terms are arranged alphabetically or sytematically, and whether terms are explained by definition or illustration, or both.

There are subject, language and author indices, the latter also containing a list of standards and similar organizations, arranged by country.

British scientific instruments, 1956.
London, Scientific instrument manufacturers association of Great Britain, 1956. 268p.

A directory of the products of the members of the British Scientific instruments manufacturers association, this handbook is divided into two sections. The first is a classified list of products manufactured by members of the S.I.M.A., and includes French, German and Spanish glossaries of the terms used. The second section lists the members of the S.I.M.A. alphabetically, showing the products they manufacture.

*** The casting of steel.**
W. C. Newell, ed. New York, Pergamon Press, 1955. 599p., illus., $15.50 (U.S.)

Prepared by a group of authorities from the British steel casting industry, this book provides a balanced view of the whole subject, from basic principles and their applications to practical problems in the foundry. The opening chapters deal with the properties of molten steel, solidification, the melting process, and refractories. Detailed descriptions of pattern making, mold preparation, and of the casting process are included, with separate chapters devoted to centrifugal and investment casting. The last part of the book covers heat treatment, properties, specificiations, and testing.

Development of power cables.
P. V. Hunter and J. T. Hazell. London, Newnes, 1956. 150p., illus., 25/—.

The authors of this work, themselves cable makers, have been collecting the data on which the book is based for over twenty years. They rescued many examples of early cables from destruction, and these now form the Hunter-Hazell Collection in the Science Museum, South Kensington. The majority of the excellent illustrations in this book are taken from items in this collection.

The history of cables is traced from the seventeenth century to the present, and the use of high-volage cables, of cables under the ocean and various manufacturing advances.

All the royalties accruing from the sale if this book are being given to the Institution of Electrical Engineers Benevolent Fund.

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• LIBRARY NOTES

*** Economic geography of industrial materials.**
A. S. Carlson, ed. New York, Reinhold, 1956. 494p., illus., $12.50 (U.S.)

In this book the economic, technological, and geographic conditions of key industries are explained and analyzed to show how various factors determine the location of plants, mills, and factories for efficient production. Among the twenty industries discussed, each in a separate chapter, are the coal, petroleum, electripower, iron and steel, aluminum, copper, titanium, glass, textile, and food industries, with consideration given to such factors as climate, soil, water resources, fuels, labor, capital, and markets. Two introductory chapters deal with the influence of world population and resources on industrial development and with transportation in the United States.

Electronics and electron devices.
A. L. Albert. New York, Macmillan, 1956. 5B2p., diagrs., $8.00 (U.S.)

This third edition of "Fundamental electronics and vacuum tubes" incorporates the new information on semiconductors which has become available since the second edition was published in 1948. The edition has been largely rewritten, but has retained its original purpose as a textbook on an undergraduate level.

Topics covered include electron tubes, vacuum-tubes, semi-conductor electron devices, transistor amplifiers, modulators, magnetic amplifiers and cathode - ray tubes. One new chapter covers wave-shaping and control circuits. The author follows the standards of the A.I.E.E. and the I.R.E. throughout. There are extensive bibliographies at the end of each chapter.

*** Essentials in problem solving, 2nd ed.**
Zuce Kogen. New York, Arco, 1956. 119p., $3.00 (U.S.)

The essential element in solving problems, as the author, a consulting engineer, sees it, is the development of general methods of approach that can be adapted to specific cases. In this small book, he discusses the formulation, adoption, and utilization of a number of approaches he has found useful and selects four for amplification and illustration. These are: for more without adding, utilize fully; to detach, attach something else; when continuity fails, alternate; and when the direct way fails, try the opposite.

Famous problems of elementary geometry.
Felix Klein. New York, Dover, 1956. 92 p., $1.00 (U.S.) pa.

These lectures discussing in the light of modern research the three famous geometric problems of antiquity — the duplication of the cube, the trisection of an angle, and the quadrature of the circle—were first presented in 1894. It is a tribute to the author that they are now being reprinted in translation over fifty years later.

Foundations: design and practice.
New York, Wiley, 1956. various paging, diagrs.; tables, $16.00

This work is destined to take its place as a valuable reference book with the author's "Data book for civil engineers". It provides up-to-date information on all aspects of foundation work, including subsurface exploration, inspection, foundation reports, specifications, estimates, contracts and design.

The design of simple elements such as plate footings is discussed first, followed by details of complex designs and allied problems. Various types of structures are discussed, ranging from concrete buildings to bridges, embankments and paving.

The book is intended for both practicing and student engineers, and its value lies in the clarity of presentation, the numerous references and tables, and the lists both of items to which particular attention should be paid and of danger signals to watch.

How to select and use your tape recorder.
Davis Mark. New York, Rider, 1956. 140 pp., $2.95 (U.S.)

In non-technical language this text describes the way in which a tape-recorder works and discusses various uses which may be found for it in the home and office. The chapter on the selection of a tape-recorder includes an up-to-date buyer's guide.

Introduction to the theory of groups of finite order.
R. D. Carmichael. New York, Dover, 1956 [c. 1937] 447 p., 2.00 (U.S.) pa.

In this work Professor Carmichael explains the theory of groups and examines fundamental theorems and their application. He discusses sets, systems, permutations, isomorphism, etc., then considers the various types of groups. A knowledge of higher mathematics is not essential to an understanding of the book.

Metal industry handbook and directory, 1956.
London, Iliffe, Toronto, British Book Service; 1956. 492p., 15/–.

This is a comprehensive reference book for all those engaged in, or connected with, the non-ferrous metal industries. It contains up-to-date information on the properties of the newer as well as the more familiar metals, and an extensive section is devoted to summaries of British standard aircraft material, D.T.D. and Admiralty specifications. Also included are sections on the chief metal finishing processes and data regarding all the common rod, bar, sheet and strip products, while a new feature in this year's edition is a section giving tables dealing with the weight of titanium alloys in sheet rod and tube.

The Directory for Buyers gives a very wide range of producers, stockists, and factors of all basic metal products, metal working machinery and tools, and metal finishing equipment.

*** Modern brickmaking, 4th ed.**
A. B. Searle. London, Benn, 1956. 734p., illus., 90/–.

This revision of a classic in the field, is a detailed exposition of all the better-known processes, machines, and equipment in use in Great Britain and Europe, with some reference to American prac-

tice. Chiefly intended as a guide to the selection of plant and production methods, the book emphasizes practical considerations in dealing with clays and non-clay materials; digging and preparation of clays; selection of factory site and manufacturing processes; hand and machine molding; the stiff-plastic, semi-plastic, and dry processes; kilns; and the manufacture of special types of bricks. Numerous revisions have been made to take into account advances made in recent years.

Modern workshop technology. (Part I—Materials and processes) 2nd ed.
H. W. Baker, ed. London, Cleaver-Hume, 1956. 511p. illus., 35/–.

The second part of this new edition will appear next year and will deal with machine tools and metrology. This first part covers the states and properties of the common engineering maerials and those processes which produce either deliberate or accidental changes in these materials.

The scope of the book is wide, including discussions of iron and steel, casting processes, powder metallurgy, forging, high tensile steel wire manufacture, welding, and of aluminium, magnesium, nickel and copper, and their alloys. The last two chapters, on plastics engineering and mechanical testing and inspection of engineering materials, have been greatly revised.

Molecular flow of gases.
G. N. Patterson. New York, Wiley, 1956. 217p., $7.50.

Recognizing the importance of molecular approach to the subject of gas dynamics, the author, the Director of the Insitute of Aerophysics at the University of Toronto, has written his book for engineers and physicists. He does not attempt to cover completely either gas dynamics or the kinetic theory of gases but rather helps the reader make a transition in outlook from the continuum to the molecular viewpoint. To illustrate and develop the molecular approach there is material included from both the kinetic theory of gases and fluid mechanics.

In this work the characteristics of a gas flow are determined from an assumed molecular model and the distribution of the velocities of the molecules. It opens with a chapter on the fundamental equations of molecular motion, then goes on to consider isentropic flow, basic equations for nonisentropic flow, and mechanics of rarefied gases. The mathematical development in the book is complete only for a monatomic gas.

Nouvelle conception de la résistance des matériaux.
Paris, Génie Civil, 1956. 78 p., diagrs., 800 fr.

In this work, reprinted from *Génie Civil*, the author expounds his theory of the strength of materials, based only on the isotropic tensile strength and the internal angle of friction.

The first chapters underline the discrepancies between experimental facts and the classical elastic theory. Then the author establishes from his initial assumptions the basic formulas which should govern the rupture phenomena. In all cases, it seems that the formulas proposed check satisfactorily, qualitatively and quantitatively, with the experimental results obtained elsewhere.

The author concludes by expressing his belief that it is the basic assumption of the elastic theory, i.e. the equilibrium both internal and external and the reality of an elementary volume, which is wrong, philosophically and practically. The whole elastic concept, and its consequences becomes then invalid, and the theoretical security coefficients derived from it, meaningless.

The last chapter looks into the validity of the continuity assumptions in reinforced concrete design.

The theory of sound.
Lord Rayleigh. New York, Dover, c. 1945. 2v., $1.95 (U.S.) per vol.

Another of the Dover reprint series, this edition of Lord Rayleigh's classic work on sound contains an historical introduction by Professor R. B. Lindsay, of Brown University, and a bibliography on the history of acoustics.

The thirteen books of Euclid's elements.
New York, Dover, 1956. 3 vols., $1.95 (U.S.) per vol.

This is a reprint of the second edition of the book published in 1926 by Sir Thomas L. Health, and contains in addition to Euclid's text all Sir Thomas's critical notes and commentary.

The detailed index to each volume includes references to all those who had issued earlier editions of, or commentaries on, Euclid.

Practical solution of torsional vibration problems. (Vol. I: Frequency calculation.) 3rd ed.
W. K. Wilson. Toronto, British Book Service, 1956. 704p., $18.00.

A new feature of this third edition is the rearrangement of the text to make each of the two volumes self-contained. Volume 2 will appear later and will deal with such subjects as the calculation of torsional vibration amplitudes and stresses in the design stage, and means for avoiding excessive vibratory stresses in operating speed ranges.

The book has been brought completely up-to-date but has retained its original purpose, that of being a comprehensive and practical reference work. Volume I contains new material in the sections on geared systems and systems containing distributed mases, as well as many other additions.

The Introduction contains some historical material on torsional vibration. This is then followed by detailed chapters on the subjects of simple and multi-mass systems, frequency tabulations, coupling effects in geared systems, effective inertia method, coupled torsional and flexural vibration in engine systems, and equivalent shafts. Examples are included throughout from marine, electrical, aeronautical and automobile engineering practice.

° The running and maintenance of marine machinery, 4th ed.
Various authors. London, Institute of marine engineers, 1955. 231p., diagrs., 17/3.

A completely rewritten edition of a standard British text intended both as an introduction to the subject for junior engineers and as a review of the best current practice for senior engineers. Various authorities have contributed the separate chapters which deal with boilers, fuel, steam reciprocating machinery, steam turbines, electrical machinery, diesel engines, refrigerating machinery, pumping arrangements, and steering gears.

Theory of games and linear programming.
S. Vajda. London, Methuen, Toronto, British Book Service, 1956. 106p., $1.45.

In this account of a new branch of applied mathematics, based on algebraic concepts, only a fairly elementary knowledge of algebra and linear analytic geometry is assumed.

The argument is developed from first principles, the first three chapters covering the theory of games and its connection with linear programming. This latter has drawn its stimulus from problems in economics, and deals with problems which cannot be solved by methods of calculus.

Examples worked out in detail are given of situations where linear programming methods have proved useful. There is also a bibliography of some thirty-one references on the subject.

Transistors I
Princeton, RCA laboratories, 1956. 676p., illus., $4.70 (U.S.)

Of the forty-one papers by members of the RCA staff in this volume, thirty-one have not previously been published. The Corporation decided to issue this compilation in order to make known recent research and development work on semiconductors, transistors and their applications.

There are two introductory papers, and the remainder are divided into five groups: materials and techniques; devices; fluctuation noise; test and measurement equipment; and applications. To complete the picture, there are abstracts of forty-six papers already published in technical periodicals.

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

Aircraft

Safety through steep gradient aircraft. R. M. Woodham. (Guggenheim aviation safety center at Cornell University)

Concrete

Cracking in reinforced concrete flexural members. A. P. Clark. (American iron and steel institute)

• LIBRARY NOTES

Investigation of the moisture - volume stability of concrete masonry units. J. J. Shideler (Portland cement assoc. Bull. D3)

Method for determining the moisture conditions of hardened concrete in terms of relative humidity. C. A. Menzel. (Portland cement assoc. Bull. D4)

Nature of bond in pre-tensioned prestressed concrete (and discussion) J. R. Janney. (Portland cement assoc. Bulls. D2 and D2A)

Education

Engineering enrollments and degrees, 1955. (U.S. Office of education)

Report on American methods of training in industrial engineering and management in universities and industrial plants. T. B. Worth.

Study of technology as a branch of education. C. W. Dannatt. (Institution of mining and metallurgy)

Electrical engineering

Application of the disperion test to the drying of high voltage transformers. D. C. G. Smith. (E.R.A. V/T123)

Canada. Second annual electric power survey of capability and load, March, 1956. (Dominion bureau of statistics)

Flameproof electrical apparatus: flanged joints, one inch in radial breadth, in mixtures of acetone, vapour and air. T. J. A. Brown and N. Simpson. (E.R.A. G/T305)

Recommended practice for electrical installations in caravans. (Institution of electrical engineers)

Stray load losses in a.c. rotating machinery. A review of the state of the art. K. C. Mukherji. (E.R.A. Z/T102)

Engineering

Engineering and enterprise. L. K. Sillcox (Toronto University. Eighth Wallberg lecture, 1955)

Fire protection

Standards for the installation, maintenance and use of first aid fire appliances. (Dominion board of insurance underwriters)

Standards for the installation of sprinkler systems. (Dominion board of insurance underwriters)

Hydraulic laboratories

The six-inch water tunnel at the St. Anthony Falls hydraulic laboratory and its experimental use in cavitation design studies. L. G. Straub and others. (Minnesota. University)

Mining and metallurgy

Basic effects of environment on the strength, scaling and embrittlement of metals at high temperatures. (A.S.T.M. s.t.p. no. 171)

Direct-reading charts for the design of welded aluminum-alloy vessels under external pressure. Marshall Holt. (Aluminum research laboratories. Tech. pa. no. 11)

The mechanical properties of wrought phosphor bronze alloys. G. R. Gohn and others. (A.S.T.M. s.t.p. No. 183)

The Mining Journal, annual review, 1956.

Straightline column formulas for aluminium alloys. H. N. Hill and J. W. Clark. (Aluminum research laboratories. Tech. pa. no. 12)

Weights and measures

Units of systems of weights and measures: their origin, development and present status. (U.S. National bureau of standards. Circular no. 570)

Miscellaneous

Administrative intelligence; our greatest need for good success. T. G. Spates. (California institute of technology)

Phenomenological treatment of ferroelectricity and antiferroelectricity in $NaNbO_3$. L. E. Cross. (E.R.A. L/T 345)

• LIBRARY NOTES

Photoelastic and experimental analog procedures. W. T. Moody and H. B. Phillips. (U.S. Bureau of reclamation. Engineering monograph no. 23)

Water sorption in heat-treated polystyrene and plasticised polyvinyl chloride. A. G. Day. (E.R.A. L/T344)

Winter construction. (N.R.C. Div. of building research. Better building bulletin No. 6)

STANDARDS REVIEWED

British Standards, British standards institution, 3 Park St., London W. 1. Also available from the Canadian standards association.

The following British Standards have been received:

2A.102—Steel bolts (Unified hexagons and Unified threads) for aircraft. **6/-.**

2A.103—Steel nuts (Unified hexagons and Unified Threads) (ordinary thin, slotted and castle) for aircraft. **3/-.**

2A.104—Corrosion-resisting steel bolts (Unified hexagons and Unified threads) for aircraft. **5/-.**

2A.105—Corrosion-resisting steel nuts (Unified hexagons and Unified threads) (ordinary, thin, slotted and castle) for aircraft. **3/-.**

2A.107—Aluminum alloy nuts (Unified hexagons and Unified threads) (ordinary and slotted) for aircraft. **2/6.**

2A.108—Steel bolts (Unified hexagons, Unified threads and close tolerance shanks) for aircraft. **5/-.**

2A.111—Cadmium plated seel bolts (Unified hexagons, Unified threads and close tolerance shanks) for aircraft. **5/-.**

2A.113—Steel mushroom head bolts (Unified threads) for aircraft. **4/-.**

2A.114—Corrosion-resisting steel mushroom head bolts (Unified theads) for aircraft. **4/.**

2A.169—Aluminum alloy bolts (Unified hexagons and Unified threads) for aircraft. **5/-.**

2A.170—Aluminum alloy mushroom head bolts (Unified threads) for aircraft. **3/-.**

2.G.113—British standard for manifold pressure gauges for aircraft. **2/-.**

S.P.115 to 117—British standard for hydraulic surface-check type lubricating nipples for aircraft. **3/-.**

Canadian standards, Canadian association, National research building, Ottawa.

HC66—1956—Seamless copper water tube and drainage tube.

This third edition replaces the second published in 1950. It covers seamless copper tube especially designed for plumbing purposes, underground water services, drainage, etc., but also suitable for copper coil water heaters, fuel oil lines, gas lines, etc.

As with the first edition, this specification was prepared as a National Standard to which reference could be made in the plumbing and heating section of the National Building Code. The third edition includes further revisions to bring this Specification into substantial agreement with current American practice and to add certain drainage tube sizes which have now been adopted. 3rd ed. $1.00

0132.1-1956—Wood sash and screen frames.

"This Specification covers the requirements for materials and construction of wood sash, and screen frames. It sets forth the quality and species of lumber which may be used, minimum construction requirements, preservative treatment, glazing requirements, certification, marking and inspection, and shows standard opening sizes and designs of pairs of sash, single sash, storm sash, and screen frames." 50 cents

The following Canadian standards have also been received:—

Canadian electrical code, Part II, essential requirements and minimum standards covering electrical equipment.

C22.2 No. 0—1956—Definitions and general requirements, 4th ed. **75 cents.**

C22.2 No. 3—1955—Construction and test of electrical equipment for oil-burning apparatus, 3rd ed. **$1.00.**

C22.2 No. 29—1955—Construction and test of panelboards and panelboard enclosures, 2nd ed. **$1.25.**

C22.2 No. 52-1955 — Construction and test of service-entrance cables, 2nd ed. **$1.25.**

C22.2 No. 57—1956—Construction and test of pull-off plugs for electro-thermal appliances, 2nd ed. **$1.00.**

C22.2 No. 81—1956—Construction and test of electric flat-irons. **$1.00.**

Business and Industrial Briefs

A DIGEST
OF INFORMATION
RECEIVED BY
THE EDITOR

Appointments and Transfers

C.G.E. Manager in Ottawa—C. A. Morrison, vice-president, Canadian General Electric Co. Ltd., announces the appointment of Archie M. Doyle as manager of the company's district office in Ottawa, succeeding Gilbert J. Doane who has retired after 37 years in that position.

Shell Oil Appointment — A. L. Wilson, vice-president, marketing, Shell Oil Company of Canada Limited, has announced the appointment of J. M. Boyd as his executive assistant, Mr. Boyd will be succeeded as manager, head office marketing operations, by H. L. Hinchcliffe.

Standard Wire and Cable—Edmund S. Rose, president of Standard Wire and Cable Limited announces the appointments of Donald A. Campbell as secretary-treasurer; G. V. Taylor, plant manager; G. W. Vogan, sales manager.

W. S. Kirkpatrick

Cominco Officers — The Consolidated Mining and Smelting Company of Canada Limited announce the appointment of W. S. Kirkpatrick as executive vice-president, and of R. D. Perry as a vice-president.

Canadian Arsenals Limited — The appointment of G. W. Hunter, assistant deputy minister of the Department of Defence Production, as a director of Canadian Arsenals Limited, has been announced by the Right Honourable C. D. Howe, Minister of Defence Production.

Canadian Vickers Board Changes—At the first annual meeting since Vickers Limited, of England, took over control of Canadian Vickers Limited, certain changes in the board of the Canadian company were announced. New directors are: The Viscount Knollys, board chairman of the British firm; Maj.-Gen. C. A. L. Dunphie, chairman of Vickers-Armstrong Limited; Lewis J-B. Forbes, president of Pilkington Bros. (Canada) Ltd.; and J. B. Hatcher, secretary of Canadian Vickers Limited. Re-elected to the board were: O. H. Barrett, president; F. H. Brown; C. L. Dewar; R. M. P. Hamilton; J. Edouard Labelle, chairman of the board; R. K. McConnell; and Jean Raymond.

Canadian Aero Service — Michael S. Reford is appointed geophysicist for Canadian Aero Service Limited, Ottawa.

R. D. Perry

Copper Mill Appointment — J. P. Sutcliffe is appointed plant manager of the Western Copper Mills Ltd. plant in Vancouver, according to Richard M. Reiner, president and managing director.

Canadian Locomotive Directors — New directors elected to the board of Canadian Locomotive Company are G. O. Saunders, M.E.I.C., vice-president, manufacturing; G. R. Wyer, executive vice-president, The Canadian Fairbanks-Morse Co. Ltd.; and William B. Morse, Fairbanks, Morse & Co., Chicago.

T. J. Bell

Fiberglas Canada President — W. E. Phillips, vice-chairman, Fiberglas Canada Limited, has announced the appointment of T. J. Bell as president of the company. Mr. Bell was made executive vice-president last August.

Dominion Bridge Head Office—Recently announced are four new appointments all as assistant to the vice-president and managing director, to the head office staff of Dominion Bridge Company Limited. These are: Ernest A. Ford, M.E.I.C.; Palmer E. Savage, M.E.I.C.; MacKenzie McMurray, M.E.I.C.; and Robert J. A. Fricker. All were previously senior officials in their respective divisional headquarters.

Canadian Westinghouse Changes—Four new departments within the industrial products division of Canadian Westinghouse Company Limited are announced. Associated new appointments are: W. A. Eskil, manager, industrial control and panelboard; Stanley Thurgar, manager, distribution apparatus; T. B. Lounsbury, JR.E.I.C., manager, meters, instruments and relays. Manager of the small motors department is to be announced later.

General Motors Diesel—Staff changes announced by General Motors Diesel Limited include: A. G. Shugg, district manager in Vancouver for diesel engine sales; N. D. Love, engine distribution manager at London, Ont., for engine sales; G. M. Lynch, district service engineer for the territory British Columbia to the Manitoba-Ontario border.

● BRIEFS

Dominion Chain Officers — Officers of Dominion Chain Company Limited announced at the recent annual meeting are: W. F. Wheeler, chairman; F. C. Cullimore, president and general manager; C. N. Johns, vice-president; J. R. Hamilton, secretary and treasurer.

Canada Iron Group — Recent appointments within Canada Iron Foundries Limited include: W. A. Marshall, M.E.I.C., president of Dominion Structural Steel Limited, a director; G. D. Turnbull, P. M. Draper, and J. E. Rehder, vice-presidents; S. A. Williams, special assistant to the president.

Among other companies of the Canada Iron group: C. D. Marshall and H. N. Magnan become directors of Disher Steel Construction Company Limited, and W. J. H. Disher, president of that company, is made a director of Dominion Structural Steel Limited.

New Equipment and Developments

Radio and Television — Canadian General Electric Company has recently introduced several new items of equipment in the fields of radio and television broadcasting. A simplified and improved 50,000-watt broadcast transmitter for AM radio stations uses germanium rectifiers for high-voltage power supply and reduced tube requirements, using only 13 tubes against the 40-odd in existing units.

A new television broadcast transmitter, available in the last quarter of 1956, will enable prospective VHF broadcasters to take advantage of low power TV channel allocations. Equipment for the 400-watt transmitter will be in packages, and can operate unattended directly from network or with facilities of a key network production centre. Another new line is the "Ultracon" remote control equipment, designed for the unattended operation of television broadcast transmitters. The company's tube department has a new line of television receiving tubes which will reduce series-string heater power 25 per cent, drawing 450 ma. heater current, and designed for portable receivers.

Direct Link to Europe — Canadian Overseas Telecommunication Corporation inaugurated in May a new direct high-speed radio telegraph link between Quebec City and Paris.

Radioisotopes at C.N.E. — The use which Britain is making of radioactive isotopes for industrial purposes will be one of the features of the United Kingdom stand at the Canadian National Exhibition, at Toronto, 24 Aug. to 8 Sep. Four display panels will show some of the industrial applications. One will show the use of radioisotopes for radiography of castings and other parts; all welds in Britain's current nuclear power station construction are checked by this method.

The second panel will show how leaks in oil and water pipes are detected by filling the pipe with an active solution under pressure, flushing out, and checking for residual radioactivity which will be found where the solution has leaked out. The third application has been used to reduce the cost of dredging estuaries and harbours by tracing tidal movements with active isotopes dropped into the water. This has been used by the Port of London Authority. Finally, thickness gauging will be shown — a technique already quite widely used in Canada.

A model of the nuclear power station at Calder Hall, Cumberland, will also be on display.

Dominion Electrohome Industries Limited, of Kitchener has announced an engineering scholarship for a graduate of the Kitchener-Waterloo Collegiate and Vocational School. The Electrohome Electronics Award is to be available this year and will amount to $1,600 on the basis of $600 for the first year, $400 for the second year, and $300 in each of the third and fourth years. The company wish to encourage students to study radio physics, electrical engineering, engineering physics or physics with electronics option at a Canadian university. The scholarship winner will be selected by both the company and the Scholarship Committee. In announcing the scholarship award to the students of the school the company stated they hoped this gesture would lead other firms to awarding scholarships which would help alleviate the national problem of a shortage of personnel with engineering training.

Telephone answered automatically — Pye Canada Ltd. has announced its telephone answering machine, an instrument designed to answer a telephone automatically in the absence of a subscriber. This instrument answers the calls with a recorded message of up to 50 seconds duration then records the caller's message which can be as long as three minutes. On completion of the recording, the line is cleared automatically. Total recording time is one hour and automatic erasion allows the recording tape to be used indefinitely. Should insufficient recording time remain available, the machine will not answer the caller, avoiding partially recorded calls.

During playback, the machine is disconnected from the line and recorded messages are reproduced via a loudspeaker or headset. A wide range of recording levels can be reproduced successfully to cover local and long distance calls. The machine operates from normal a.c. mains; 100-150 or 200-250 volts 40/60 cps.

High Temperature Alloys — Two new high temperature alloys for aircraft and industrial gas turbine applications are announced by the International Nickel Company. The first, Inconel "700" age-hardenable nickel-cobalt-chromium alloy, contains approximately 50 per cent nickel and 30 per cent cobalt. This modification of Inconel "X" was developed for air-

craft designers who were seeking adequate strength for forged aircraft gas turbine blades at temperatures up to 1650 deg. F. A metal was required that could be operated at a working temperature approximately 150 deg. F. higher than the Inconel "X" alloy. The mechanical properties of the Inconel "700" alloy at 1650 deg. F. are very similar to those of Inconel "X" at 1500 deg. F. The second new product, Incoloy "901" nickel-iron-chromium alloy, has been developed for use in aircraft and industrial gas turbines for those components requiring high creep and rupture strength in the temperature range of 1000 deg. to 1400 deg. F. An important physical property of the new alloy is its low co-efficient of thermal expansion. Containing approximately 40 per cent nickel, it is close enough to ferritic alloy steels to permit the two materials to be joined without special provision for thermal expansion. Incoloy "901" is expected to find wide application for use in turbine rotor and compressor discs and structural parts calling for an intermediate temperature range of 1000 to 1400 deg. F.

Canadian Machines for U.S.– A battery of four special purpose bearing-torque machines is nearing completion at the Toronto plant of Standard-Modern Tool Company Limited for one of the leading automobile manufacturers in Detroit. Each multi-station machine automatically pre-loads and torque tests the bearing lock nut of the pinion shaft in an automobile rear end assembly. Narrow torque limits are 18 to 24 in.-lb. The machine tightens the lock nut, then checks the pre-load torque on tapered roller bearings during a 5-second run-in period. Three stations on the continually rotating machine turn out 240 assemblies per hour, or one every 15 seconds.

Change of Location – Head office and manufacturing facilities of Micanite Canada, Ltd., recent acquisition of Minnesota Mining and Manufacturing Company, have been moved from their former location at Granby, P.Q. to the 3M plant at London, Ont.

Rotary Unscrambler – The Line-O-Flex rotary unscrambling table is designed to unscramble cylindrical containers such as bottles, jars, and cans. This unit is usually installed as the first operation on production lines for single lane transfer to washers or cleaners, fillers, cappers and labellers. Available in 3 standard sizes to suit any discharge angle, and speeds up to 200 per minute. Accumulating table similar to the unscrambler is available. Both these machines are designed and manufactured by Specialty Manufacturing & Distributing Co. Ltd., Toronto.

Hydraulic Oil Coolers—A line of air type and water type oil coolers for industrial hydraulic systems is now available from Vickers-Sperry of Canada Limited. The coolers feature a high rate of heat transfer per unit of space occupied. Designated Series OCW, Vickers water type oil coolers are available in single unit sizes for oil flows up to 100 g.p.m. and for continuous power removals up to 37 h.p. (based on 85 deg. F. entering water temperature). Greater requirements can be met with two smaller coolers of equal size used in parallel.

New Plant – The Packard Electric Company Limited, of St. Catharines, Ont., is to build a plant at Three Rivers, Quebec, at an estimated cost of $225,000 for the manufacture of transformers and watthour meters. The plant is expected to start production early in the fall.

Industrial Fans—A new line of industrial fans designed for high efficiency is now available from Canadian Sirocco Company, Ltd. Designated series 106, the new standard industrial fans are available in sizes 11 through 37 with adjustable discharge in V-belt driven arrangements 1 and 9 for the full range, and in direct-connected arrangements 4 and 8 for limited sizes. Series 106 fan sizes 11 through 37 permit a choice of three types of wheels: AH (air handling), MH (material handling) and LS (long shavings). In sizes 41 through 60, the new units are available with fixed discharge in arrangement 1 with choice of two types of bearing supports. Series 106 fans sizes 41 through 60 can be obtained with either of two types of wheels, AH or MH.

The new series 106 packaged industrial fan, a modification of arrangement 9, is a completely self-contained unit, eliminating the need for a separate motor foundation and minimizing floor area requirement. Packaged industrial fans are available in sizes 11 through 26 with adjustable discharge housings. MH wheels only are standard with the new packaged units; AH or LS wheels can be furnished on special order.

Safety Awards – For the first time a single Canadian company has won both first prizes awarded by the National Safety Council for outstanding safety records in the wood preserving industry in North America. Canada Creosoting Company Limited, a subsidiary of Dominion Tar & Chemical Company, Limited, won the award for plants operating more than 60,000 hours and also for plants operating less than 60,000 hours during the year 1955. The first award was won by the Delson, Quebec, plant, the second by the North Vancouver plant. The awards were made for a complete accident-free year. Four other awards were won by other subsidiaries of Dominion Tar & Chemical Company, Limited, making a total of six National Safety Council awards won by this company for 1955.

Air Conditioning Units – A new line of complete central-station, cabinet-type air conditioning units for industrial and commercial applications is now available from Canadian Sirocco Company, Ltd. Capacity range in all types is from 600 to 48,000 cu. ft. per minute. Three basic types of units are included: (1) air conditioning units, (2) sprayed coil conditioner units and (3) multi-zone conditioner units. The air conditioning and sprayed coil conditioning units are available as either horizontal or space-saving vertical arrangements, both with horizontal air flow through the cooling coils. Multi-zone conditioner units are made in one arrangement for either horizontal or vertical air flow. Manual or automatic controls can be provided for temperature, multi-zone or ventilation control.

Plant Expansion — J. Gilchrist, managing director of Ex-Cell-O Corporation of Canada, Limited, announces that a $200,000 administration and engineering building is to be erected at their plant in London, Ont.

Portable Cutting Machine — Canadian Liquid Air announce the introduction of a new, lightweight, portable and inexpensive motor-driven cutting machine, known as the L. A. Handicutter. Weighing only 16 lb., the Handicutter easily performs the tasks met with in the general repair shop or plant. It cuts steel from ⅛ in. to 4 in. in thickness, in straight line, square (90 deg.) or bevelled (plus or minus 45 deg.); and circles from 1½ in. to 45 in. in diameter. A limited degree of hand-guided cutting for slow curves and single irregular outlines may also be performed.

Turbine for Laurie River – Sherritt Gordin Mines Limited have ordered a 7000 h.p. water turbine from the English Electric Company of Canada for installation on the Laurie River in Manitoba. one hundred miles north of Sherridon. The unit is a vertical shaft reaction (Francis) turbine and has an operating net rated head of 55 ft. The rate output is 7000 b.h.p. with an operating speed of 163.6 r.p.m. The turbine is to be built for English Electric by its associate company, John Inglis Co., Toronto, and delivery is planned for early 1957.

"Packaged" Program on Concrete – The Master Builders Co. Limited has announced an informative "packaged" program on concrete that should be of interest to program chairmen. Comprising two short coloured films with sound together with the services of a qualified speaker for a following question and answer period, the program runs between 1½ and 2 hours.

The first film produced by the American Concrete Institute in conjunction with the Portland Cement Association is entitled "Placing, Finishing and Curing Quality Concrete". The second entitled "The Man With The Trowel" deals with the problems of controlling the variables that affect not only the quality but also the cost of concrete in place. The question and answer session is directed towards answering questions related to specific field problems.

Bookings are now being made for fall and winter meetings and interested program chairmen should communicate with The Master Builders Co. Limited, 95 Ingram Drive, Toronto, Ont. Telephone Cherry 1-8641.

Mould Release Emulsion – An improved silicone mould release emulsion, designed to give finer surface detail, better surface finish, and greater economy in emulsion system operation, is available from Canadian General Electric's chemical materials section. It is designated as SM-62 in the department's product line. Product data sheets may be obtained by writing to Chemical Materials Sales, Canadian General Electric Co. Ltd., 1601 Davenport Road, Toronto.

Copper for Electrical Conductors — Information on the electrical properties and uses of copper and copper alloys, bus conductor shapes, wire, cable, and conduit, and special shapes, is given in Publication C-25, which is comprehensively illustrated with pictures, diagrams, and tables. The publication is obtainable from Anaconda Brass Limited, New Toronto, Ont.

British Aluminum Contracts—Canadian British Aluminium Company has awarded the contract for construction of its new aluminum smelter at Baie Comeau, P.Q., to Anglin-Norcross Corp. Ltd., and Atlas Construction Co. Ltd., as announced by P. T. Ensor, general manager. Construction is to proceed in two stages. The first is to be completed in the fall of 1957, and the second at the end of 1958.

Stage I will comprise two furnace rooms (pot rooms), each of which will have two furnace lines (pot lines). The furnace rooms will each be 1710 feet long and 78½ feet wide, with an elevated operational floor about 10 feet above yard level. Other buildings to be built, he said, include a rectifier house, casting shop, workshop and furnace lining building, a boiler and compressor house and a carbon factory. There will also be alumina and coke silos, a laboratory and an office building. The schedule calls for power to be connected with the stage I furnaces in November, 1957.

Stage II, to be finished in 1958, will add two more furnace rooms of the same capacity, more alumina and coke silos, and necessary extensions to the rectifier house and casting shop.

Hydro Standardization — Quebec Hydro-Electric Commission have awarded a contract to the Canadian Westinghouse Company for frequency standardization at Beauharnois station No. 1. The order calls for one 150,000/200,000 kva., 3-phase, 60-cycle, 230/120 kv., 55 deg. C. rise, type ONS/ONP, surge protected auto-transformer. This transformer is equipped with on-load tap changing equipment in the LV winding.

In addition, the company will supply six 50,000 kva., type OFW outdoor surge protected step-up transformers 120/13.8 kv., and sixteen 138 kv. oil circuit breakers with a 5000 Mva interrupting capacity, and 3 cycle interrupting time.

Another frequency conversion job is a contract to rebuild the generators at the Masson station of the McLaren Quebec Power Company.

It calls for the conversion and replacement of all parts needed to convert four 2000 kva. waterwheel generators for 60 cycle operation.

Wide Band Modulator — A wide band modulator, the FR-1, has been introduced by the telecommunications engineering department of the Canadian Westinghouse Company. It produces an I.F. signal in a frequency range between 5 and 100 Mc/s. This signal can be frequency-modulated with modulating frequencies of 10 kc/s - 5000 kc/s, to produce an r.m.s. deviation of 8 Mc/s. For a typical deviation of 1 Mc/s, both the second and third harmonic distortions are of the order of 60 db. It can also be used as a low distortion driver and modulator for a wide band communication system, by heterodyning the output up to any R.F. carrrier frequency.

Change of Address.—The Toronto office of Spartan Air Services Limited and Canadian Aero Service Limited is now at 347 Bay St. (Empire 6-2233).

New Headquarters.—The headquarters and Montreal division office of Racey, MacCallum and Associates Limited has moved to the Professional Arts Building, 5890 Monkland Ave., Montreal (Hunter 9-4941).

Tool Company Purchase.—It is announced in a joint statement that Remington Arms Company, Inc., Bridgeport, Conn., has entered into an agreement to purchase the Mall Tool Company, of Chicago; this agreement includes the Canadian subsidiary, Mall Tool Limited, of Toronto.

Company Merger.—Effective July 1, 1956, Standard Sanitary and Dominion Radiator Limited changed its name to American-Standard Products (Canada) Limited. Standard-Dominion is a leading Canadian manufacturer of plumbing and heating products and is a subsidiary of American-Radiator & Standard Sanitary Corporation, maker of American-Standard plumbing and heating products in the United States.

At the same time two other affiliated Canadian companies will become a part of American-Standard Products (Canada) Limited. These are Canadian Sirocco Company, Limited of Windsor, manufacturers of air handling and air conditioning equipment, and Kewanee-Ross of Canada Limited, Toronto, engaged in the industrial heat exchanger and steel boiler business. Their assets and business will be transferred to American-Standard Products (Canada) Limited, and will continue to produce and sell the same products as at present. American-Standard Products (Canada) Limited will have three plants in Toronto and one in Windsor, employing a total of 1800 people.

Clarence W. Johnson has been elected president of American-Standard Products (Canada) Limited. Mr. Johnson is now president of Canadian Sirocco. Other officers of American-Standard Products (Canada) Limited are George C. Crawford, chairman of the board; Albert O'B. Andrews, vice-president; Thomas B. Cooper, vice-president, secretary and treasurer; Arthur R. MacCallum, vice-president, comptroller; and Alex Pirrie, vice-president, manufacturing.

ENGINEERING CAREERS

The Electrical Industry

In this article the parts of the electrical industry to be considered are those concerned with the manufacture of heavy and light electrical equipment, instruments, telecommunication systems, and electronic devices, together with associated research and development facilities.

The electrical power industry, concerned with the production and distribution of hydro-electric, thermal, and nuclear power, will be dealt with in a subsequent article.

The electrical industry is not only of interest to electrical engineers, since design and development work, particularly in the heavy equipment field, has need of graduates in mechanical engineering and engineering physics.

Heavy Equipment

The heavy electrical industry is largely concerned with supplying the power facilities with generating and distributing equipment. For this and other industrial power requirements the items produced include generators and motors, transformers, rectifiers, capacitors, switchgear and fusegear, circuit breakers, and so on.

Another important operation is the manufacture of wire and cable.

Increasing demand for power supply and the growth of Canadian industry generally provide a large potential market for heavy electrical equipment. It is a highly competitive market, and Canadian electrical manufacturers are constantly trying to improve productivity to reduce the cost of the equipment. This calls for efficient engineering departments both for design and for production. For example, in the production of a large generator, components weighing several tons have to be machined and assembled, probably to a tight schedule. The production or industrial engineering department would be concerned with such problems as minimizing the handling operations involved.

In general, the heavy equipment industry requires engineers in design, production, development, and sales departments, and supervisory and management positions in these departments are often filled by engineers.

Apparatus Industry

The electrical industry also produces equipment and appliances for industrial and domestic use. These items are often mass-produced, again calling for production engineers. To meet a competitive market, design and productivity are important features.

Instrumentation and Control

Modern industry is turning more and more to automatic control, and new applications are constantly being found. Automatic control is at present probably most advanced in the process industries, such as petroleum and chemical, in which large and complex plants are run continuously by a few operators, often from a central control room.

Instruments are required for recording and controlling variables throughout the process, such as temperature, pressure, flow rates, and so on, and also to operate motors, pumps, valves, and other electrical and mechanical equipment by remote control.

Recording and control instruments are constantly being improved and developed to meet new applications, and there is considerable scope for the engineer in this side of the electrical industry.

Expansion in the field of electronics in recent years has been among the greatest for any industry. Part of one major electrical manufacturer's electronic engineering program is this analogue computer; one of the largest in Canada.

Telecommunications

From the early days of the telegraph, telecommunications have developed into a vast network, using the telephone, radio, and television. This represents a large industry, ranging from the manufacture of a trans-Atlantic cable to the design of an electronic circuit for a closed industrial television system.

Engineers are needed for the design and manufacture of telecommunication equipment, in which certain Canadian companies specialize, and are also required for the installation and maintenance of systems that are the province of the operating companies.

As an example of some of the work involved in this field, we would refer to the article "Microwave Radio Project of the Trans Canada Telephone System" in this issue of *The Engineering Journal.* This is a transcontinental project, but the industry is equally concerned with small internal comunications systems.

As with other manufacturing operations, design and production engineers are required for the equipment manufacturers' plants.

Electronics Industry

The so-called electronics industry, of which instrumentation and communication equipment may also be considered a part, has expanded enormously in the past ten or so years, mainly through the industrial application of developments made during the war years and the continued extension of military programs.

There has been a correspondingly great demand for electronic engineers, which is likely to continue for some time. This is to be expected, since the demand occasioned by a vast new industry, using new techniques and developing new applicaitons, has far outgrown the supply of graduates trained in the necessary principles.

Despite this intensive demand for the specialist electronics engineer and engineering physicist, the prospective graduate should not lose sight of the opportunities that exist in the broader fields of the electrical industry.

Automatic control and instrumentation of industrial processes has been mentioned above. Aviation, both civil and military, is developing rapidly and on a large scale. Aircraft instruments and navigational equipment are being widely developed by the electronics and electrical engineer, and this work is even more specialized in the field of guided missiles.

In many industrial fields there is considerable interest in the application of electronic computing devices, which are being developed on a considerable scale.

Behind all these developments, there lies a great amount of fundamental research work, in which the engineer plays a large part, together with the physicist and mathematician. This work is carried out by academic and pure research organizations and by industry.

The electronics industry, like other branches of the electrical industry, employs electrical, electronic and mechanical engineers, and engineering physicists, in departments of pure and applied research, design, production (manufacturing), and sales. There is also very good scope for the engineer to advance to management and executive positions.

At the opposite end of the scale from electronics is the heavy electrical equipment side of the industry. Here, a transformer coil is being clamped to size before drying and treatment.

Qualification and Training

For employment in an engineering department, most organizations in the electrical industry require the candidate to be a graduate engineer. Most companies also offer summer employment to undergraduates.

Training schemes vary in detail, but the recent graduate joining a company will have ample opportunity of further training to suit the particular needs of the industry he is entering. Courses may include on-the-job training, financial support for post-graduate courses, specialized technical training by the company, and facilities for attending special courses provided by external technical and management organizations.

Salary Scales and Benefits

For the graduate engineer in an engineering department, salary may range from about $4000 a year to $10,000 a year, according to age and experience, with higher salaries available to the man who progresses to management and executive positions.

Paid vacations are customary, and most companies offer pension and health benefits. In some cases bonuses are paid; for example, in certain field operations. Other benefits may include discounts on the purchase of company products.

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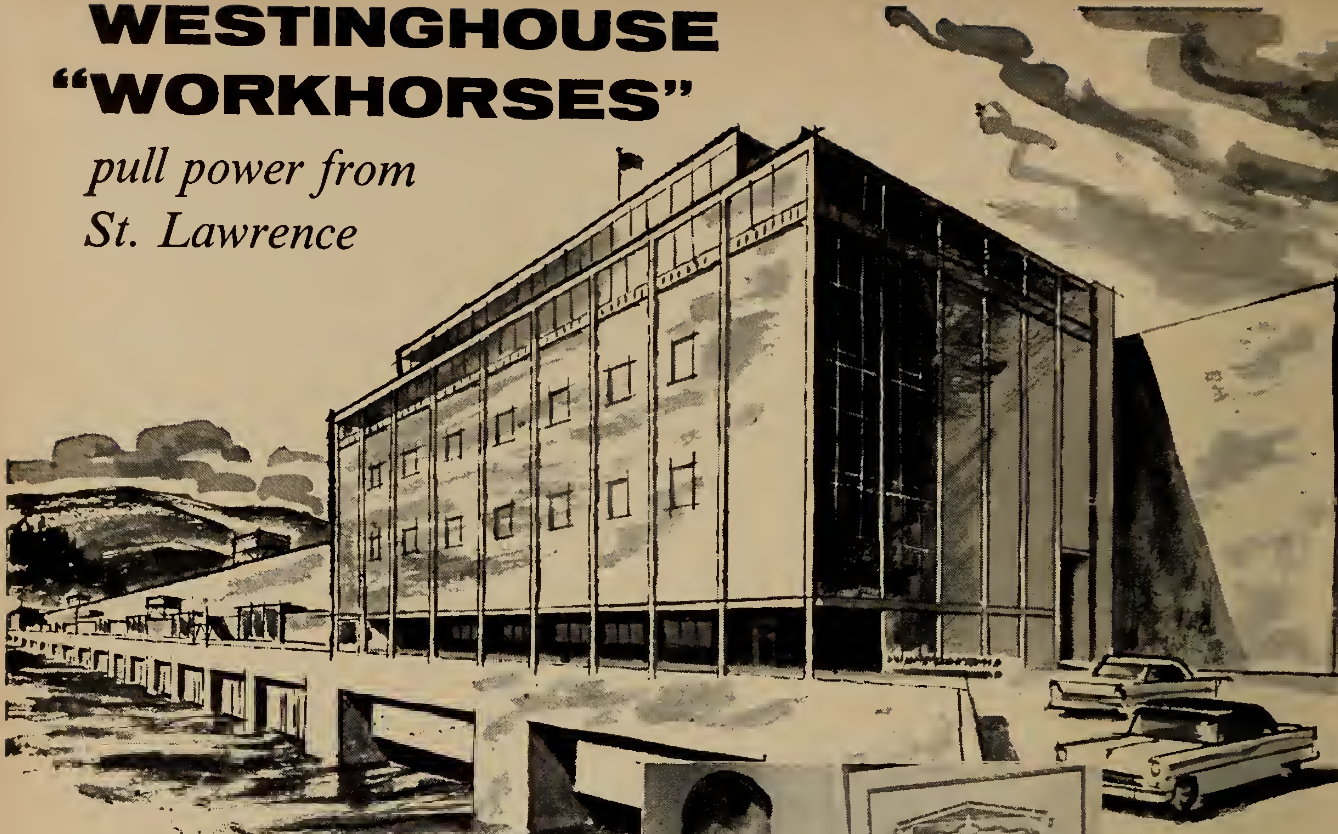
"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

Contents - September 1956

17,600 copies of this issue printed.

WESTINGHOUSE "WORKHORSES"

pull power from St. Lawrence



WESTINGHOUSE SUPPLIES GIANT GENERATING AND TRANSMISSION EQUIPMENT FOR VITAL ST. LAWRENCE POWER PROJECT

Model of giant outdoor geoerators, now being built by Westinghouse, will help feed 820,000 Kilowatts of new power to Ootario.

Mid-1960 will bring 820,000 Kilowatts of new Hydro power to Canadian homes and industries—vitally needed electricity from Ontario Hydro's mighty St. Lawrence Power Project.

Eight massive Westinghouse generators, each two storeys high, will handle half this giant power job. The project's entire output will pass through Westinghouse step-up transformers; and Westinghouse Jetaire circuit breakers help protect the multi-million dollar investment in heavy equipment.

More than half Canada's hydro power already comes from Westinghouse generating equipment. On the St. Lawrence, Westinghouse engineering skill and equipment will contribute still further to Canada's already highly electrical way of living.

Huge Westinghouse step-up transformers like this are now being built at Westinghouse for the St. Lawreoce Geoerating Station.

Arriving at the St. Lawrence Transformer Station, Westinghouse Jetaire circuit breakers will protect power equipment on the Hydro system.

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CANADA

THE ST. LAWRENCE SEAWAY AUTHORITY

OTTAWA, July 9th, 1956

OFFICE OF THE
PRESIDENT

Dear Doctor Wright,

The Engineering Journal has been bringing to its readers many good articles concerning the progress of works for the St. Lawrence Seaway and Power Project. The September issue, devoted to featuring the project and including the texts of several excellent papers concerning the work, should be of lasting interest to professional and lay reader alike.

This is an engineering project but furthermore it is a social achievement for the lasting good of the peoples of Canada, the United States and of many other countries throughout the world. To the completion of this monumental enterprise, an example of the power of man over the face of Nature, the engineer has been an essential and prime contributor.

At this time I wish to take the opportunity of commending the editors of the Engineering Journal on their careful coverage and particularly on the production of this record of the Seaway progress.

Yours sincerely,

Lionel Chevrier

Dr. L. Austin Wright, M.E.I.C.,
Editor - The Engineering Journal,
2050 Mansfield Street,
MONTREAL 2, P.Q.

Reproduced above is a letter received by The Engineering Journal from the Honourable Lionel Chevrier, President of the St. Lawrence Seaway Authority. When Mr. Chevrier heard that a special Seaway issue of the Journal was in preparation he kindly gave his endorsement in the thoughts expressed here.

An Historical Review of the Seaway

With particular reference to the contributions made by members of the Engineering Institute of Canada

IT MAY justly be claimed that the 'seaway', more properly termed "The Great-Lakes St. Lawrence Deep Waterway and Power Project", would never have become a reality were it not for the part played by many members of The Engineering Institute of Canada. No other great national undertaking has held such a prominent place in their dreams, or has absorbed so many hours of their time in the scientific studies of all its aspects, and finally in the planning, design, and in the carrying out of its construction.

Statesmen of the two participating nations, the United States and Canada, many members of Parliament, Congress, and two Senates, prominent jurists and members of the legal profession, public servants, scientists, statisticians, economists, publicists and many authors have all played their part in bringing the dream to reality. But to Canada's leading engineers is due the credit for first conceiving the idea of a 'deep waterway' and for their persistent efforts over some sixty years in finding the right solutions to the many physical and economic problems involved.

First Conceived a Century Ago

As early as 1825 the Honourable John Young, of Montreal, began agitation for a St. Lawrence Seaway, and this was supported in 1832 by a widely-publicized article "The Concise View on Inland Navigation of the Canadian Provinces". However, from the point of view of the engineer, probably the story of the "seaway"[1] ". . . has its beginning in the dreams of Thomas Coltrin Keefer, M.E.I.C., first president of the Canadian Society of Civil Engineers (1887), later The Engineering Institute of Canada. Born in Thorold, Ontario in 1821, throughout his life he insisted upon the mystic and indissoluble union of Canada with its parents, Great Britain and France. At eighteen he was an engineer upon the Erie canal; he soon returned to Canadian waterways, to become their protagonist

1 The Engineering Journal, 1954, Dec., p. 1637

and special pleader for the remainder of his long life. In 1845 he was chief engineer of the Ottawa River works, in charge of the log chutes and skidways which expedited the passage of timber to ports of lading.

"Eight years later he was Chief Harbour Commissioner of Montreal. But he never was chair-borne for very long at a time. Throughout the sixties and the seventies he planned and supervised scores of waterway projects, mostly for the improvement of traffic conditions upon the Canadian rivers. He became the Grand Old Man of Canadian Engineering and honours were heaped upon him, not only by Canada but also Great Britain and the United States. He died in 1915.

"The prolific period of his life lay between 1848 and 1863. In the former year he lost his job through a change of government. Whereupon he took up the pen; in a series of books and in scores of pamphlets, articles and addresses he hymned his devotion to the bounty of nature as revealed in Canadian lakes, streams and rivers. The St. Lawrence was to him a broad passage into the heart of a virgin continent, whose commerce sooner or later must take to the Seas.

"In so far as natural obstacles were concerned on the St. Lawrence system — falls, rapids, and portages— he had one sovereign remedy—to cut more and more canals, until there was uninterrupted navigation for a thousand miles to the west, so that the ships of all nations could pick up cargoes at every cove on the Great Lakes. He fought vehemently for this particular waterway. To his sorrow it never came to pass in his lifetime."

In 1895 the Governments of the United States and Canada created an international waterways commission called the International Commission, and instructed it to report on the feasibility of a deep channel from the Great Lakes to the sea. The Canadian commissioners, appointed on 30 November 1895, were O. A. Howland, chairman, T. C. Keefer, and Thomas Monro. The United States commissioners were Dr. James B. Angell, John E. Russell, and Lymen E. Cooley. The first joint meeting was held on 17 January, 1896.

Thomas Coltrin Keefer, first president of the Canadian Society of Civil Engineers (1887), which later became the Engineering Institute of Canada. He was a great protagonist of the Canadian waterways.

International Joint Commission Formed

In 1900 a board of engineers appointed by the U.S. Senate recommended to the President of the United States the construction of a canal of 21 ft. depth along the American side of the International section of the St. Lawrence. In December 1903, at the suggestion of the United States, the International Waterways Commission was established with three members each for the broad purpose of reporting upon the use and protection of the Great Lakes. Canadian members were James P. Mabee, K.C., W. F. King, M.E.I.C., Chief Dominion Astronomer. and Louis Coste, M.E.I.C.,

Mr. Mabee resigned on 21 November, 1905, and was succeeded by George C. Gibbons, K.C., (afterwards Sir George). Dr. King resigned in March, 1907, and was succeeded by William J. Stewart, Dominion Hydrographer, on 13 April, 1907.

The International Waterways Commission reported to the Governments of Canada and the United States from 1905 to 1913. The Commission's work covered studies on Niagara power, St. Lawrence power levels, the regulation of Lake Erie, the Chicago drainage canal, the St. Mary's River (Sault Ste. Marie), etc. The engineering and other reports filed with the two governments were the first reports ever prepared on boundary water disputes between the United States and Canada and pointed out the need for the adoption of definite principles to be followed by the two countries in settling these disputes.

During his period in office as chairman, Mr. Gibbons brought this view before the Prime Minister, Sir Wilfrid Laurier, and in due course at Sir Wilfrid's direction Mr. Gibbons conferred with James Bryce, then British Ambassador to the United States, on the matter. Subsequently the Hon. Elihu Root, Secretary of State of the United States, and Mr. Chandler P. Anderson, worked with Mr. Bryce and Mr. Gibbons in drafting various versions of what became the Boundary Waters Treaty of January 11, 1909. The International Joint Commission was established under Article VII of the Treaty of 1909 and the organization meeting was held in Washington in January, 1912. The first Canadian commissioners appointed in November, 1911 were Th. Chase Casgrain, K.C., Henry A. Powell K.C., and Charles A. Magrath, HON. M.E.I.C.

First Report of Joint Board

From 1909 until the end of World War I the subject of the Seaway received little public attention, though a number of commissions and boards in the United States made studies and reports on a deep waterway. On 21 January 1920 the Governments of the United States and Canada referred to the International

Joint Commission certain questions relating to the improvement of the St. Lawrence River between Lake Ontario and Montreal for navigation and power.

Included in the reference was a letter of instruction to the board of engineers created by the two governments to report to the Commission on the engineering features of the proposed improvements. Lt. Col. W. P. Wooten was appointed by the United States Government and W. A. Bowden was appointed by the Canadian Government. With competent staffs at their disposal these two engineers made a thorough study of the St. Lawrence River and in June 1921 made their report to the International Joint Commission.

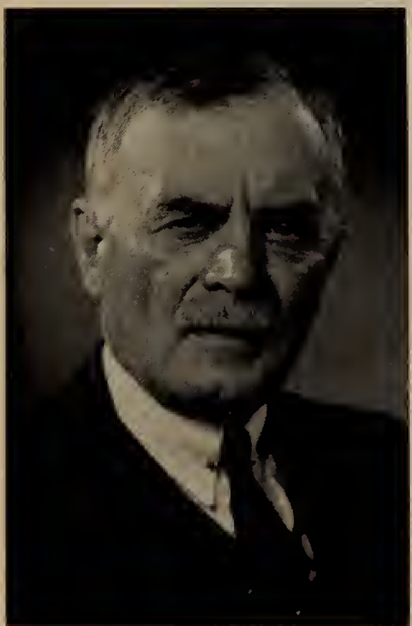
After holding extensive hearings and receiving many briefs on economic and other aspects of the project, the International Joint Commission on 19 December, 1921 replied to the various questions of the reference and recommended that a treaty be entered into between the governments of Canada and the United States for a scheme of improvement of the St. Lawrence River between Montreal and Lake Ontario. The commission also recommended that before any final decision was reached that the report of the board and other documents filed with the commission be referred back to the board enlarged by other leading members of the engineering profession. Canadian commissioners at this time were C. A. Magrath, HON. M.E.I.C., chairman, H. A. Powell, K.C., and Sir William H. Hearst. The secretary of the Canadian section was Lawrence J. Burpee.

The recommendation of the commission in regard to further studies was accepted and the Joint Board of Engineers was increased to six members. Those appointed for Canada were D. W. McLachlan, M.E.I.C., Department of Railways and Canals, Olivier O. Lefebvre, M.E.I.C., chief engineer, Quebec Streams Commission, and Brig. Gen. C. H. Mitchell, C.M.G., C.B., M.E.I.C., Maj. Gen. Edgar Jadwin, Col. William Kelly, and Lt. Col. George B. Pillsbury, all of the Corps of Engineers, U.S. Army, were the American members.

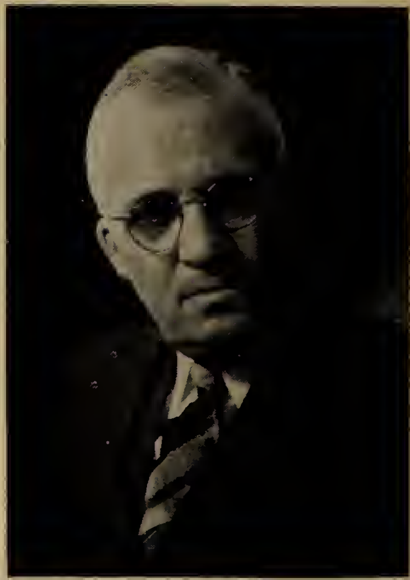
The Hon. G. P. Graham, Minister of Railways and Canals (Canada) was chairman of a National Advisory Committee appointed by the Government of Canada, and the Hon. Herbert Hoover, Secretary of Commerce (United States) was chairman of the United States St. Lawrence Commission. Both bodies studied the broader national aspects of the project.

A statement and engineering report on the development of power on the St. Lawrence river was submitted to the International Joint Commission in 1925 by the Hydro-Electric Power Commission of Ontario, whose chairman at the time was Sir Adam Beck; F. A. Gaby, M.E.I.C., was chief engineer, with H. G. Acres, M.E.I.C., as hydraulic engineer and R. S. Lea, M.E.I.C., as consultant. This report proposed three alternative schemes for development, giving estimated costs for each, and noting that extensive markets existed for power, gave the opinion that St. Lawrence power could produce energy at rates that were competitive and commercially attractive within radius of 300 miles.

General the Hon. A. G. L. McNaughton, M.E.I.C., chairman of the Canadian Section, International Joint Commission.



J. G. G. Kerry, M.E.I.C., made extensive studies of ice conditions and proposed a national power project and waterway.



Guy A. Lindsay

Report of 1926 and Treaty of 1932

In 1926 the Joint Board of Engineers submitted a comprehensive report, which may with justice be looked upon as the engineering corollary of the 1921 report of the International Joint Commission. It recommended a 25 ft. waterway (the Canadian majority favouring a 27-ft. depth) with a 30-ft. depth over the lock sills. In 1931 the board reconsidered these recommendations and revised its proposals to a 27-ft. depth. The board, which had raised the Wooten-Bowden estimates considerably after a two-year study, recommended that the new Welland canal be absorbed into the project, and set the probable cost of the whole project excluding interest charges for both power and navigation at some $850 million, about one-third of it payable by Canada and two-thirds by United States. The cost for power alone, they said, would reach $500 million. Annual charges on the Canadian share would be $9.6 million.

With a channel depth of 27 feet, they estimated the capacity of the waterway at 24,000,000 tons yearly after certain locks were "twinned". As of the year 1941, they estimated Canadian seaway traffic would amount to 7,675,000 tons, more than half of it grain and flour, on which the saving in transportation would amount to over $10 million yearly.

Tolls were discussed but no definite recommendation was given. Estimated length of the construction period was eight years and might take 16 years. The Canadian section favoured a two-stage development, in the International section of the St. Lawrence, while the American members preferred the single-stage.

A treaty between Canada and the United States, based on the 1926 report, was signed in July 1932, but failed of ratification by the U.S. Senate in 1934 after months of debate. This treaty had recommended the harnessing of 2,200,000 horsepower in the International section in two stages, one powerhouse at Chrysler Island and one at Barnhart Island. The cost would be divided equally between the two countries with credits allowed to each for any work previously done.

Other Developments on Seaway Route

Meantime, two projects which would ultimately form part of the completed seaway were being undertaken in Canada, namely, construction of the new Welland ship canal, and the development of power at Beauharnois in the Soulanges section. The former was being built by the Canadian Government, while the latter was undertaken by the Beauharnois Light Heat and Power Company with the proviso that the power canal would later be improved and deepened and widened to the dimensions necessary for use as a navigation channel for the Seaway.

Robert H. Saunders, chairman of Ontario Hydro from 1948 until his death in 1955.

The new Welland ship canal, fourth and largest of a series of four canals built in Canada to connect lakes Erie and Ontario, was commenced in 1913. Work was suspended in the fall of 1916 but was resumed after World War I and completed in 1932 at a capital cost of $130 million. The last eight miles of channel are now being deepened to 27 feet.

This new canal was designed by the Department of Railways and Canals at Ottawa, under W. A. Bowden, M.E.I.C., chief engineer. Dr. Alexander J. Grant, M.E.I.C., was engineer in charge of construction during the life of the project, with W. H. Sullivan, M.E.I.C., as principal assistant, and F. E. Sterns, M.E.I.C., in charge of designs. E. G. Cameron, M.E.I.C., was principal assistant during the later stages. Col. A. E. Dubuc, D.S.O., M.E.I.C., succeeded W. A. Bowden, M.E.I.C., as chief engineer in the mid twenties.

It was Mr. R. A. C. Henry, M.E.I.C., then chief engineer of Beauharnois Light, Heat and Power Company, who made the imaginative and far-sighted proposal that the difficulties of power development in the Soulanges section should be overcome by the construction of a canal between Lake St. Francis and Lake St. Louis to take the full flow of the St. Lawrence.

The Beauharnois development of the Beauharnois Light, Heat and Power Company, now owned and operated by Hydro-Quebec, is one of the largest plants in Canada with 1,350,000 hp. at present installed. When completed it will produce over two-million horsepower. Located in the Soulanges section, it was commenced in 1929. The power canal is 16 miles long and is now being dredged to a 27-foot depth throughout. Two locks are at present being installed by Canada's Seaway Authority. The initial development was designed by a board of consulting engineers composed of Dr. T. H. Hogg, M.E.I.C., W. S. Lea, M.E.I.C., and F. B. Brown, M.E.I.C., Construction was done under the direction of F. H. Cothran, M.E.I.C., vice-president and general manager, with D. F. Noyes, M.E.I.C., as superintendent and M. V. Sauer, M.E.I.C., as hydraulic engineer.

Two More Treaties Failed to Get U.S. Approval

In 1936 proposals for a new treaty were discussed with the United

R. A. C. Henry, M.E.I.C.

States, but without success. Following the request by the Hydro-Electric Power Commission of Ontario to divert additional Niagara water equivalent to the volume diverted from the Ogoki watershed into Lake Superior, negotiations were opened between the two countries, resulting in the establishment of a new joint board of Canadian and American engineers.

Representing Canada on this board were: Guy A. Lindsay, M.E.I.C., Dr. T. H. Hogg, M.E.I.C., Olivier O. Lefebvre, M.E.I.C., and M. C. Hendry, M.E.I.C. Representing the United States were Brig. Gen. T. H. Robins, U.S. Army, Roger B. McWhorter, and Gerald V. Cruse.

A Canada-U.S. agreement of March 19, 1941 was based on the report of this newly constituted joint board, presented in January of the same year. It called for the establishment and maintenance by both governments of a Great Lakes-St. Lawrence Basin Commission, which would prepare a combined project for navigation and power on the International section. Each government would have the obligation to carry out construction of various works within its own territory. The agreement bestowed exclusive right to the use of any waters diverted from any other watershed into the St. Lawrence Basin. The single-stage development for power in the International section was agreed upon.

The attack on Pearl Harbour on December 7, 1941 caused the seaway project to give way to more

The Hon. Lionel Chevrier, president of The St. Lawrence Seaway Authority.

urgent defence matters. Once the war was over, interest in the matter was resumed, but the U.S. Congress was not disposed to approve the agreement.

Engineering Studies Continued by Canada

During this period further study of the project, which had been proceeding under the direction of D. W. McLachlan, M.E.I.C., as engineer in charge, was transferred to a newly formed general engineering branch of the Federal Department of Transport at Ottawa. D. W. McLachlan, and later Guy Lindsay, M.E.I.C., were in charge of this work under the general direction of R. A. C. Henry, M.E.I.C., chairman, Air Transport Board, as consulting engineer. Concurrently the Hydro-Electric Power Commission of Ontario carried out further studies of the power aspects in the international section, under the successive direction of Dr. T. H. Hogg, M.E.I.C., Robert H. Saunders, and Dr. R. L. Hearn, M.E.I.C., as chairmen; with R. L. Hearn, M.E.I.C., as chief engineer and assistant chairman. Later Dr. Otto Holden, M.E.I.C., was appointed manager, engineering.

A board of engineers was appointed in September 1947 by the Canadian Government to determine whether the scheme for improvement of the Lachine section of the Seaway as recommended by the Joint Board of Engineers in 1926 was practical; what alternative schemes, if any, would be better adapted to the ends desired; and what would be the revised estimate of costs. Members were R. A. C. Henry, M.E.I.C., Dr. Arthur Surveyer, HON. M.E.I.C., Guy Lindsay, M.E.I.C., and C. W. West, M.E.I.C., director of canal services, Department of Transport.

With the co-operation of Hydro-Quebec, its manager René Dupuis, M.E.I.C., and its chief engineer, F. P. Rousseau, M.E.I.C., this board made exhaustive studies of several alternatives in the Lachine section. Their report in October, 1948, stated that the scheme for navigation alone prepared by Guy Lindsay, M.E.I.C., of the Department of Transport was the most suitable, the cost of which was estimated at $87,300,000.

For combined navigation and power the report proposed a navigation channel on the south side of Laprairie basin and along the south shore of the St. Lawrence opposite the port of Montreal, a dam and a powerhouse at alternative locations below Victoria bridge, built to develop 1,200,000 horsepower, with retention of Victoria bridge. The total cost was estimated at $256 million with an additional $19 million if the bridge was replaced by a tunnel. With the powerhouse located at an alternative location 3500 feet below the bridge the estimated cost would be $266.3 million.

Canadian Government Report of 1949

A report was issued by the Department of Transport in Ottawa in June 1949 on the entire Seaway project. This report proposed dredging navigation channels to a depth of 27 feet from Prescott to Montreal, as well as the balance of the channel through the Welland ship canal. It advocated adoption of a controlled single-stage project as agreed upon between Canada and United States representatives in 1940, with an installed capacity in the International section of 2,200,000 h.p.

It also proposed a control dam at Iroquois and a dam at the Long Sault rapids, built on the American side, as well as a navigation channel on the American side with two locks; rehabilitation of the towns of Iroquois and Morrisburg; deepening of the Beauharnois canal and provision for two locks thereon; and improvement of the navigation channel in the Lachine section by Canada as recommended in the 1948 report.

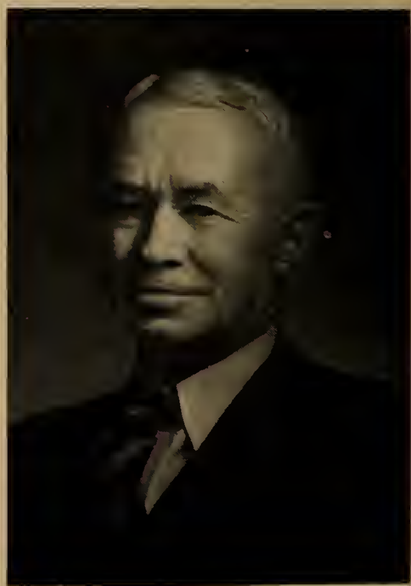
The estimated cost of completion, based on improvement of the Lachine section for navigation only, was given as $336 million for Canada and $470 million for the United States, a total of $806 million. These figures inluded work to be done by the United States in the Upper Lake section, as well as all monies already spent by both countries both there and on the Welland ship canal and in the Thousand Islands section.

Canada Proposes all-Canadian Seaway

Up to this time the proposal for the completion of the St. Lawrence "Seaway" had been based on the conception that these facilities would be toll free. However, in the 1940's the idea that the Seaway should be self-supporting had gained a wide measure of acceptance since it was evident that both in the power and navigation aspects, the St. Lawrence project could be organized on a self-liquidating basis.

In 1950, despite the support of President Truman, the 81st Congress, hindered by the U.S. Senate's reluctance, adjourned without approving the agreement of 1941. The Canadian Government, anxious to get the project started, then notified the United States that, if need be, Canada would undertake the navigation part of the project alone and bear the whole cost, subject to tolls to defray charges for operation, maintenance and amortisation. In this proposal the power works in the International section would be constructed at the cost and for the benefit of the Hydro-Electric Power Commission of Ontario and of an 'entity' to

Dr. Richard L. Hearn, M.E.I.C., who has been chairman of the Hydro-Electric Power Commission of Ontario since 1955.



be named by the Government of the United States.

In 1951 the Canadian Parliament at Ottawa passed the St. Lawrence Seaway Act, setting up a St. Lawrence Seaway Authority to undertake the work, to be composed of three members, whose mission was to carry on the necessary construction for the navigation portion of the project, locating the channel entirely through Canadian territory. The staff of the general engineering branch of the Department of Transport was moved to Montreal in 1953.

Until 1948 intensive efforts had been made to obtain Congressional approval of a combined power and Seaway project. In 1948, however, New York State applied to the U.S. Federal Power Commission for a power licence separate from the Seaway, believing this course could more quickly resolve both projects. This was blocked by the United States authorities until 1952 because of continuing efforts to obtain approval of the combined seaway-power project.

Applications to IJC, 1952

Under date of 30 June 1952 the International Joint Commission received the applications of the Governments of Canada and of the United States for an order of approval of the construction of certain works for development of power in the International Rapids section of the St. Lawrence River. Extensive public hearings were held by the Commission at cities and towns on the St. Lawrence River and on Lake Ontario in Canada and the United States.

The Commission issued an order of approval of the power project on 29 October 1952 in Montreal. This project was to be carried out by the Hydro-Electric Power Commission of Ontario and an 'entity' to be named by the Government of the United States. The conditions of the order provided that the works to be constructed by the power entities would assist and facilitate the addition of the works required for navigation.

The order also provided for the coordination of design and construction in the International section by an International St. Lawrence River Board of Engineers and most importantly for the regulation of the St. Lawrence on the completion of the project by the International St. Lawrence River Board of Control established by and responsible to the International Joint Commission.

Members of the Canadian Section, International Joint Commission at this time, who had been closely associated with Seaway negotiations over the past several years were General the Hon. A. G. L. McNaughton, M.E.I.C., Colonel J. Lucien Dansereau, M.E.I.C., and Dr. George Spence, AFFIL. E.I.C. The United States members were Hon. A. O. Stanley, chairman, Roger B. McWhorter, Eugene W. Weber, and Jesse B. Ellis, secretary.

In July 1953 the United States Federal Power Commission issued a licence which was accepted by the Power Authority of the State of New York in November 1953. Actual work was however held up by litigation in the New York State Courts. The navigation project was given approval by the United States Congress through passage of the Wiley-Dondero Act on May 13, 1954. This Act authorized a U.S. Government agency, the St. Lawrence Seaway Development Corporation, to undertake the navigation development in the International section on the American side.

On June 7, 1954 the U.S. Supreme Court finally handed down a decision refusing to review a decision of the U.S. Circuit Court of Appeals, District of Columbia, adverse to the Lake Ontario Land Development and Beach Protection Association, Inc., which had sought delay on the basis of a claim its members would be damaged by raising the levels of Lake Ontario.

On June 10, 1954, state legislation clarifying the New York State Power Authority's right to condemn property and to issue notes for temporary financing was obtained at a special session, and the first contract for cofferdams at Long Sault dam was advertised. Construction was started simultaneously by both countries on August 4, 1954.

The Four Authorities

Improvements to navigation between Lake Erie and the Port of Montreal on the Canadian side are being built by the St. Lawrence Seaway Authority, president of which is the Hon. Lionel Chevrier, with Charles Gavsie and C. W. West, M.E.I.C., as directors. A. Gordon Murphy, M.E.I.C., and Lawrence H. Burpee, M.E.I.C., are chief and deputy chief engineers respectively. (Mr. Burpee is a son of the late Lawrence J. Burpee, who as the then secretary of the Canadian Section, International Joint Commission, had carried a major responsibility for the preparation of the Commission's 1921 report to the governments of Canada and the United States on the St. Lawrence.)

Improvements to navigation in the International section on the American side are being done by the St. Lawrence Seaway Development Corporation, Inc., with Lewis G. Castle at Washington as administrator, M. W. Ottershagen, deputy administrator, W. S. Chapin, general manager, and Raymond F. Stellar, chief engineer.

At ground-breaking ceremonies in 1955 marking the start of the power project were Prime Minister Louis St. Laurent, the Hon. Thomas E. Dewey, Governor of the State of New York, the Hon. Leslie M. Frost, Prime Minister of Ontario, and Robert H. Saunders, then chairman of Ontario Hydro.

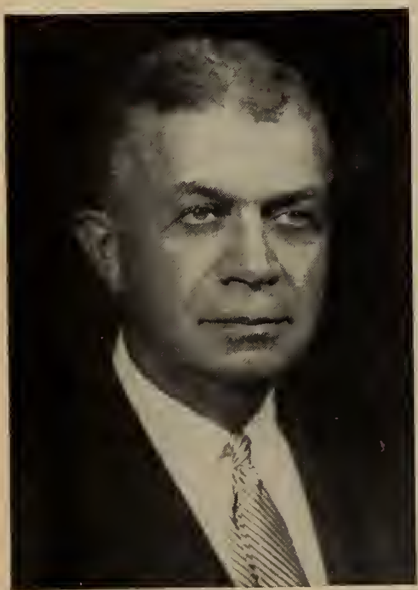
Design and contract awards are by the Corps of Engineers, U.S. Army. Uhl, Hall & Rich, of Boston, are consulting engineers.

Development of power is being undertaken jointly by the New York State Power Authority and the Hydro-Electric Power Commission of Ontario. Chairman of the Commission is Dr. Richard L. Hearn, M.E.I.C., Dr. Otto Holden, M.E.I.C., is assistant general manager and chief engineer. Gordon Mitchell, M.E.I.C., is project manager. Chairman of the New York State Power Authority is Robert Moses, with William Wilson vice-chairman, while J. Burch McMorran is chief engineer.

Supervision and Control

Supervising and co-ordinating the engineering of the four "Authorities" on the International Section is the St. Lawrence River Joint Board of Engineers, established by the two governments in accordance with the recommendations of the International Joint Commission. Representing Canada are the Hon. G. C. Marler and Hon. Lionel Chevrier. Alternates are H. W. Lea, M.E.I.C., and George Kohl, M.E.I.C. The late Max V. Sauer was an alternate member of the St. Lawrence River Joint Board of Engineers until his death in April 1956. U.S. members are the Hon. W. M. Brucker and the Hon. Jerome K. Kuykendall, with Maj. Gen. C. G. Holle and Francis L. Adams as alternates.

Responsible to the I.J.C. for the regulation of the flows of the St. Lawrence is the International St. Lawrence River Board of Control, with T. M. Patterson, M.E.I.C., of the Department of Northern Affairs and National Resources as chairman, and J. B. Bryce, M.E.I.C., of Ontario Hydro, and Dr. René Dupuis, M.E.I.C., of Hydro-Quebec, as members of the Canadian Section. G. A. Hathaway, U.S. Corps of Engineers is chairman, and Francis L. Adams, chief, Bureau of Power, Federal Power Commission, and Bertram D. Tallamy, New York State Department of Public Works, are members of the United States Section.



Lewis G. Castle, Administrator, the St. Lawrence Seaway Development Corporation, Inc. (Washington, D.C.)

Supplementary Order, IJC, July 1956

On 2 July 1956 the International Joint Commission met in Montreal and issued a supplementary order to the order of approval of 29 October, 1952 in the matters of development of power in the International Rapids section of the St. Lawrence River and the regulation of the level of Lake Ontario.

The principal effect of this supplementary order is to give precision to the methods to be followed in the regulation of the levels of Lake Ontario and the flow of the St. Lawrence River.

At this time the Hon. Len Jordan, formerly Governor of Idaho, had replaced Hon. A. O. Stanley as chairman of the U.S. Section of the Commission, and Ames W. Williams had replaced Jesse B. Ellis as secretary.

Many Members Have Made Contributions

Besides the Institute members whose names have been already mentioned herein as occupying executive positions on various boards and commissions, or in charge of planning, design or construction, are many members, and junior and student members, occupying responsible intermediate or junior positions, the work of which has contributed substantially to the end results. The total would be numbered in the hundreds.

Beyond these are many prominent Institute members who from time to time have contributed scientific, economic and statistical research studies connected with the project or have been engaged as consultants. Many other members have made valuable contributions in the form of engineering studies, addresses or articles. A partial list of these includes the following.

William Hamilton Merritt, C.E., of Hamilton, Ontario, was one of the earliest advocates of a Welland canal (circa 1821).

Lt. Col. John By, of the Royal Engineers, who built the Rideau canal in 1828-32, did much to make Canadians aware of the advantages of a Great Lakes-St. Lawrence Seaway. With the Rideau canal system completed ships could sail up from the sea via the Ottawa River, thence through the Rideau canal to the Great Lakes. This first 'seaway' became a commercial reality in 1841. Colonel By was consulted regarding the building of the early Welland and Grenville canals. The system of construction he developed on the Rideau was followed on the early Welland canals.

Walter Shanley, C.E., and **T. C. Clark**, C.E., made reports on the proposed Georgian Bay ship canal project in 1858.

John Page, C.E., chief engineer, Federal Department of Public Works, made a report on the St. Lawrence ship channel in January 1869.

F. C. Capreol, C.E., made a series of reports in 1871 on the proposed Huron and Erie ship canal.

George F. Swain, M.E.I.C., made an appraisal for the Royal Commission on Railways and Transportation in Canada (Drayton Acworth Report) in 1931/32. This appraisal and the report which followed it in 1932 had a direct bearing on the economic aspects of the proposed deep waterway.

Arthur V. White, M.E.I.C., consultant to the Commission of Conservation for Canada, in 1918, in the Commission's 9th annual report called for retention of St. Lawrence power for use in Canada, rather than allowing it to pass into the hands of powerful private interests who would export much of it for those in the United States. Mr. White also published a special report "Long Sault Rapids, St. Lawrence River" (Com. of Conservation, 1913).

Hugh L. Cooper, M.E.I.C., internationally known hydro-electric engineering consultant of New York City, made a report on the St. Lawrence waterway as a consulting engineer in 1920.

Dr. Howard T. Barnes, M.E.I.C., of McGill University, an expert on ice problems, conducted extensive studies during the 'twenties of ice problems and of the types, formations and removal of ice in the St. Lawrence ship canal, the St. Lawrence River, the Great Lakes, and at the port of Montreal.

J. T. Johnston, M.E.I.C., director, Water Power and Reclamation Service, Ottawa, in the twenties, contributed extensive hydraulic studies on stream flow and on hydro-electric power development in Canada.

F. W. Cowie, M.E.I.C., presented a paper before the Montreal Branch of the Institute in April 1923 entitled "Transportation Routes in Canada".

E. A. Forward, M.E.I.C., consulting engineer, in a paper read before the Montreal Branch, Engineering Institute of Canada, in October 1923, proposed a regulating dam at Rapide du Plat, a dam opposite Morrisburg from Clarks Point to Mariatown, a Canadian powerhouse on Canada Island and an American powerhouse on Clarks Island. He also advocated a waterway up the Ottawa to North Bay.

Studies by **C. V. Christie,** M.E.I.C., and **P. T. Davies,** M.E.I.C., on the cost of electric power were published in *Transactions, Engineering Institute of Canada,* 1924, vol. xxxv.

Frederick B. Brown, M.E.I.C., was the author of a report for the Beauharnois Light, Heat and Power Co., on the proposed hydro-electric power development on the St. Lawrence between Lakes St. Francis and St. Louis, in May, 1927.

Frank H. Keefer, M.E.I.C., in 1927 published a pamphlet on the St. Lawrence developments, entitled, "A Corollary to the Duncan Report".

Lesslie R. Thomson, M.E.I.C., consulting engineer of Montreal, presented a paper entitled "The St. Lawrence Problem" before the 43rd General Professional Meeting of the Institute in 1929. This paper embodied a complete history of the project from its earliest stages and dealt in detail with its economic aspects in relation to both navigation and power. Many maps, graphs, tabulations and appendices were included, as well as a complete bibliography of reports, articles and papers to date on the subject.

Beaudry Leman, M.E.I.C., was a member of the Royal Commission of Railways and Transportation in Canada (Drayton Acworth Report) in 1931-32.

J. L. Busfield, M.E.I.C., addressing the Montreal Branch of the Institute in March 1936 on the subject of the St. Lawrence Ship Channel, recommended the construction of a submerged regulating dam at Cap a la Roche, and a 300-ft. wide "control channel", as invented by **DeGaspe Beaubien,** HON. M.E.I.C., and himself, to eliminate undesirable features of the standard lock.

Max Sauer, M.E.I.C., hydraulic engineer and general superintendent, generating stations, Montreal Light Heat and Power Co. Cons., for many years, who in the early forties designed and built the remedial works in the St. Lawrence river for the Beauharnois project, presented a paper before the Montreal Branch, Engineering Institute of Canada, in October 1943 on this project. Mr. Sauer was also a Canadian member for the St. Lawrence River Joint Board of Engineers until his death in April 1956.

J. G. G. Kerry, HON. M.E.I.C., consulting engineer, devoted years of study to ice conditions, particularly in relation to the St. Lawrence. He had long held the vision of an 'all season' Seaway, kept ice-free by means of the latent heat in the deep waters of Lake Ontario. Mr. Kerry also advocated in 1951 a wholly national power development and waterway, diverting Canada's share of water from a point near Galop Island across the Eastern Ontario lowlands into the Ottawa River at Point Fortune, as first proposed by **Noulan Cauchon,** M.E.I.C., about 1920, and reviewed and supported by **W. F. Coutlee,** M.E.I.C.

Mr. Kerry also made extensive studies of ice conditions in the St. Lawrence estuary and gulf, and maintained winter navigation could be made possible on the ship channel below Quebec by a dam or barrage across the Ile au Coudres channel, cutting off the tidal flow and controlling a flow of relatively warmer water to ride over the saltier waters of the estuary.

Robert Moses, Chairman of the Power Authority of the State of New York.

George Washington Stephens, past president of the Montreal Harbour Commission, wrote a comprehensive work entitled "The St. Lawrence Waterway Project" published by Louis Carrier and Company in Montreal and New York in 1929.

The late **Robert H. Saunders,** chairman of the Ontario Hydro-Electric Power Commission in the early 1950's, was a vigorous promoter of the "seaway". Though not himself an engineer, his interest in public affairs and public relations, combined with his tireless energy and diplomacy, was instrumental in advancing the project to a reality.

Probably the longest continuous connection with the St. Lawrence project of any of those at present serving under the Government of Canada is that of Miss Elizabeth Sutherland, at present the secretary of the Canadian Section, International Joint Commission, who became the secretary to C. A. Magrath, M.E.I.C., then chairman of the Canadian Section, I.J.C., in 1912.

In so far as has been possible, names of Canadian engineers who have contributed their services in connection with the project have been gathered from available official reports and records.

Inevitably, however, the names of some will be found to have been unintentionally omitted. To them the Engineering Institute of Canada offers its sincere apologies. *The Engineering Journal* will be grateful to hear from the membership of any further names which should be added to the list.

General Design of The St. Lawrence Seaway

D. M. Ripley, JR.E.I.C.,

Senior Assistant Engineer (Hydraulic), The St. Lawrence Seaway Authority

Read at the 70th Annual General and Professional Meeting, The Engineering Institute of Canada, Montreal, May 1956

This paper deals generally with the design and inter-relationship of the main features of the St. Lawrence Seaway. A brief history of the development and mention of the power projects are followed by a description of the principal features of the Seaway from the Welland canal to Montreal. The author concludes with a note on the material requirements of the project and the progress made.

FROM the Canadian point of view the St. Lawrence Seaway may be defined as the works necessary to provide and maintain, either wholly in Canada or in conjunction with works undertaken by an appropriate authority in the United States, a deep waterway between Lake Erie and the Port of Montreal. The object of this development is to place the Great Lakes ports in direct communication with the lower St. Lawrence River and ocean transport. Fair and reasonable tolls are to be established to place the project on a self-liquidating basis.

Navigation Standards

The standards adopted for the St. Lawrence Seaway conform to those of the Welland Ship Canal, which, although completed in 1932, was constructed to dimensions that anticipated the early extension of deep-draught navigation facilities eastward to Montreal and the increase in traffic that would result.

As at the Welland Ship Canal, the St. Lawrence Seaway will have locks 80 feet in width and 859 feet in length. The length of the locks between breast wall and gate fender will be 765 feet, which gives a practical usable length of 715 feet. The depth over lock sills at minimum low water conditions will be 30 feet.

The controlling channel depth will be 27 feet. The bottom width of navigation channels and canals will be not less than 200 feet where flanked by embankments on both sides, not less than 300 feet where flanked by one embankment and not less than 450 feet where both banks are submerged. These widths are to be increased where cross currents make navigation more difficult or where required to reduce current velocities to those suitable for navigation. In general, average current velocities in channels to be used for navigation will not exceed 4.0 feet per second. Somewhat lower current velocities will be provided at lock entrances and in similar locations where vessels will be required to reduce speed. The minimum radius of curvature for navigation channels will be 5,000 feet with a minimum distance between bend reversals of one quarter mile.

The minimum vertical clearance provided at bridges will be 120 feet.

History of Development

The St. Lawrence Seaway project will provide a standardized and integrated plan of development for deep-draught navigation of the Great Lakes — St. Lawrence River system from Lake Erie to Montreal Harbour. This development, together with the improvement of the Great Lakes connecting channels by the United States, will provide the final necessary links in a continuous waterway, 2,200 miles in length, across half a continent from the head of Lake Superior to the Atlantic Ocean.

Canada has been building canals in the St. Lawrence River for over 100 years, but, except for brief periods, the navigation facilities on and between the Great Lakes have been more advanced in the scale of progress than those in the 114-mile portion of St. Lawrence River above the port of Montreal. The present St. Lawrence River Canals, in this section of the river which accommodate vessels of 14-ft. draught, fell well behind with the opening of the Welland Ship Canal in 1932, and their obsolescence has been hastened by the continued improvement of the St. Lawrence Ship Channel between Montreal and the sea to the present 35-ft. depth.

The St. Lawrence Seaway — or Deep Waterway as it has been called — is not a new idea. Comprehensive studies were begun by the International Joint Commission in 1919 and these led to the establishment of a Joint Board of Engineers. This Joint Board of Engineers did their work so well that their report, which was submitted in 1926, may still be considered to be a standard reference document on the St. Lawrence project. The recommendations of the 1926 Joint Board of Engineers were embodied into the 1932 St. Lawrence Deep Waterway Treaty. This treaty failed of ratification. Again, with the St. Lawrence Basin Agreement in 1941, efforts were continued to have the project approved but without success.

Up to this point provision for a deep waterway from Lake Erie to Montreal had linked with it proposals for the development of power in the International Section of the St. Lawrence River. The many difficulties encountered in obtaining approval of such an integrated project led to the adoption of a new approach by Canada in 1951. Briefly, this new approach would enable the power aspect of the project to be developed separately from the Seaway by the entities most appropriately concerned, namely, the Hydro-Electric Power Commission of Ontario and a power development entity to be designated by the United States. To ensure continuation of navigation under these circumstances, Canada agreed to construct concurrently with the power works such navigation works necessary to provide a 27-ft. canal system on the Canadian side of the river between Montreal and Lake Erie which was referred to as the All-Canadian Seaway.

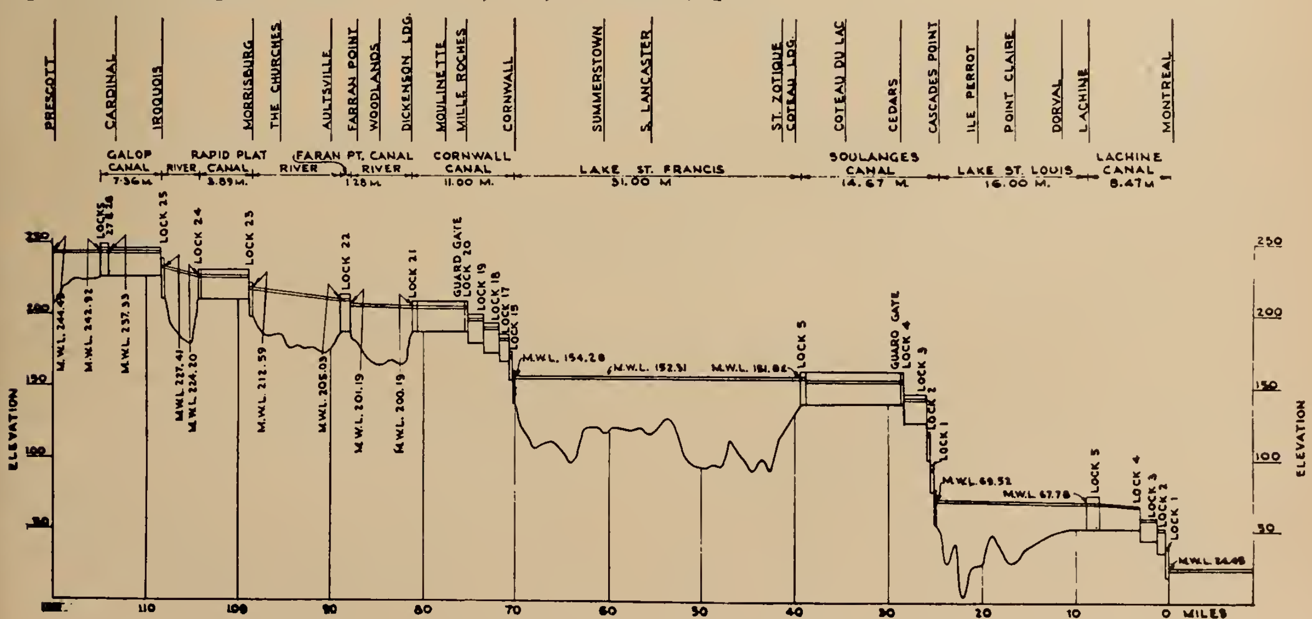
The matter of the power development in the International Section of the St. Lawrence River by the Ontario Hydro-Electric Power Commission and, as eventually arranged, by the Power Authority of the State of New York, received the approval of the International Joint Commission in October 1952. From this point events moved quickly. In May 1954, President Eisenhower signed the Wiley-Dondero Bill, an act passed by the Congress of the United States authorizing an American agency to construct navigation works on the United States side of the St. Lawrence River between Cornwall Ontario, and Lake Ontario. Corresponding legislation in Canada, the St. Lawrence Seaway Authority Act, which was proclaimed in force in July 1954, authorized the St. Lawrence Seaway Authority to proceed with the seaway construction, according to Section 10 of the Act, "either wholly in Canada, or in conjunction with works to be undertaken by an appropriate authority in the United States." The close cooperation between Canada and the United States, which has prevailed in all matters relating to boundary waters, resulted in the construction arrangement for the seaway that is now in effect. While acknowledging the right of each country to construct seaway facilities on its own side of the river, Canada initially will construct the seaway locks and canals at Iroquois, Ontario, and at Beauharnois and Montreal, Quebec, together with the channel work in Lakes St. Francis and St. Louis, and Montreal Harbour, and the deepening of the Welland Ship Canal. The United States agency, the Saint Lawrence Seaway Development Corporaton, will construct navigation locks and canals from Lake St. Francis to above the Barnhart Island Powerhouse and the channel deepening on the United States side of the international boundary in the Thousand Islands section. In all, Canada will construct five locks with connecting canals and channels, and the United States will construct two locks with connecting canals and channels.

Because of the interest focused on the construction in the International Section of the river as a result of the many international negotiations and discussions leading to the final agreement on the seaway and power project, it is not generally realized even today that a major share of the seaway work is being carried out in the Canadian section of the river. Actually, of the seven new locks being constructed, four of them are near Montreal and, of the total expenditure to be made on Seaway construction, the St. Lawrence Seaway Authority will provide approximately two-thirds, chiefly on works in Canada. In fact, the project now under construction differs from the so-called All-Canadian Seaway only near Cornwall, Ontario, where two locks and connecting canals on the U.S. side of the river have replaced for the present the similar structures it was proposed to build in Canada.

Power Developments

Concurrent with the construction of the St. Lawrence Seaway is the large-scale development of power on the St. Lawrence River at two sites, and possibly three. The development of power in the International Section of the river near Cornwall, Ontario, will make available to the Province of Ontario and the State of New York equal shares of some 2,200,000 horsepower. This power development will facilitate the navigation improvement as a result of the creation of a lake-like reach extending from the Barnhart Island powerhouses to Iroquois, Ontario, at which point the Iroquois Control Dam, a structure to be used to regulate the outflow and levels of Lake Ontario, will be located. Enlargement of the

Fig. 1. Present navigation facilities - Prescott, Ont., to Montreal, Que.



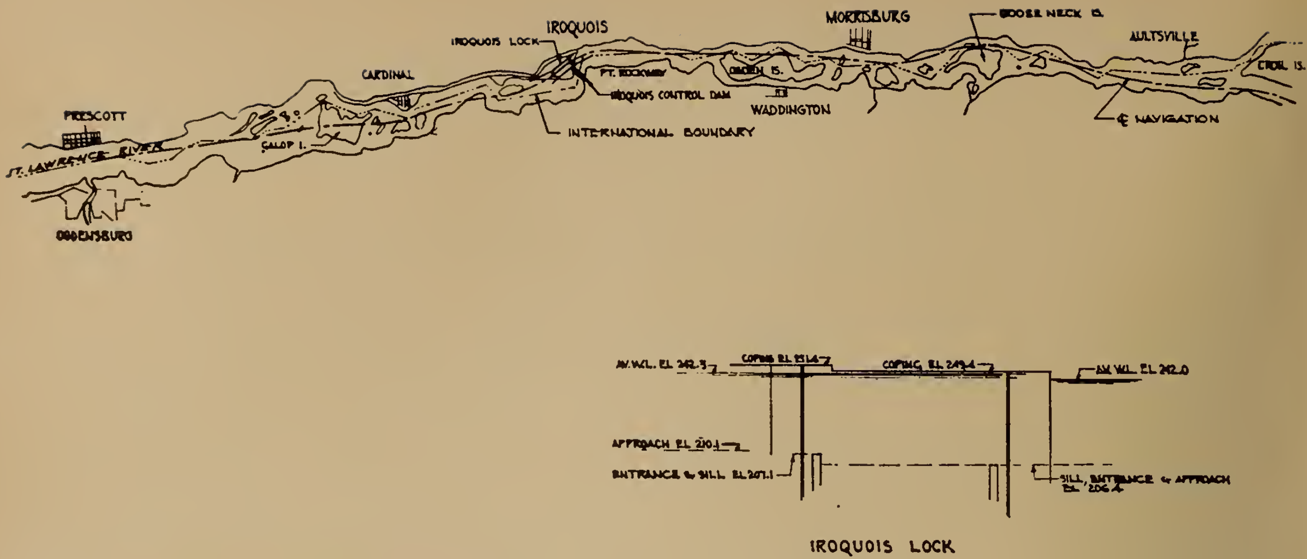


Fig. 2. Location and profile of the Iroquois lock.

river above the Iroquois Dam by the power entities will provide satisfactory navigation channels.

The second of the power developments, the Beauharnois plant of Hydro-Québec, was begun in 1932 and has been under continual expansion since that time. The present Beauharnois plant develops about 70 per cent of the more than 2,000,000 horsepower potential at that site, and the broad deep headrace canal which diverts water to the powerhouse from Lake St. Francis will provide a navigation canal in a 600-ft. wide portion along its north shore.

At Montreal, the Lachine Rapids will provide at least another 1,000,000 h.p. When this power potential at the Lachine Rapids is developed the St. Lawrence Seaway will tie in with the construction and operation of the power works in a manner to be described later.

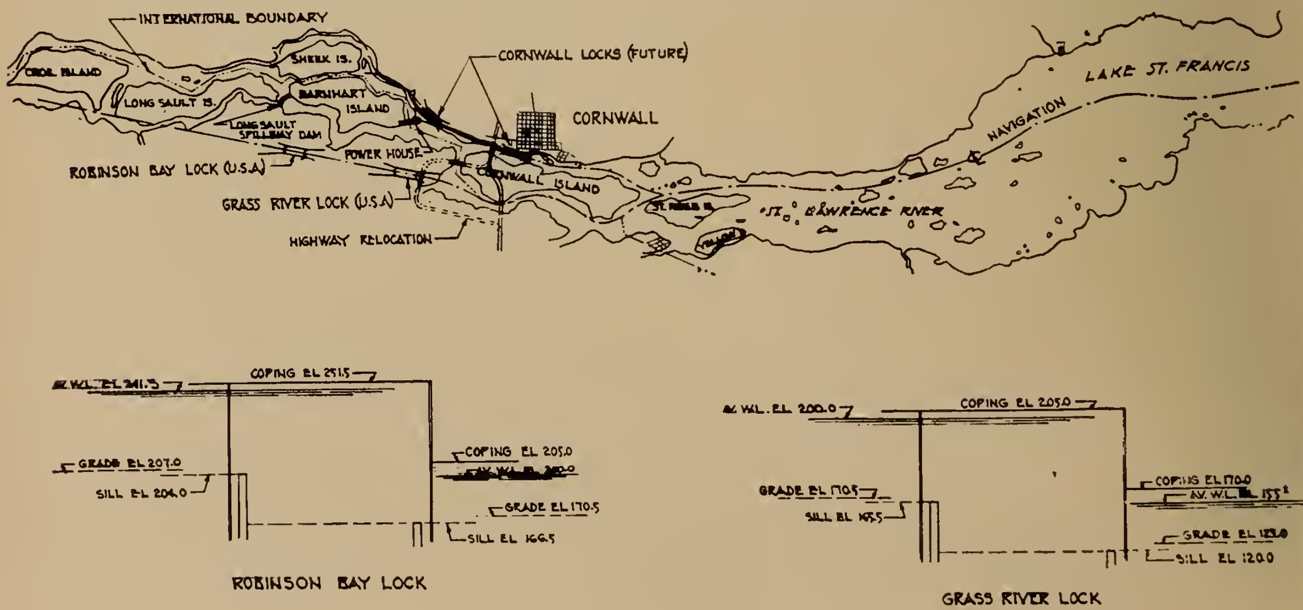
Present Navigation

Figure 1 illustrates the present navigation facilities of the St. Lawrence canals in profile. The significant features of this present system are the 14-ft. available depth at low water on the lock sills and the 22 locks require to overcome the rapids reaches of the river. The controlling lock dimensions, other than depth, are: length 255 feet, width 43.7 feet, and overhead clearance 94.8 feet. Of the 114 miles between Montreal and Prescott, 47 miles are spent traversing locks and canals and 67 miles traversing river and lake reaches. It may be of interest to note that the present 14-ft. canals system has been constructed to conform to the natural regime of the river.

Principal Seaway Features

The major works of the St. Lawrence Seaway are located in the 114-miles portion of the St. Lawrence River between Montreal, Quebec, and Prescott, Ontario. Relatively minor dredging above Prescott, through the Thousand Islands and in the reaches between the locks in the Welland Ship Canal complete

Fig. 3. Location and profile of Robinson Bay and Grass River locks. Future Cornwall locks are indicated.



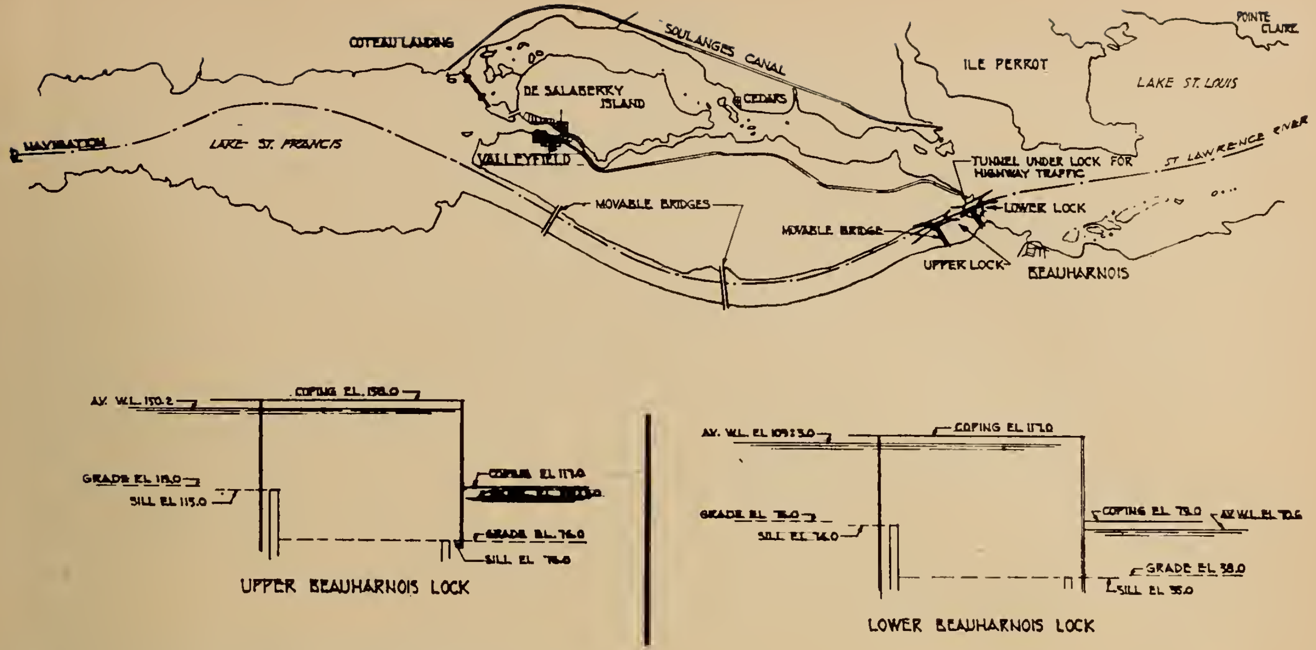


Fig. 4. Location and profile of Beauharnois locks.

the standardization process.

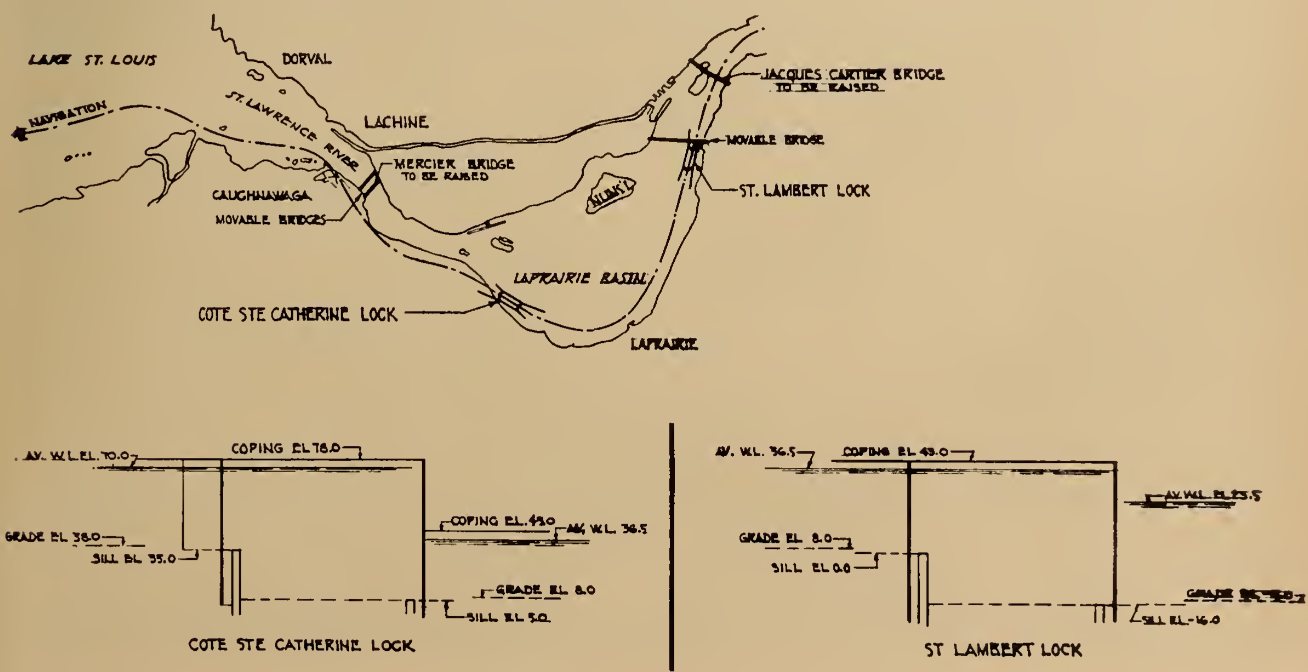
The navigation works that are to replace the present obsolete locks and canals are illustrated in plan and profile in Figures 2 to 5. It may be noted that the twenty-two old locks are to be replaced by seven new locks having a minimum depth over sills of 30 feet. The lock dimensions, as previously described, are similar to those of the Welland Ship Canal. All Seaway features are being so located and designed that extension of navigation facilities, including twinning of the locks, may be accomplished with a minimum of difficulty to meet traffic demands in the future.

Compared to the 47 miles of canal reaches of the present St. Lawrence Canals, the Seaway canal reaches will be reduced to 40 miles. Of more importance, the number of lockages will be reduced to 7 from the present 21. The resulting saving in time of passage from Kingston to Montreal will be at least 12 hours. Another significant comparison is the increased capacity of the seaway canals. The present canals accommodate vessels carrying 3,000 tons, whereas the seaway canals will handle ships carrying over 20,000 tons. All these improvements will result in an increase in annual tonnage capacity from the present 10 million tons to over 60 million tons.

Welland Ship Canal

Downbound vessels from the upper lakes when passing through the Welland Ship Canal will find the

Fig. 5. Location and profile of Cote Ste. Catherine and St. Lambert locks.



controlling channel depth increased from the present 25 feet to 27 feet. The existing canal will be widened in places to 350 feet to facilitate passing. The contracts for this work, which call for excavation in the dry during the winter months from Thorold to Lake Ontario and dredging from Thorold to Lake Erie, have been awarded and the work is in progress. Dry excavation in this latter portion of the canal is not possible because of the necessity for continuance of a diversion of water down the canal from Lake Erie for domestic and power purposes.

The Welland Ship Canal will be otherwise unaffected; in fact, as mentioned above, this canal provides the standard for the Seaway features elsewhere. Experience gained in construction and operation of the Welland Ship Canal has been, and continues to be, an invaluable aid in the design of the St. Lawrence Seaway. The St. Lawrence Seaway Authority is fortunate to have on its staff several engineers formerly employed on construction and operation of the Welland Ship Canal.

Port Weller to Prescott

From Port Weller the vessel track is 120 miles across Lake Ontario to Kingston where shipping enters the St. Lawrence River. Below Kingston the first navigation improvements encountered will be the enlargement of the present navigation channel through the Thousand Islands. Although the channel from Kingston through the Thousand Islands to the National Harbours Board elevator near Prescott is now in regular use by the largest of the upper lakes bulk carriers, it will be widened and deepened by dredging to conform to the seaway navigation standards. The work in this section of the river on the Canadian side of the international boundary will be carried out by the Seaway Authority and that on the United States side by the Seaway Development Corporation.

Prescott to Cornwall

Beginning at a point 4 miles downstream from Prescott, navigation will encounter a complete change of circumstances in comparison with those now existing. At the Galop Rapids, which form the natural outlet control of Lake Ontario, the power works begin in the form of a series of large hydraulic cuts specified in the Order of Approval of the power project. The navigation channels will be located to take advantage of these channel enlargements. The Order of Approval requires that the average current velocities in the cross section of the channels to be used for navigation must not exceed 4.0 feet per second at any time during the navigation season. The design and construction of these channels is primarily the responsibility of the power entities and exhaustive studies of these works are being made by Ontario Hydro at their Islington, Ontario, Hydraulics Laboratory. The design has now been accepted by all concerned and at the time of writing requires only the final approval of the St. Lawrence River Joint Board of Engineers, the approving agency of the Canadian and United States Governments. Briefly, the navigation standards have been met with a channel of 600-ft. minimum width. Curvation is moderate and the hydraulic model studies indicate no objectionable cross currents.

About 15 miles down river from Prescott (see Fig. 2) will be located the Iroquois Control Dam, the structure required to replace the natural outlet control for Lake Ontario that will be removed by the Galop Rapids excavation. Construction of the Iroquois Dam by the power entities is well advanced. This may be seen to the right in Fig. 6. To the left in Fig. 6 may be seen the exca-

Fig. 6. Iroquois lock and dam sites.

Fig. 7. Cote Ste. Catherine lock site.

vation for the Iroquois Lock, the navigation feature required to by-pass the dam.

The Iroquois Lock is being constructed by the St. Lawrence Seaway Authority. The contract for the lock was awarded in January 1955 and completion is scheduled for opening of navigation in 1958. The unique feature in the design of this lock is the use of sector gates; filling and emptying will be through the gate openings rather than the more conventional culvert filling system. The application of hydraulic model studies to lock design generally and the sector gate design in particular will be covered in another paper.[1]

The current velocities that will be experienced at the approaches to the Iroquois Lock have been studied on the Ontario Hydro river models at Islington, Ontario. These and other model tests undertaken by Ontario Hydro have provided the data for the establishment of the sill elevations and gate heights at the Iroquois Lock.

The normal lift at the Iroquois Lock will vary from a few tenths of a foot, when the Iroquois Dam is fully open, to 5.5 feet during the period when the water level above the Barnhart Island Powerhouses is at a maximum elevation 238.0, for a test period as required by the Order of Approval. The Iroquois Lock is being designed also to permit its use by 14-ft. navigation for a short time during the construction period, when the water level above the Iroquois Dam will be raised and the river below the dam kept as under present conditions. Under these circumstances the lift at the Iroquois Lock may be as much as 24.5 ft. Provision for such a lift will also permit use of the lock at 14-ft. draught should emergency circumstances arising after the seaway and power projects have been placed in operation require lowering of the pool between the Barnhart Island Powerhouses and the Iroquois Dam.

Proceeding below the Iroquois Lock, shipping will pass through the lake-like section created by the raised level at the Barnhart Island Powerhouses. Channels of at least the standard set out above will be available in this portion of the river. At Croil Island, 20 miles below the Iroquois Lock, vessels will enter the Long Sault Canal. This work, which is being undertaken by the Saint Lawrence Development Corporation, will provide an access canal 10 miles in length to the Robinson Bay and Grass River Locks (see Fig. 3). These locks divide about equally the lift required to overcome the fall of 87 feet at the Barnhart Island Powerhouses. The Robinson Bay and Grass River Locks are separated by an intermediate pool which is to be controlled at about elevation 200.0. Basically these locks are similar in dimension to those at the Welland Ship Canal.

Immediately downstream from the Grass River Lock will be undertaken an extensive channel enlargement designed to lower the current velocities in the South Cornwall Channel to the 4.0 feet per second required by navigation. Compensatory excavation will be done concurrently in the North Cornwall Channel to maintain the flow distribution to either side of Cornwall Island either as in nature or as agreed upon by Canada and the United States. A necessary requirement of this compensating excavation is that it will be so located and designed as not to preclude or make more difficult the future development of navigation on the Canadian side of the river near Cornwall, Ontario. The location of the

[1] "The use of hydraulic models in the St. Lawrence Seaway planning and design" by D. McIntyre, M.E.I.C., published on p. 1154 of this issue.

future 27-ft. navigation locks on the Canadian side of the river may be seen in Fig. 3.

In the Cornwall area the Seaway encounters the first vehicular crossing. A combined railway and highway bridge, the Roosevelt Bridge, at present crosses the North Cornwall Channel at Cornwall and the South Cornwall Channel about two miles below the Grass River Lock. Improvement for navigation will require the relocation of the south span of this bridge. This will be accomplished by a new movable bridge across the Grass River Lock with a new fixed span across Polly's Gut. The north span at Cornwall will remain unchanged for the present.

Cornwall to Beauharnois

Below the head of Lake St. Francis, a few miles downstream from Cornwall, the St. Lawrence River lies wholly in Canada and from this point to Montreal the seaway construction is being undertaken by the Seaway Authority.

Across Lake St. Francis the navigation channel follows a practically direct course for 30 miles to the Beauharnois power canal. Dredging required to deepen and widen the navigation channel at Fraser Point, Lancaster Bar and near the power canal entrance is now in progress.

The upper entrance to the Beauharnois Locks will be provided by the Beauharnois Power Canal. Under the terms of the Order-in-Council authorizing the diversion of water for power purposes at Beauharnois, the power canal has been constructed to include a 600-ft. wide navigable portion of adequate depth along the north bank. The layout of this feature may be seen in Fig. 4.

The Beauharnois Locks, to be located as shown in Fig. 4, will be very similar to the Robinson Bay and Grass River Locks in relation to each other. The fall from Lake St. Francis to Lake St. Louis of about 82 feet will be overcome by two locks separated by an intermediate pool having a controlled water level at elevation 109. These locks are equipped with mitre gates and a conventional side-filling and emptying system. The usual guard gate for ensuring retention of the upper pool in case of a gate failure resulting from collision by a vessel has been replaced by an emergency sector type gate, which may be closed against a head of water should a gate failure occur. A considerable saving in the time for a vessel to traverse the canal is thus affected. Contracts were awarded recently for the preliminary work on the Beauharnois Locks construction.

In the 15-mile length of the Beauharnois power canal there are a railway bridge and two combined railway-highway crossings. The three present bridges — one near Valleyfield, another near St. Louis, and one near the Beauharnois Powerhouse — will be replaced by vertical lift bridges. Highway No. 3 will be carried under the locks through a tunnel, thus eliminating any possible interruption of highway traffic.

Beauharnois to Montreal

Proceeding down-river from the Beauharnois Locks the navigation channel follows the naturally deep water in Lake St. Louis for 10 miles until above St. Nicholas Island, from which point the channel comes close to the south shore. A dredged channel 600 feet in width leads to the canal entrance near Caughnawaga. Dredging of this channel has been in progress since early in 1955.

In the past there have been many proposals for the improvement of the Lachine Rapids section for navigation. Some of these proposals were to be carried out concurrently with a power development. Although at the time of writing no power development appears likely in the Lachine Section

Fig. 8. St. Lambert lock site.

in the immediate future, the St. Lawrence Seaway will be so constructed in the Lachine Section that the power development may be carried out at a later date.

An overland channel of 250 feet minimum width and eight miles in length is being excavated through rock from Caughnawaga to Cote Ste. Catherine, where a lock is now under construction (Fig. 7). The Cote Ste. Catherine Lock will have an average lift of 33 feet. It will be equipped with mitre gates and a side-filling and emptying system. As at Beauharnois, an emergency operating sector type gate will be installed to ensure retention of the upper pool in case of a gate failure.

From the Cote Ste. Catherine Lock the navigation channel will be isolated from Laprairie Basin bv a continuous dyke throughout the eight mile length of the channel down to St. Lambert. The pool formed by the dyke will be controlled during the navigation season initially to elevation 35.0. Figure 5 shows the location of the Cote Ste. Catherine and St. Lambert Locks and the centre line of the canal from Lake St. Louis to Montreal Harbour.

At St. Lambert the lower lock of the St. Lawrence Seaway will be constructed. The lock location in relation to topographic features is shown in Fig. 8; the approach channel below the St. Lambert Lock and the dyke that separates the channel from the river may also be noted.

Fig. 9. Approach channel below St. Lambert lock during construction.

The approach channel is being excavated in rock with finished side slopes at 1.5:1 as shown in Fig. 9. The Seaway construction actually will terminate in Montreal Harbour where a turning basin is being dredged to facilitate entrance to and exit from the seaway canal without undue interference with port traffic.

Because of the wide variation in river stage experienced in Montreal Harbour during the navigation season the St. Lambert Lock, which will have an average lift of 13 feet, must handle shipping at river stages requiring lifts varying from 20 feet at low water to only 2 feet at high water.

Fig. 10. Longueuil water supply intake being placed below the St. Lambert lock approach channel. The Jacques Cartier bridge is seen in the background.

Integration with Municipal Services

The integration of the Seaway features with municipal and other facilities in the Montreal area raises many interesting problems. These problems arise because of the many service facilities intercepted by seaway construction such as highways, railways and water and sewerage systems.

At Longueuil and St. Lambert new water supply intakes are being constructed to replace those removed or interfered with by the seaway construction. In Fig. 8 and 10 may be seen the preliminary construction of the Longueuil water supply intake. Similar facilities are being continued and improved upon where required throughout the length of the seaway canal.

The bridges in the Lachine Section are being raised where possible, This is the case with respect to the Hon. Mercier Bridge and Jacques Cartier Bridge, both of which will be raised to give 120-ft. clearance. Modern traffic interchanges will be constructed at the southerly end of both of these bridges. Grade limitations, however, necessitate the installation of movable bridges at Victoria bridge and at the Canadian Pacific Railway bridge at Caughnawaga. The latter bridge will be provided with a vertical lift span.

Because of the traffic density — both railway and highway—on the Victoria Bridge, the Seaway Authority, in co-operation with the Canadian National Railway, is making every effort to avoid delays resulting from the seaway operation. Figure 11 illustrates how the Seaway Authority has proposed to handle the traffic problem, although at the time of writing the matter is still under study. The Victoria Bridge is a double-track railway bridge with a 16-ft. wide highway traffic lane on the upstream bracket. The Montreal and Southern Counties Interurban Railway line has been removed from the downstream bracket and another highway lane has replaced it.

A combined railway and highway lift span crossing the lower end of the St. Lambert Lock, an additional highway rolling-lift bridge crossing the upper end of the lock, and a traffic distribution system will enable highway traffic to continue to use Victoria Bridge without interruption during passage of vessels through the St. Lambert Lock.

At Cote Ste. Catherine a rolling-lift bridge across the lock will complete the bridge picture in the Lachine Section. However, provision for an additional rolling-lift bridge may be made at Cote Ste. Catherine, having in mind the need for increased traffic capacity should a power development near Heron Island be undertaken in the future.

Integration with Lachine Power Development

When the Lachine Rapids power development is carried out, presumably with a powerhouse located near Heron Island, a considerable enlargement of the Lachine Rapids will be required to reduce the current velocities to the 2.0 feet per second considered necessary to permit an ice cover to form in the river above the powerhouse. Hydro-Québec have indicated that a channel enlargement in the Lachine narrows to a 120,000 square feet cross-sectional area is the economic limit. This means that a Lake St. Louis outflow of 240,000 cubic feet per second can be handled in the river during the ice-forming period. The more recent plans for regulation of Lake Ontario call for a maximum river flow at Lachine of 280,000 cubic feet per second during the ice-forming period. To enable such a plan of regulation to be put into effect the Seaway Authority has agreed to make available the seaway canal from Caughnawaga to Cote Ste. Catherine as a by-pass canal during the non-navigation season. Under this arrangement, which will also require discharge works into the river below the future powerhouse near the Cote Ste. Catherine Lock, the Seaway canal will carry the 40,000 cubic feet per second discharge in excess of the river capacity.

Seaway Construction Will Not Affect Water Levels

It is natural that those who own property or operate businesses on the shores of the St. Lawrence River, Lake St. Francis, Lake St. Louis or Montreal Harbour, should express some concern regarding the water level conditions that will obtain after the Seaway is completed. The Seaway Authority is taking steps to ensure that the construction of the Seaway features will not alter natural conditions. The St. Lawrence River discharges will be influenced by the regulation of Lake Ontario which will be carried out as recommended by the International Joint Commission and approved by the Governments of Canada and the United States. Studies of Lake Ontario regulation are continuing under the direction of the International Joint Commission, but it has now been established by approval of the Canadian and United States Governments that Lake Ontario, which has ranged in the past between elevation 242.6 to elevation 249.3, will be regulated within a range of stage 244.0 (navigation season) to 248.0, as nearly as may be.

These continuing studies of Lake Ontario regulation will recognize the requirements of the downstream interests and the plan finally approved for operation will ensure that circumstances at least as favourable as those of record will be maintained.

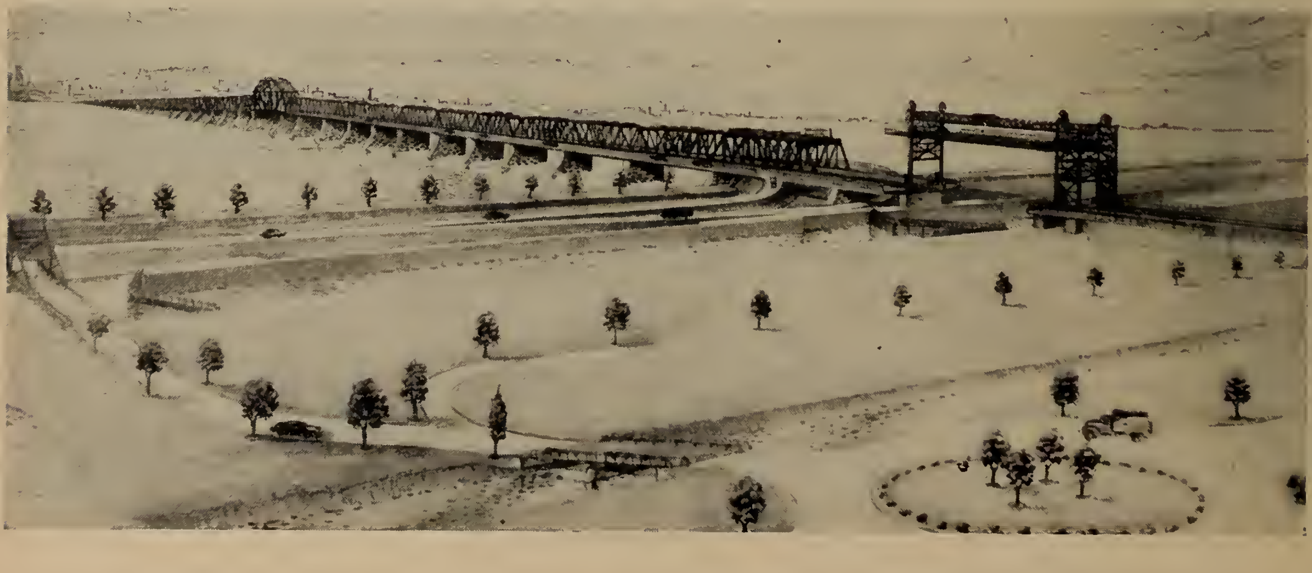
Except for the river reach from near Prescott, Ontario to the Barnhart Island Powerhouses, where there will be a substantial change in river levels resulting from the power development that must be provided for, the Seaway project has been designed to conform to the present river regime.

Geological Conditions

In general, the geological conditions prevailing along the Seaway

(Continued on page 1184)

Fig. 11. Seaway Authority proposal for railway and highway crossing at St. Lambert lock.



Mechanical Design Features of the St. Lawrence Power Project

O. Holden, M.E.I.C., *Chief Engineer*

P. Pemberton-Pigott, *Assistant Mechanical Engineer*

The Hydro-Electric Power Commission of Ontario

Read at the 70th Annual General and Professional Meeting, The Engineering Institute of Canada, Montreal, May 1956

The St. Lawrence Power Project, now being constructed jointly by the Ontario Hydro and the Power Authority of the State of New York, requires a wide range of mechanical equipment. This paper describes the design features of the items to be installed in the various structures with particular attention being paid to hydraulic gates and cranes. A reference is also made to the variations between some of the equipment in the Canadian and American powerhouses.

THE INTERNATIONAL Rapids section of the St. Lawrence River extends some 40 miles from Prescott to Cornwall, Ontario. It is in this stretch of the river that the St. Lawrence Power Project is currently being constructed. This involves the building of five main structures, which are:

(a) The powerhouse, which is a single structure, combining both the Canadian and American powerhouses.

(b) Long Sault dam

(c) The canal closure structure

(d) Massena intake

(e) Iroquois dam

The maps, Figs. 1, 1a, and 1b show the location of the main structures required for the generation of power and for maintaining the water levels for navigation, both during and after construction. Referring to Fig. 1a, item "A" indicates the American and Canadian powerhouses located about four miles upstream from Cornwall, these being combined into a single structure spanning the International channel of the river from the Canadian shore to the north side of Barnhart Island. The International Boundary passes through the centre of the channel geographically dividing the structure into two halves, each in its respective country.

On the south side of Barnhart Island is the Long Sault dam, shown as Item "B". This is the main spillway structure and during construction it is the key item of the whole project, as it is from here that the river levels up to the Town of Iroquois are controlled at their natural elevations during the various stages of river diversion.

On the north side of the powerhouse is the canal closure structure, shown as item "C". This structure permits 14-foot navigation to continue on the Canadian side until the last stage of river closure.

Next, going up river, is the Massena intake, shown as item "D". This structure ensures the continuance of a water supply to the Massena power plant during construction, and later for the supply of process water to the Alcoa plant.

Lastly, there is the Iroquois dam, spanning the river between Iroquois and Point Rockway, Fig. 1b. This dam permits the control of the outflow from Lake Ontario.

The mechanical design features of the project will be outlined by discussing the main structures one at a time with a brief description of the main items of the equipment involved.

Iroquois Dam

The Iroquois dam shown in Fig. 2 consists of 32 sluices, each 50 feet wide, with the sill only a few feet above the rock bed of the river; at each end, bulkhead sections join up to the supporting contours. Each sluice is provided with a single section fixed-wheel roller gate 48 feet high. A second gate slot is located upstream of the main checks for use with a set of stoplogs during maintenance work on the main gate. The gates are handled by 350-ton capacity gantry cranes and are held in the raised position by "dogs" located at deck level.

The maximum head on the Iroquois Dam will occur during the construction period when the water level above the dam will be raised to assist dredging operations, while the water level below the dam will remain at its natural elevation. At this time the differential head on the dam will be of the order of 24 feet, and this has been instrumental in establishing the design criteria for both the structure and the gates.

Due to the almost complete submergence of the gates at certain periods, provision for their heating presents an unusual problem. The final arrangement adopted was for a light downstream skin plate to be added to the gate, in effect forming a box section. The space thus enclosed becomes filled with water as the gate is lowered and is heated by electric tubular type heaters placed inside vertical pipes which run the full height of the gate. The heaters themselves are divided into two sections and are so arranged that either the top half or the bottom half of the gate may be heated at any one time. This arrangement reduces the connected heating load to 60 kilowatts per gate. The portion of the gate to be heated will, of course, depend upon the position of the gate in the water.

In addition to the gate body heating, gain heaters are provided for the main service checks.

Two gantry cranes will be provided, each of 350-ton capacity. Particular attention has been paid to the appearance of these cranes, and the architectural treatment given to them results in the main hoist machinery trolley and the upper girders of the crane being completely enclosed in a sheet steel housing as shown in Fig. 3. The housing is 46 feet long by 42 feet wide and about 18 feet high and the overall height of the crane from rail to roof is about 75 feet. Thus it is readily appreciated that these cranes will be the most outstanding feature of a long, low structure like Iroquois Dam.

The cranes are designed to lift the gates at a speed of seven feet per minute and to travel along the deck of the dam at 75 feet per minute. The hoist is of the double drum, double hook type, and will handle the gates through a semi-automatic lifting beam. The crane is provided with normal wound rotor motor control with thruster brakes on the hoist drive. For fine control of the positioning of the crane, the first point of the bridge travel controller will be a drift point. The crane may then be brought to rest by use of hydraulic brakes controlled from the cab rather than with the solenoid operated brakes connected into the travel motor circuits.

Massena Intake

In order to limit the length of this paper, detailed description of the mechanical equipment, consisting of control gates for the intake for the Massena power canal and a pumphouse for the water supply to the nearby Alcoa plant and the town of Massena have been omitted. Data about these gates, however, are included in the material given in Tables III and IV.

Long Sault Dam

The Long Sault dam which, with the powerhouse, will maintain the forebay level, is located between

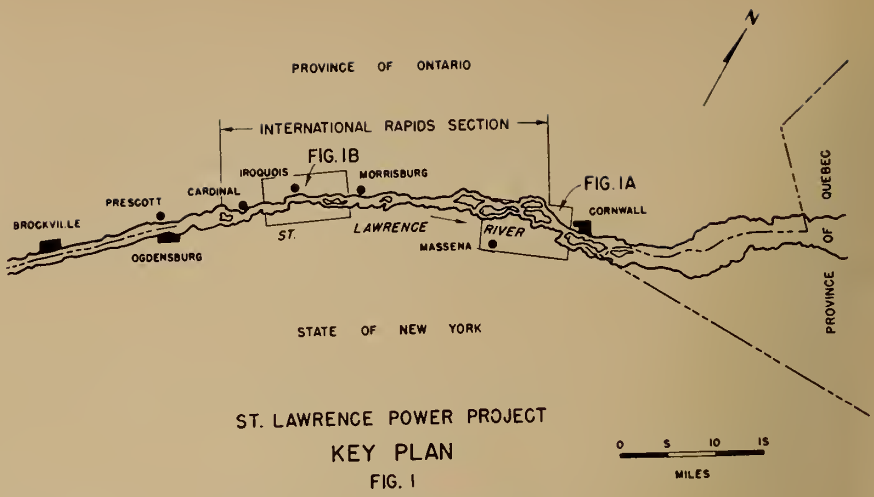


Fig. 1. St. Lawrence River, International Rapids section.

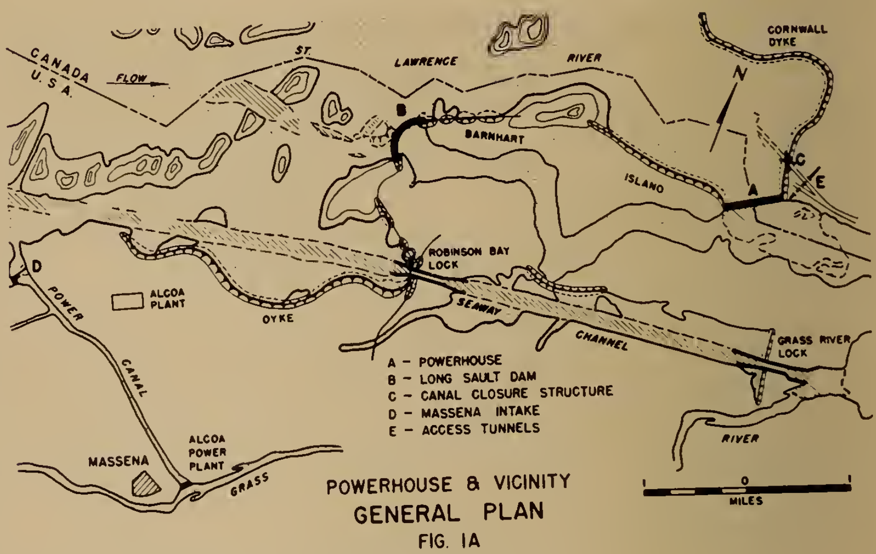


Fig. 1A. St. Lawrence power project, powerhouse area.

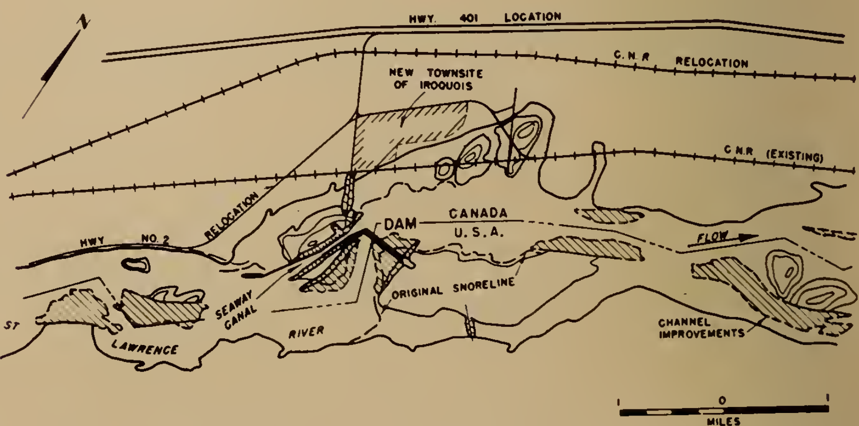


Fig. 1B. St. Lawrence power project, Iroquois area.

Barnhart Island and the American mainland. It is curved in plan although designed as a gravity section and is shown as Fig. 4. As will be seen, it consists fundamentally of a rollway surmounted by 30 spillway gates with a bulkhead gravity section at each end.

Each of the spillway gates is 50 feet wide by 30 feet high. Eighteen of these gates are provided with fixed towers and hoists, and the remaining twelve are operated by the means of two gantry cranes.

These thirty gates provide discharging capacity of several times the maximum river flow. The eighteen gates associated with the fixed hoists are made in two sections with semi-automatic couplings being provided between the sections. The upper section may be raised for the sluicing of ice or the whole gate can be raised as one unit.

The two gantry cranes at Long Sault (Fig. 5) are similar in design to those at Iroquois Dam. Each crane has a hoist capacity of 275 tons and a hoisting speed of two feet per minute. The main difference is that the Long Sault cranes are designed to allow the main hooks to reach 12 feet in front of the upstream rail for use during construction operations. A 10-ton auxiliary hook is added to the main hoist trolley for use in general maintenance work.

The architectural treatment given the cranes is similar to that applied at Iroquois dam. In this case, however, the cranes are even more massive being 79 feet long from bumper to bumper and 64 feet high. The machinery housing is 70 feet long by 64 feet wide and 21 feet 6 inches high and the weight of each crane without counterweight is estimated at 750,000 pounds.

During construction Long Sault dam provides the diversion course of the river. The first stage of construction at Long Sault provides 13 sluiceways with sills at elevation 165, the rollway portion being left out at this time as shown in Fig. 6. The water is passed through these openings during stage 2 construction and

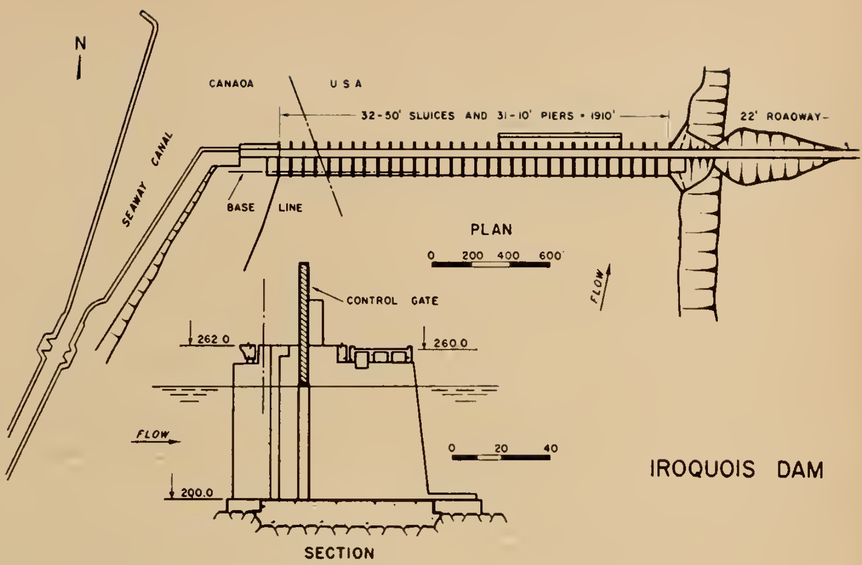


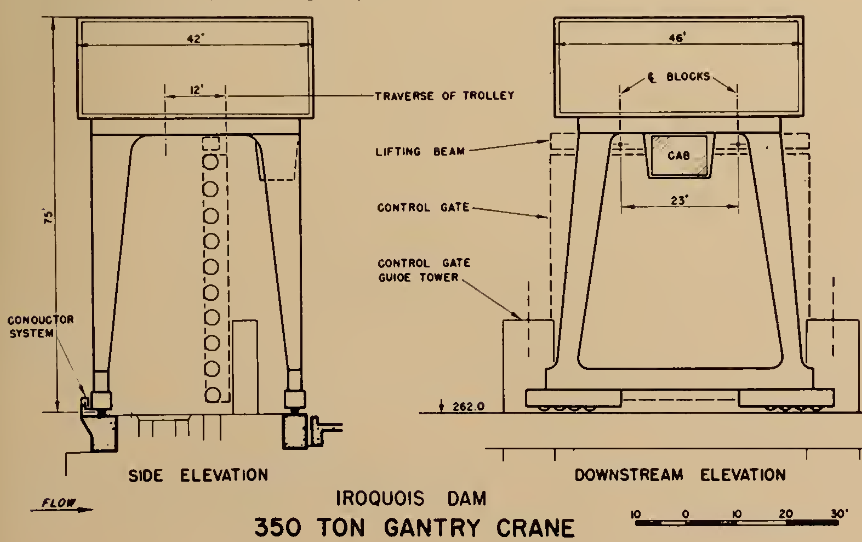
Fig. 2. Iroquois dam, general arrangement.

the water level is controlled to maintain the natural level at lock 21 on the Canadian 14-foot canal, thereby avoiding interference with present navigation. In order to provide this flow control, portions of the spillway gates are bolted together to give a gate 50 feet wide by 45 feet high. These are handled in their location on the upstream side of the dam by the two 275-ton gantries.

In the portion of the dam constructed during stage 2, Fig. 7, thirty-four ports, each 16 feet by 19 feet high, are provided. During the final stage of closure, these ports handle the entire river flow. Fixed roller gates are provided to close off these ports as required for closure flow control and for concreting operations.

During the closure process, the thirteen 50-foot wide diversion sluices are closed and concreted first, the river flow being progressively diverted to the closure ports. This does not affect the water level at lock 21 and permits 14-foot navigation to continue. The final operation is to close off the diversion ports.

Fig. 3. Iroquois dam, 350-ton gantry crane.



For maintenance of the sluice gates, a second set of checks is provided just upstream of the main service checks. A spare sluice gate is provided which may be lowered into this position to allow one sluice gate at a time to be taken to the gate maintenance shop located in the dam abutment. For the gates equipped with fixed towers and hoists, the hoists are arranged so that they can be removed, permitting the gates to be lifted out by the gantry cranes.

Protection against icing is provided by direct electric heating of the gate checks together with an air bubbler system (Fig. 8). Provision is also being made for the interior heating of the gate bodies. Heating of the gate sills is also provided by hot oil being circulated through a pipe attached to the sill beam. The electric heat exchangers and circulating pumps for the sill heating are located in the service gallery.

Powerhouses

As previously noted, the powerhouse consists of two structures located so as to meet at the International boundary (see Fig. 9). Each powerhouse contains sixteen 75,000-h.p. fixed-blade propeller turbines to which are directly connected 60,000 kva. vertical generators.

Although the equipment in both sections of the powerhouse is similar in capacity and function, there are variations between comparable items in order to meet the individual requirements of the two constructing entities. The exterior appearance of both sections of the powerhouse has been made identical and the cranes and other service items have been made interchangeable.

The powerhouses are of the semi-outdoor type with an enclosed erection bay located at each shore. The spacing between machines is 80 feet, giving a total powerhouse length of 3120 feet and a plan area of 13½ acres. In addition to the 32 generating units, there are six ice chute sluices located within the plants; two of these are at the centre astride the International Boundary, and the others pass under the erection bays located at each shore end. The generators are arranged with the top of the stator just a few feet below the powerhouse deck level, as shown in Fig. 10, and removable covers are provided over the generators to give a weather-tight housing for each unit. Crane service is provided to the powerhouse by two 300-ton totally enclosed gantry cranes. These cranes can be moved over a unit to provide a weather-tight area over the machine during maintenance.

Each turbine is arranged with a three-conduit intake and each individual water passage is provided with a 17-foot wide headgate. The headgates are operated by individual hoists located in pockets below the level of the headworks deck. Removable covers are provided over the hoist pockets to allow the headgates to be removed for maintenance.

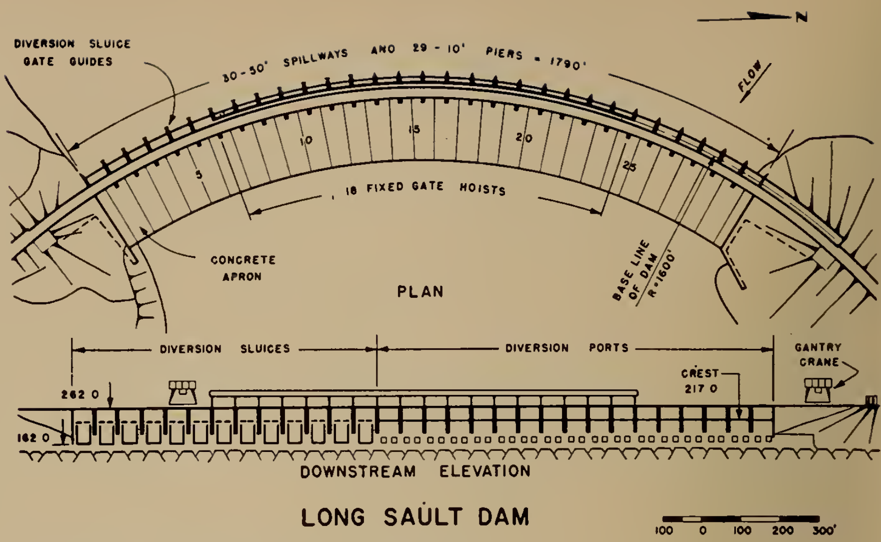


Fig. 4. Long Sault dam, general arrangement.

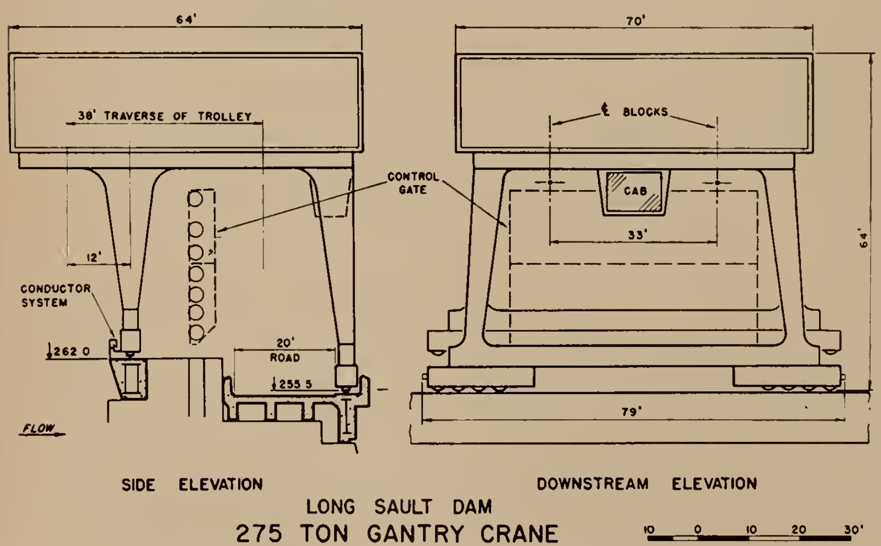
The headgates in the Canadian powerhouse are removed by being traversed forward into a cut-out in front of the hoist and then being hoisted vertically out of the gate pocket. To move the gate forward it is suspended from hanger links attached to a lifting beam. When moved forward, the lifting beam and links are disconnected from the headworks gantry crane and the bare hook block is connected to the gate for its transportation. While this change is being carried out the gate rests on the floor of the gate pocket.

The headgate hoists are designed for a hoisting speed of 5 feet per minute and a lowering speed of 10 feet per minute. The gates are lowered without power being supplied to the hoist motors, the speed braking effect being obtained from a fan brake which consists of an overloading type fan. During the normal hoisting motion, the fan absorbs only about five per cent of the horsepower absorbed when running in the reverse direction at twice the speed.

A solenoid-operated holding brake is fitted on the motor shaft, the coil being energized to release. The coil is designed for a 115-volt, d.c. supply and, during normal service, it is energized from the hoist supply circuit through a rectifier. In the event of an emergency involving failure of the normal station service supply, the brake may be released by energizing the coil from the station control batteries.

This arrangement of fan brake and d.c. holding brake is made for a particular reason. The fitting of fan brakes to headgate hoists is standard within the Commission's modern plants and the fitting of the d.c. holding brake is currently being adopted as a standard. The reason that this is done is that it is considered of paramount importance that it shall be possible to lower the headgates of a plant under any condition whatsoever, be it fire, loss of station service or turbine runaway. Thus, the fan brake is fitted as it permits the gate to be lowered without the hoist motor being energized. Its function is, of course, to restrict the rotational speed of the motor within safe limits, i.e., within 2½ times normal speed. The holding brake is fitted with a d.c. coil as this permits the provision of an "emergency lower" circuit supplied from the station control batteries — the most reliable source of electrical power. Should this source fail at the same time as the station service circuit, it is always possible to release the brakes manually with a

Fig. 5. Long Sault dam, 275-ton gantry crane.



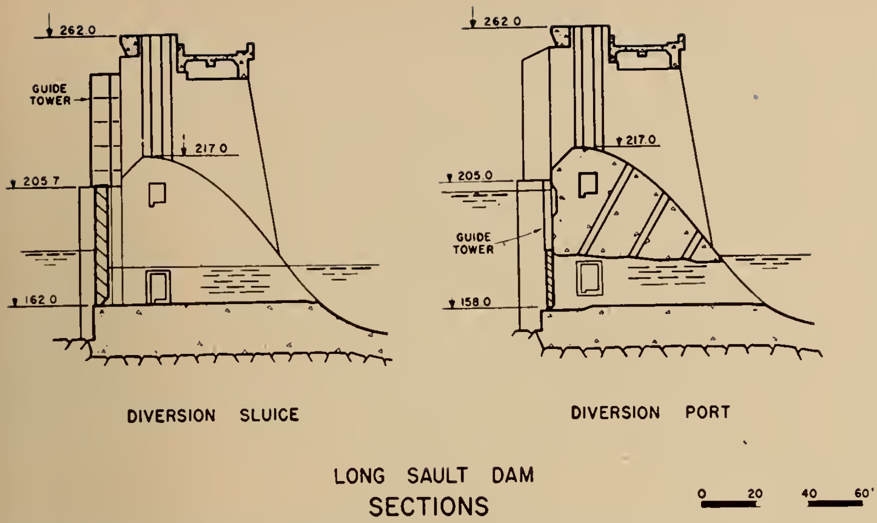


Fig. 6. Long Sault dam, diversion sluice for use during stage II construction.

Fig. 7. Long Sault dam, diversion port for use during final closure.

suitable lever or crowbar. This may be done in absolute safety as the fan brake will restrict the hoist motor speed as described above.

The capacity of the headgate hoists has been checked by model tests carried out in the hydraulic model laboratory of the Ontario Hydro at Islington, Ontario. A complete model of the intake structure and the gate was built to a true scale of 1:36. The actual test procedure used was one developed and refined during the past few years and consists essentially of supporting the model gate in such a way that all the horizontal hydraulic forces on the gate are balanced, allowing the vertical forces to be accurately weighed. This technique was proved in the design of the two large tunnel portal gates installed in the intake to the Sir Adam Beck-Niagara generating station No. 2 at Niagara Falls, Ontario.

Similar tests have also been carried out for the gates for Iroquois and Long Sault dams and also for the Massena intake. In the case of the diversion port gates at Long Sault, it was possible to reduce the hydraulic downpull to as little as one-third of the downpull found with the original design. The importance of such tests cannot be underestimated and their value to the gate designer is worth many times their cost.

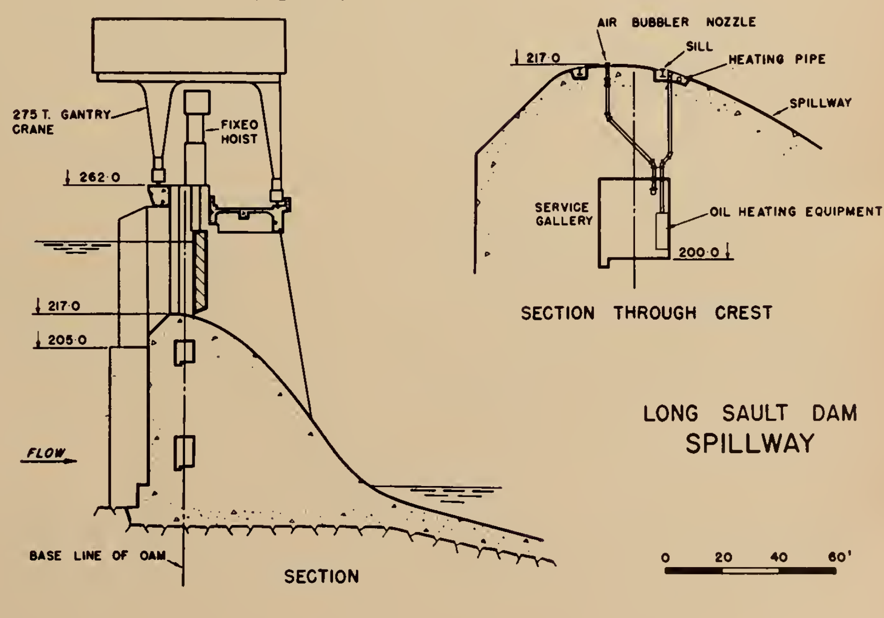
The two headworks gantry cranes are each of 90-ton capacity and their arrangements are shown in Fig. 11. Due to the difference in the arrangement for handling the headgates, the American gantry is of the double - drum, double - hook type, while the Canadian gantry is provided with a standard single hook. The only unusual feature of the cranes is the auxiliary jib hoist located on one of the upstream legs of each crane. These jibs service the stoplog checks and the trash racks. The jibs are arranged on the two cranes to face each other so that together they will handle the ice chute service gate frame. This frame is just under 80 feet long, and communication between the crane operators and their foreman for the closely co-ordinated motions that must be made, will be by short-wave radio. For maintenance of the headgates, a working area is provided at each shore abutment.

The ice sluice gates form one of the main features of the headworks block. The gates themselves will be of the hydraulically-operated drum type. Of the six gates installed, four are 75 feet long and the other two 50 feet long. The profile of the gate drum was determined from model tests conducted in a "plexi-glass" flume, as was the arrangement of the extended bucket portion under the erection bay (Fig. 12).

During the tests conducted for design of the gate profile, particular attention was paid to the manner in which passing floes of ice struck the rollway. The final results incorporated two protrusions on the upper skin plate of the drum. These had the effect of tending to destroy the horizontal velocity component of the flow passing over the gate, pulling the nappe upstream. This ensures that the ice is placed on the upper curve of the rollway instead of being dumped into the bucket at elevation 154.

The gates themselves will be raised or lowered hydraulically by adjusting the relative positions of two butterfly valves located in the valve chamber at elevation 191, under each gate pocket. One valve admits water at headpond pressure into the chamber under the drum; the other valve controls the flow from this chamber to the tailrace. The resulting water pressure within the chamber determines the elevation at which the drum gate will remain. Considering the extreme cases, if the outlet valve is closed the gate will rise to its fully closed position. If the inlet valve is closed and the drain valve opened the gate will move downwards to the fully open position. The control of the gate position will be initiated from a control

Fig. 8. Long Sault dam, spillway.



box located on the headworks deck. A position sensitive device controlling the position of the butterfly valves ensures that the gate will remain in the required position.

Electric heating of the interior of the drum, the side seal armature plates, and upstream and downstream seals is provided to prevent the formation of ice on the gate or the surfaces over which the seals pass during operation. Heating of the discharge valve line outfall is also provided. The heaters are controlled from the control point at deck level and the heating load for each gate totals about 275 kilowatts.

One service gate frame is provided to enable the ice sluice gates to be dewatered for inspection and maintenance. The frame is constructed so that it may be adjusted to fit across either the 75-foot or the 50-foot wide opening. Once lowered into position in front of the gate to be dewatered it is made into a watertight bulkhead by the use of steel stoplog sections normally used for unwatering the headworks. These are lowered into slots or checks in the frame, the whole handling operation being carried out by the 15-ton auxiliary jib booms of both headworks gantry cranes.

The decision to install the hydraulically-operated drum gates was made only after careful study. It was found that restrictions in space for locating the very large hoisting machinery required for any other type prove prohibitive. The upstream and downstream space available for the gate was also extremely limited. The drum gate has the advantage of forming part of the rollway in its lowered position and this, after modifications in profile determined by model testing, was a final factor in the decision.

Table I — St. Lawrence Power Project — Turbine Data

All Units are Fixed Blade Propeller Type Rated at 75,000 h.p. at 81-foot Head

Item		Canadian Powerhouse	American Powerhouse	
Manufacturer		English Electric Company of Canada	Allis-Chalmers	Baldwin-Lima Hamilton
No. of Units		16	8	8
Guaranteed performance				
75-foot head	Output	65,750 h.p.*	57,500	57,500
	Efficiency	92.5%	88.5%	89.7%
81-foot head	Output	71,000 h.p.*	71,000*	71,000*
	Efficiency	92.5%	90%	90%
87-foot head	Output	77,000 h.p.*	77,500	75,500
	Efficiency	92.5%	89.6%	88.8%
Maximum output at 87 feet		82,200 h.p.	85,000	82,400
	Efficiency	91.3%	....	....
Runner diameter		252 in.	240 in.	229 in.
Centre of distributor elevation		154.0	154.0	154.0
Main shaft coupling elevation		165.0	171.0	171.0
Diameter of outer headcover		341 in.	324 in.	308 in.
Diameter of inner headcover		270 in.	253 in.	245 in.
Governor capacity, foot-pounds		1,000,000	410,000	625,000

*Best efficiency points.

An erection bay is provided at the shore end of each powerhouse. Each is provided with cranes and other mechanical equipment and though, in general, similar facilities are provided, these vary in detail and to avoid undue length of this paper only those in the Canadian powerhouse will be described.

The erection bay is 215 feet long by 60 feet wide and is provided with crane service of 150-ton capa-

Table II — St. Lawrence Power Project — Powerhouse Auxiliary Equipment

	Canadian Powerhouse				American Powerhouse			
	Size or Capacity	Pressure psi. (nominal)	No.	Location	Size or Capacity	Pressure psi. (nominal)	No.	Location
Air compressors								
Station service	200 cfm.	100	2	Erection	500 cfm*	100	4	Divided between
	100 cfm.	100	2	bay area				erection bay
Governor system	87 cfm.	350	1	at eleva-	20 cfm.	350	2	and centre ice
	37.5 cfm.	350	1	tion 174.0				sluice at eleva-
Air blast breakers	27 cfm.	215	4		125 cfm.	100	2	tion 174.0
Oil handling equipment								
Insulating oil tanks	5,500 gal.	..	2	Oil room	8,000		2	
	2,000 gal.		1	in U-				
Lubricating oil tanks	3,500 gal.		2	abutment	4,000		2	Erection bay
	200 gal.		1	at eleva-				area
Filter Presses	40 gpm.		3	tion 174.0	1,200 gpm.			
Centrifuge	..				600 gpm.		2	
Oil purifier	..		1		..			
Draught tube dewatering								
Sumps	9'-0" x 7' -0"		8	Between			2	Divided between
Pumps	5,500 gpm**		8	each pair	5,000		4	erection bay
				of units				and centre ice
								sluice
Station drainage pumps	350 gpm.		8		200		4	One per 4 units
Fire pumps	1,000 gpm.	100	4	143.0 gallery	Water drawn from outside storage tank			

* Connected to draught tube depression system
** Direct connected to draught tube-gravity drainage for scroll case

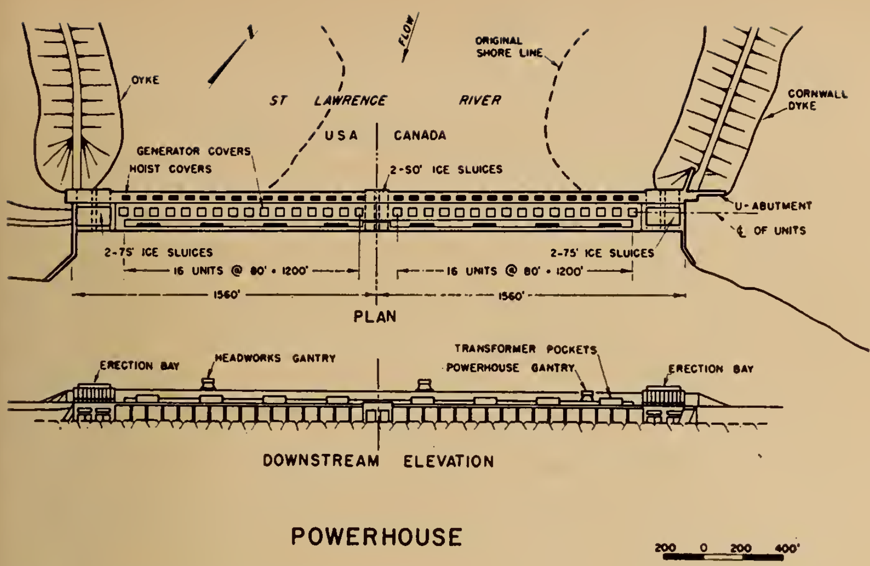


Fig. 9. Powerhouse, general arrangement.

city. This is achieved by two 80-ton cranes which can be used as one 150-ton unit by connecting their hooks with a lifting beam (Fig. 13). These cranes have the rather unusual feature of an auxiliary hoist outboarded to one side of the main crane girder, allowing the cranes a very close end approach. In fact, the auxiliary hook may be placed within a foot and a half of the end wall of the erection bay. This makes for greater use of the erection bay floor area and also enables the crane to reach down to the lower service galleries through a hatch in the erection bay floor.

In the end of the erection bay, adjacent to the powerhouse, is a vertical sliding door some 60 feet wide by 58 feet high. This door permits the main powerhouse gantry crane to enter the erection bay to pick up or set down its loads. The door is power-operated and will be capable of being raised in less than a minute. The lower level of the erection bay is used for a variety of purposes such as storage and the installation of auxiliary equipment.

Figure 10 shows a typical cross-section through one of the generating units in the Canadian powerhouse. As the various items of equipment for the 32 generating units are being supplied by several different manufacturers, variations exist from unit to unit. However, a typical unit comprises a fixed blade propeller turbine of 75,000 horsepower at 81 foot head and running at 94.7 r.p.m. The distributor centre line is at elevation 154, which is also the minimum tail-water elevation. The de-

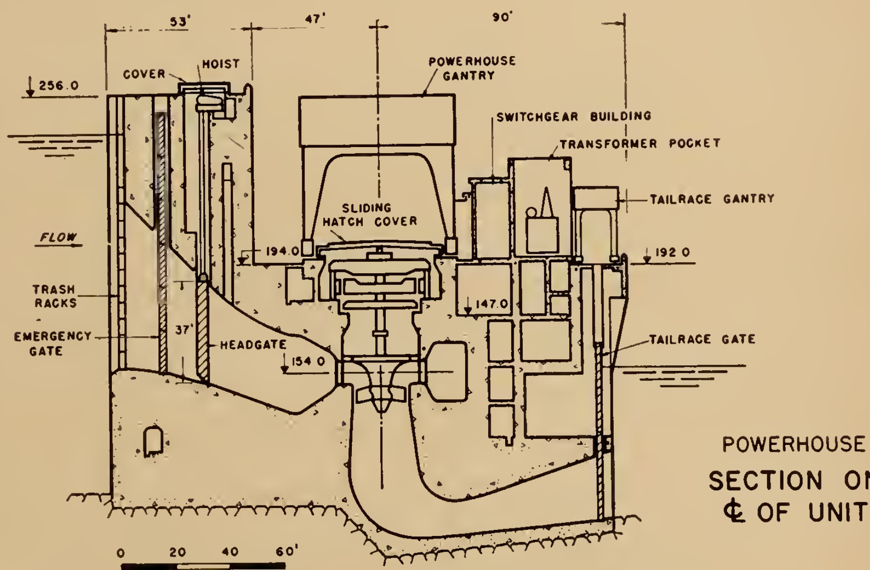
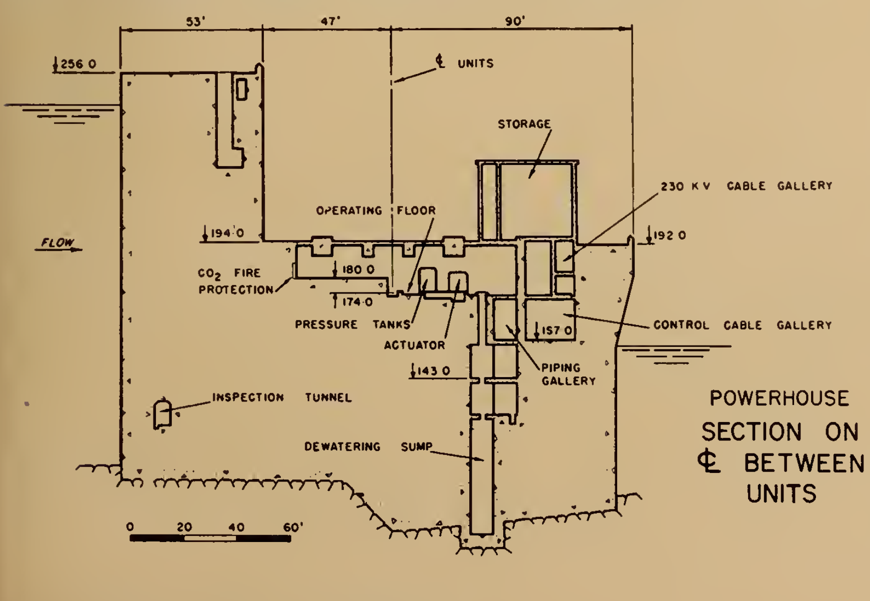


Fig. 10. Canadian powerhouse, typical cross-section through a unit.

Fig. 10A. Canadian powerhouse, typical cross-section between units.



tails of the various machines to be installed are shown in Table I.

The turbine pit liner is extended up to the generator foundation, which has been set as low as practicable to give a minimum overall height to the powerhouse. The generators are rated at 60,000 kva. at 95 per cent power factor. The covers over the generators are designed to split in the centre and are rolled back to permit maintenance work to be carried out on the units. The covers are some 46 feet wide by 43 feet long and are designed to be moved by electric power.

Between each pair of turbines at the 174 level is located the governor actuator cabinet. The actuators are of the twin unit type and include the governor mechanism, pressure

Table III. — St. Lawrence Power Project — Hydraulic Gate Data

Item	No.	Gate Opening Width	Gate Height	Design Head on Sill (feet)	Gate Weight (lb.)	Downpull from Tests (lb.)	*Type of Wheel	**Type of Bearing	Method of Operation	Lifting Speed (ft. per min.)
Iroquois Dam—										
Main gates	32	50'-0"	48'-0"	25 max. differential	340,000	16,000	Flanged	bronze	Gantry	7
Steel stoplogs	6	50'-0"	8'-0"	"	60,000	....	....	....	Gantry	7
Long Sault Dam—										
Main gates	18	50'-0"	29'-8"	29.5	(See Note [1])	10,000	Flanged	roller	Fixed hoist	1
Main gates	13[2]	50'-0"	29'-8"	43	200,000	10,000	Flanged	roller	Gantry	2
Gates coupled for diversion	13	50'-0"	45'-0"±	43	284,000	52,000	Flanged	roller	Gantry	2
Diversion port gates	34	16'-0"	21'-6"	88	61,000	150,000	Flanged	roller	Gantry	2
Massena Intake—										
Service gates	4	15'-0"	31'-0"	85	90,000	20,000	Flanged	roller	Fixed hoist	5 (10 lowering)
Emergency gates	4	15'-0"	35' 6"	85	94,000	136,000	Flanged	roller	Fixed hoist	5 (10 lowering)
Steel stoplogs	8	15'-0"	6'-0"	85	11,000	....	....	....	Operated by mobile crane	
Canal Closure Structure—										
Steel stoplogs	1 Set	50'-0"	74.5	72.5	50,000 max.	....	....	....	Operated by mobile crane	
Barnhart Island Powerhouse—										
Ice chute drum gates	4	75'-0"	17'-0"	16	209,500	....	....	bronze	Hydraulic operation by control floatation chamber pressure.	
	2	50' 0"	17'-0"	16	147,500	....	....	bronze	Gate designed to be fully opened in not more than 60 sec.	
Service frame	1	50'/75'	18'-0"	17	50,000	....	....	....		
Headgates—Canadian	48	17'-0"	37'-3"	96	87.500[3]	238,000	Plain	Bronze	Fixed hoist	5 (10 lowering)
Headgates—American	48	17'-0"	39'-3"	97	140,000	....	Flanged	roller	Fixed hoist	5
Intake steel stoplogs—Canadian	33[4]	17'-0"	8'-6"	90.5	15,500	....	....	....	Gantry	30
—American	6	17'-0"	8'-2"	91	19,000	....	....	....	Gantry	30
Draught tube gates										
Canadian steel stoplogs	66[4]	17'-0"	8'-6"	90.5	15,500	....	....	....	Gantry	60
American steel stoplogs	18	17'-0"	7'-10"	90	17,000	....	....	....	Gantry	30

NOTES: (a) Gates designed for maximum ice load of 10,000 pounds per linear foot extending down four feet from water surface.

(b) Model tests of hydraulic downpull were conducted at the Ontario Hydro Hydraulic Laboratory, Islington, Ontario.

*Type of Wheel F—Double flanged wheel running on a heavy rail
P—Plain wheel running on a planed steel surface

**Type of Bearing, Bronze — Bronze bushing with graphite inserts

[1] Three different types of split gates provided
Top section height varies: 12'-0", 14'-0" and 17'-0"
Weight varies 206,000, 216,000 and 200,000 pounds respectively

[2] Includes one extra gate for diversion position — later used a spare gate

[3] 85,000 pounds of concrete ballast extra

[4] Stoplogs are interchangeable between intake and draught tube

system pumps, and the sump tanks for two units. The governor pressure tanks are located on the same floor behind the actuator cabinet.

Two auxiliary turbine driven emergency governor pumps are installed on the 143.0 floor of the Canadian powerhouse. These units draw their water supply from the scroll cases of units 4 and 12 and are each capable of supplying the governor oil pressure necessary to operate one main generating unit, providing an emergency standby for the electric-motor driven governor pumps located in the actuator cabinets of those units. The auxiliary governor pressure pumps will give complete reliability for starting of the main generating units even in the event of the complete electrical isolation of the plant, as it will always be possible to start up one or two units to restore normal station service to the plant.

Two totally enclosed 300-ton gantry cranes are to be supplied, one for each powerhouse. These cranes are identical in external appearance and have the same general architectural treatment that was applied to the gantry cranes at Long Sault and Iroquois dams (Fig. 14). The upstream and downstream sides of the cranes are sheathed with aluminum, and rolling doors at each end complete the enclosure. Once the crane has been centred over a unit and the generator cover has been rolled back, the doors will be lowered to give a weatherproof working space, enabling maintenance of a generating unit to be carried out under any climatic conditions.

The cranes run on a common track

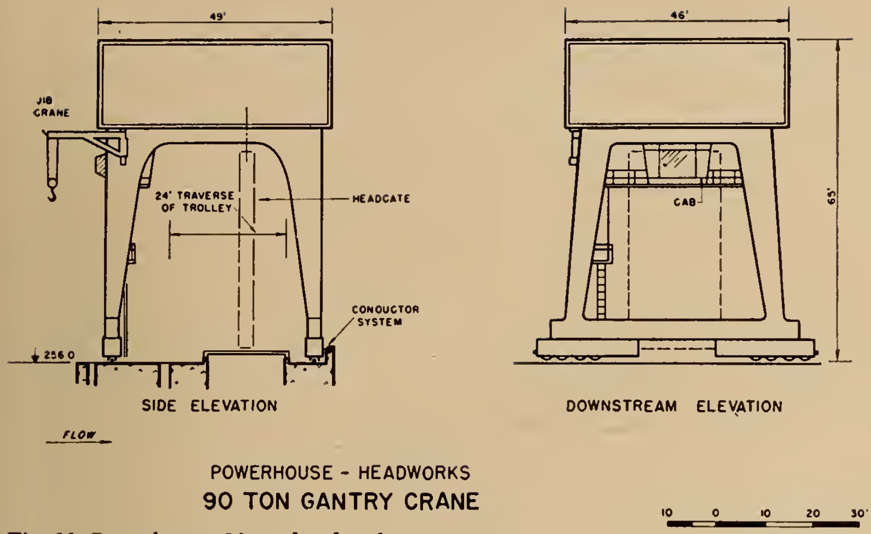


Fig. 11. Powerhouse, 90-ton headworks gantry crane.

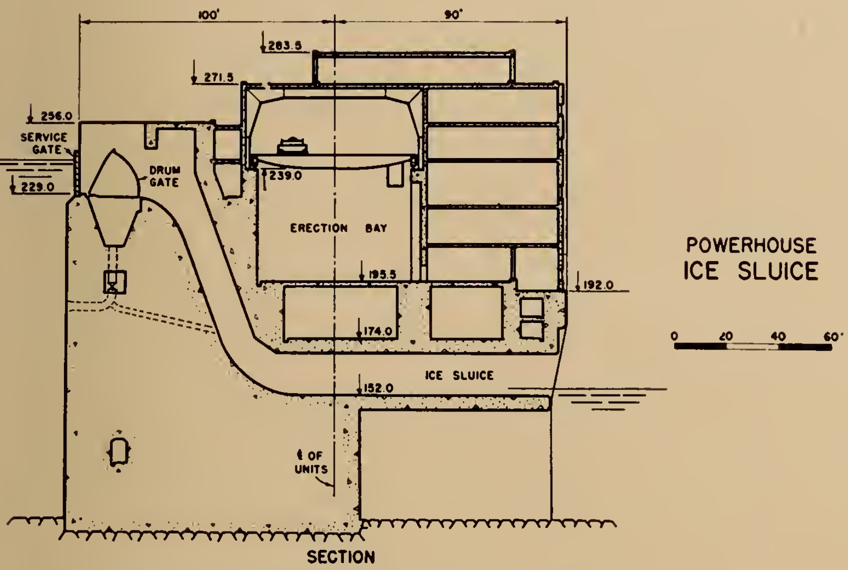


Fig. 12. Powerhouse, section through shore ice sluice and erection bay.

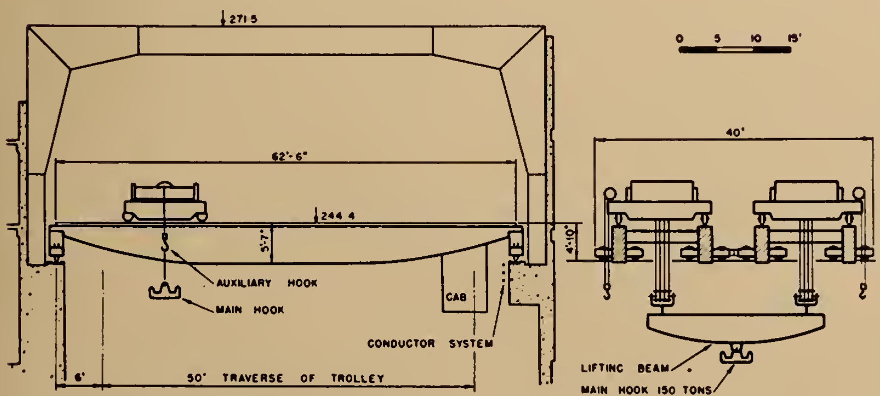


Fig. 13. Canadian powerhouse, 80-ton erection bay cranes.

with the rails set 53 feet apart. This track extends from the shore end of the Canadian erection bay to the shore end of the American erection bay. This arrangement permits the cranes to service any unit and to carry the parts into either erection bay. Thus, in an emergency both cranes could be used in one powerhouse to minimize delay and thereby shorten the outage time of the units under repair.

Each crane has a single hook 300-ton hoist and an arrangement for auxiliary hook service. Within the Canadian crane there are two 15-ton auxiliary jib cranes which are mounted on the underside of the main hoist bridge girders. These jibs are designed to rotate the full 360 degrees and give complete coverage of a unit without any travel motion of the gantry. They may place loads on the roadway immediately upstream of the crane by passing their booms through a door in the side sheathing of the crane. This feature eliminates the necessity of having to travel the gantry crane to set down minor loads.

The Canadian crane is provided with a speed-load compensating d.c. drive. The hoist control is arranged to give a speed limitation varying with load in both the hoisting and lowering directions. The unloaded main hook speed is about 18 feet a minute and this is reduced to six feet a minute if the hook is fullv loaded. The control svstem also allows the operator to "float" any load. The hoist brake may then be set or released without the load changing position. The controls and drive are so selected, that they mav be connected either to the main hoist motor or to the travel motors. The auxiliary jibs within the crane are provided with normal a.c. wound rotor motor drives and control.

Due to the size of the powerhouses a radio communication svstem is to be installed between the main cab of the gantry cranes and the powerhouse telephone switchboards. Walkie-talkie type sets will be provided for communication to the jib crane operators.

The main power transformers for the station are located on the tailrace deck. Two transfer trucks are provided to handle the transformers in and out of their pockets and, when necessary, to carry them to the erection bay, the truck for one powerhouse being available to the other during maintenance work. As a re-

Table IV — St. Lawrence Power Project — Gantry, Crane and Hoist Data

Item	Main Hoist							Main Hoist – Hoist Trolley					Auxiliary Hoist								Bridge										Number installed	Total weight
	Capacity (tons)	Type	Lift above rail	Total lift	Hoist Speed (ft/min)	Motor hp	Motor type	Brake type	Total Trolley Traverse	Traverse Speed (ft/min)	Motor hp	Motor type	Brake type	Capacity	Type	Lift above rail	Total lift	Hoist speed	Motor hp	Motor type	Brake type	Span	Type	Travel speed	Motor hp	Motor type	Brake type	Number of wheels	Wheel dia	Maximum static wheel load	Rail wt.		
		(a)					(b)	(c)				(b)	(c)		(d)					(b)	(c)		(e)			(b)	(c)						
Iroquois Dam Gantry crane	350	OD	53'-6"	110'-0"	7	200	WR	S	12'-6"	15	15	WR	S	..								38'-0"	EM	75	4 at 20	WR	S+H	16	24	90,000	175	2	670,000
Long Sault Dam Gantry crane	275	OD	45'-4"	95'-0"	2	50	WR	S	38'-0"	15	10	WR	S	10	T	45'-4"	80'-0"	15	10	WR	S	42'-0"	EM	75	4 at 20	WR	S+H	16	36	152,000	175	2	750,000
Gate hoists	175	OD	..	35'-0"	2	25	SC	S	....					..								60'-0"	EM	..								18	70,000±
Massena Intake Gate hoists	100	SS	..	45'-0"	5	50	SC	F+S	....					..								..										8	32,000
Powerhouse Headgate hoists Can	120	SS	..	56'-7"	5-10(f)	40	SC	F+S	....					..																		48	39,000
USA	115	SS	..	54'-9"	5	2 at 25	SC	T	....					..																		48	36,400
Headworks gantry crane Can	90	SS	44'-6"	114'-6"	5	50	WR	M+S	24	50	15	WR	S	15	J	24'-0"	120'-0"	30(g)	40	WR	M+S	42'-0"	EM	100	4 at 15	WR	T	8	27	91,000	105	1	375,000
USA	90	OD	44'-6"	104'-6"	5	40	WR	M+S	25	15	5	WR	S	15	J	36'-8"	116'-0"	30(g)	25	WR	M+S	42'-0"	EM	100	4 at 7½	WR	T	16	24	52,000	105	1	453,000
Powerhouse gantry crane Can	300	SS	43'-6"	79'-0"	6-18(h)	125	DC	R+S	24' min	20-60(h)	12½	OC	R+S	2 at 15	J	32'-0"	92'-"	60(i)	75	WR	M+S	53'-0"	TE	100-200(h)	4 at 35	OC	R+T	16	30	143,200	175	1	1,176,000
USA	300	SS	43'-6"	75'-0"	5	125	WR	M+S	30'-3"	15	10	WR	T	10	M	35'-0"	100'-0"	25(j)	20	WR	M+S	53'-0"	TE	100	4 at 15	WR	T	16	27	111,800	175	1	740,000
Erection bay crane Can	80(k)	SS	2'-2" BELOW	60'-4"	7.65	60	WR	M+S	50'-6"	43.5	10	WR	..	15	T	4'-5" BELOW	103'-1"	51.5	60	WR	M+S	62'-6¾"	S	129	40	WR	N	8	20	57,000	85	2	136,000
USA	150(l)	2-SS	0	60'-0"	5	30	WR	M+T	38'-0"	34	3	WR	S	1 at 25	T	0	68'0"	27	50	WR	M+T	62'-0"	S	75	20	WR	H	8	33	94,000	100	1	213,000
USA	5(m)	SS		40'-0"	35		WR	M+S		75		WR	S	..								60'-0"	S	75		WR	S	4			40	2	24,500
Tailrace deck gantry Can	15	SS	20	105'-0"	60		WR	M+S		30		SC		..								15'-0"	EM	150		WR	T	4			90	1	
USA	15	SS																				15'-0"	EM								90	1	

(a) Hoist type OD = Double drum - double hook
SS = Single drum - single hook

(b) Motor type WR = Wound rotor induction motor
SC = Squirrel cage induction motor
OC = Direct current mill-type motor, power supplied from a.c./d.c. M.G. set

(c) Brake type S = Solenoid holding brake
F = Fan load brake
M = Mechanical load brake
T = Thruster holding brake
H = Hydraulic-controlled from cab
R = True regenerative
N = Mechanical-controlled from cab

(d) Aux hoist type T = Mounted on main trolley
J = Jib crane type
M = Mono rail type

(e) Bridge type EM = Enclosed machinery housing
TE = Totally enclosed
S = Standard

(f) Raising speed 5 ft/min, lowering speed against fan brake 10 ft/min

(g) Jib slew speed, 1 rpm

(h) Speed limit varies with load in both raising and lowering directions ("maxspeed" control)

(i) Jib trolley travel 40 ft/min, slew speed 2 rpm

(j) Monorail travel speed 25 ft/min

(k) Combined capacity of both cranes with lifting beam = 150 tons

(l) Combined capacity of two trolleys on crane

(m) Floor controlled

sult, it will be possible to reduce outage time resulting from a transformer fault. Power supply for the operation of the trucks is obtained from the tailrace gantry conductor system located in the downstream parapet wall.

Two 15-ton capacity tailrace deck gantry cranes will be used for handling the steel stoplog sections required to close off the draught tube exits when a unit is to be dewatered. The hoisting speed will be 60 feet per minute and it is anticipated that both cranes will be used together during maintenance in order to reduce the time required for transporting and setting the gate sections. The details of the auxiliary systems in the two powerhouses are shown in Table II.

The powerhouse drainage and draught tube dewatering arrangement in the Canadian powerhouse is arranged on a two-unit basis, a sump being provided between each pair of units which takes all drainage below tailwater level. A main cooling water header runs the length of the plant and is fed from take-offs on each scroll case, and additional take-offs are provided on alternate scroll cases.

The station air compressors are located in the lower level of the erection bay, while those for the air blast breakers are located at units 4 and 12. The oil handling equipment is located under the gate maintenance area in the U-abutment at shore end of the headworks block. Automatic CO_2 fire protection is provided on a four-unit basis for the generators and a separate CO_2 bank is provided for the oil room.

The heating system for the Canadian erection bay and control building areas is based on two large capacity heat pumps. These units are located in the lower level of the erection bay and will provide a heating effect of 5,390,000 B.t.u. per hour or a cooling effect of 239 tons of refrigeration. The source of heat for these units is the generator cooling water. Temperature control valves are fitted on the discharge lines from the generators and three transfer pumps are used to deliver the discharged cooling water to the erection bay. This heating system will not only supply the control area but will also be used to heat the entire erection bay. The installation of this arrangement enabled the 550-volt station service rating to be reduced by some 1000 kilowatts.

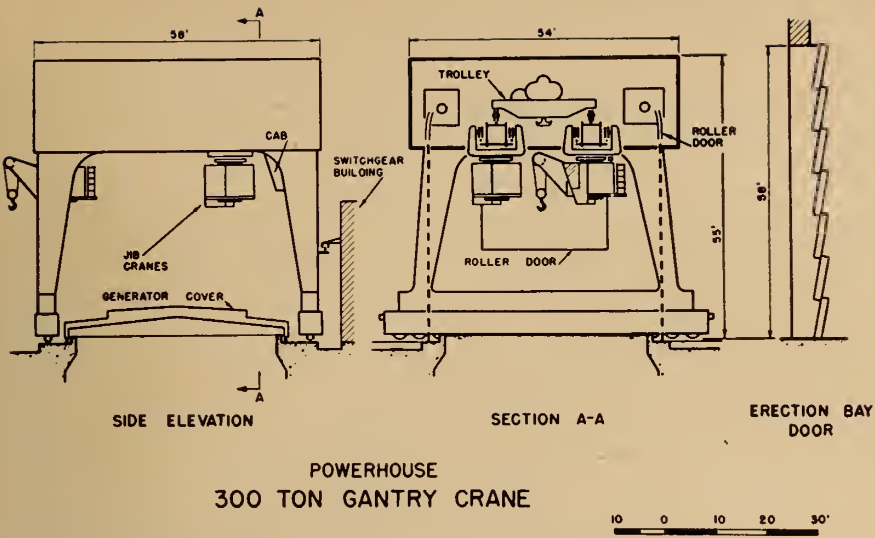


Fig. 14. Canadian powerhouse, 300-ton powerhouse gantry crane.

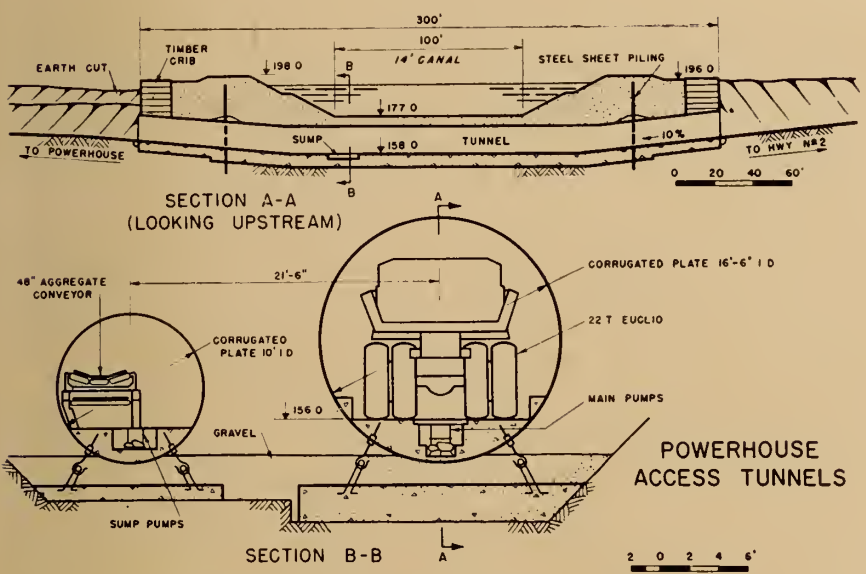


Fig. 15. Access tunnel under 14-foot navigation canal.

Access Tunnels

One unusual feature of the access to the Canadian side of the project is the tunnels under the 14-foot navigation canal and its diversion cut (Fig. 15). The one with the larger diameter provides ready and rapid access to the dewatered powerhouse site for heavy construction equipment, and the smaller tunnel is for personnel and a conveyor system. The problem of providing a pumping system to drain these tunnels was quite considerable as it was considered inadvisable to pierce the corrugated steel tunnel liner. A concrete roadway was poured in the larger tunnel to a maximum depth of three feet and it was within this concrete block that the pumping system was located. The final arrangement for the larger tunnel was for four submersible pumping units, operating under sequenced electrode control, placed in a shallow trench or sump on the centre line of the roadway. Each unit has a capacity of 250 gallons per minute and the sump has a depth of only 30 inches. The sumps are covered with a very substantial reinforced floor plate designed to take the wheel load of a loaded 15-ton truck. Electric heating of the roadway has been provided to ensure continuous access to the powerhouse area even under the severest weather conditions.

The conveyor tunnel is protected from water draining down the approach cuts and is provided with two small sumps. A domestic type submersible pump is installed in each sump to transfer leakage water to the sump in the larger tunnel.

Future Annual Meetings

1957
Banff Springs Hotel, June 12, 13, 14

1958
Quebec, Chateau Frontenac, May 21, 22, 23

1959
Toronto, Royal York Hotel, May

1960
Winnipeg. Details to be determined

The Use of Hydraulic Models in the St. Lawrence Seaway Planning and Design

D. McIntyre, M.E.I.C.,

Hydraulic Engineer, The St. Lawrence Seaway Authority

Read at the 70th Annual General and Professional Meeting, The Engineering Institute of Canada, Montreal, May 1956

IN SCOPE and intensity the hydraulic model study work, in various stages of completion, being carried out in connection with the St. Lawrence Seaway planning and design, is probably unsurpassed in the history of engineering. This huge model study program has been made necessary not only by the number and complexity of engineering problems which must be solved in the limited time available, but also because of the multiplicity of interests affected by Seaway works. Parties vitally concerned in any changes in the natural state of lakes and river channels along the Seaway route run the full range from individual property owners to Federal Governments. The international, interprovincial, and interurban character of the St. Lawrence Seaway makes it essential that the effects of all development work be predicted accurately, and that the best engineering design procedures be used.

In discussing the use of hydraulic models in the St. Lawrence Seaway planning and design it is convenient to separate them into two groups according to whether their purpose is to develop plans for river channel improvements, or to provide design information for hydraulic structures. In so far as possible the models discussed in this paper will be limited to those connected with the development of a Seaway channel as opposed to those relating to power development. Hydraulic structures for which models have been built can be divided quite easily into those, such as locks and guard gates typically associated with navigation channels, and those, such as dams and spillways, typically associated with the power project. However, most river channel improvements affect both power and navigation so that practically all river models have yielded information useful to both power and the navigation interests.

It has been necessary to undertake a large program of model studies to solve many of the complex engineering problems inherent in the Seaway works and because of the multiplicity of interests which they affect. A broad picture of the use of models is given here, without detailing the mathematical aspects.

Since the author has not been directly associated with river model work, little more than a brief description of each river model, together with a list of the more important engineering data required from each can be given. The hydraulic structures models are dealt with somewhat more fully, an attempt being made to show how these models are used to develop design improvements. Due to the fact that several different organizations are involved in model study work a brief description of methods used to co-ordinate the model study program is also presented.

River Models

Laboratories conducting river model studies relating to the St. Lawrence Power and Navigation Project include the Waterways Experiment Station at Vicksburg, Miss., the Ontario Hydro-Electric Power Commission Laboratory at Islington, Ontario, and the National Research Council Laboratories at Ottawa, Ontario. Additional model studies are to be made in a new hydraulic laboratory now under construction at Montreal, Quebec.

Organizations directly responsible for Seaway design are the United States St. Lawrence Development Corporation, which has delegated the U.S. Army Corps of Engineers to design and construct the American portion of Seaway works, and the Canadian St. Lawrence Seaway Authority. Those responsible for power development works include the Power Authority of the State of New York and the Hydro-Electric Power Commission of Ontario.

The fact that river model studies are being conducted by or for the different organizations concerned with navigation and power development at widely separated points has called for close co-operation between these organizations to prevent excessive duplication of effort. Integration of the model study program is attained through frequent meetings between representatives of all groups concerned with design and model study work. Basic data such as water and river bed elevations are exchanged as well as test results from the models. Considerable model study work is also done on an exchange basis so that the most efficient use may be made of all models. When a model belonging to one group is being used to obtain test results of general interest, other groups are privileged to maintain one or more engineers at the laboratory concerned. These engineers report model test results to their home offices and, in general, look after the interests of their respective organizations. This method of co-operation has worked out so well that there has been no call for the setting up of a special committee to co-ordinate model study work.

Generally speaking, improvement of the river channel between Lake Ontario and the Barnhart Island power house is considered primarily a power requirement, although this improvement is beneficial to navigation. This is largely due to the fact that power requirements limit the maximum mean flow velocity in river channels to 2.25 feet per second during the freeze-up period in order that an ice cover will be formed, while maximum mean velocities of four feet per second may be tolerated in navigation channels. River improvement works upstream from the power house have, therefore, been allotted to the power interests with the stipulation that these works must also satisfy the needs of navigation. As a result of this arrangement, all models for this section of the river have been constructed by the Hydro-Electric Power Commission of Ontario. These models will be dealt with first, beginning with those representing upstream reaches of the channel.

All river models are of the fixed bed type built of concrete, the method of construction varying somewhat at different laboratories. With one exception these models are built to a distorted scale, distortion ratios of 1:1.6, 1:3 and 1:5 being used.

(1) The Galop Rapids Reach

In the Galop Rapids reach of the St. Lawrence River is located the control section for outflows from Lake Ontario. The plan for improvement of this reach calls for increasing the channel cross-section, thus transferring the control of river discharge to a dam now under construction at Iroquois. The model used to develop a final plan for improvement of the Galop Rapids reach was built by Ontario-Hydro at the Islington laboratory. The entire reach from Prescott to Iroquois was reproduced in this model, as shown in Fig. 1, the scale ratios being 1 to 100 and 1 to 500 in the vertical and horizontal directions respectively.

The purposes for which a model of this reach was required were:

(a) To develop the most economic channel improvement plan in the way of excavation and spoil bank locations to best serve the interest of power and navigation.

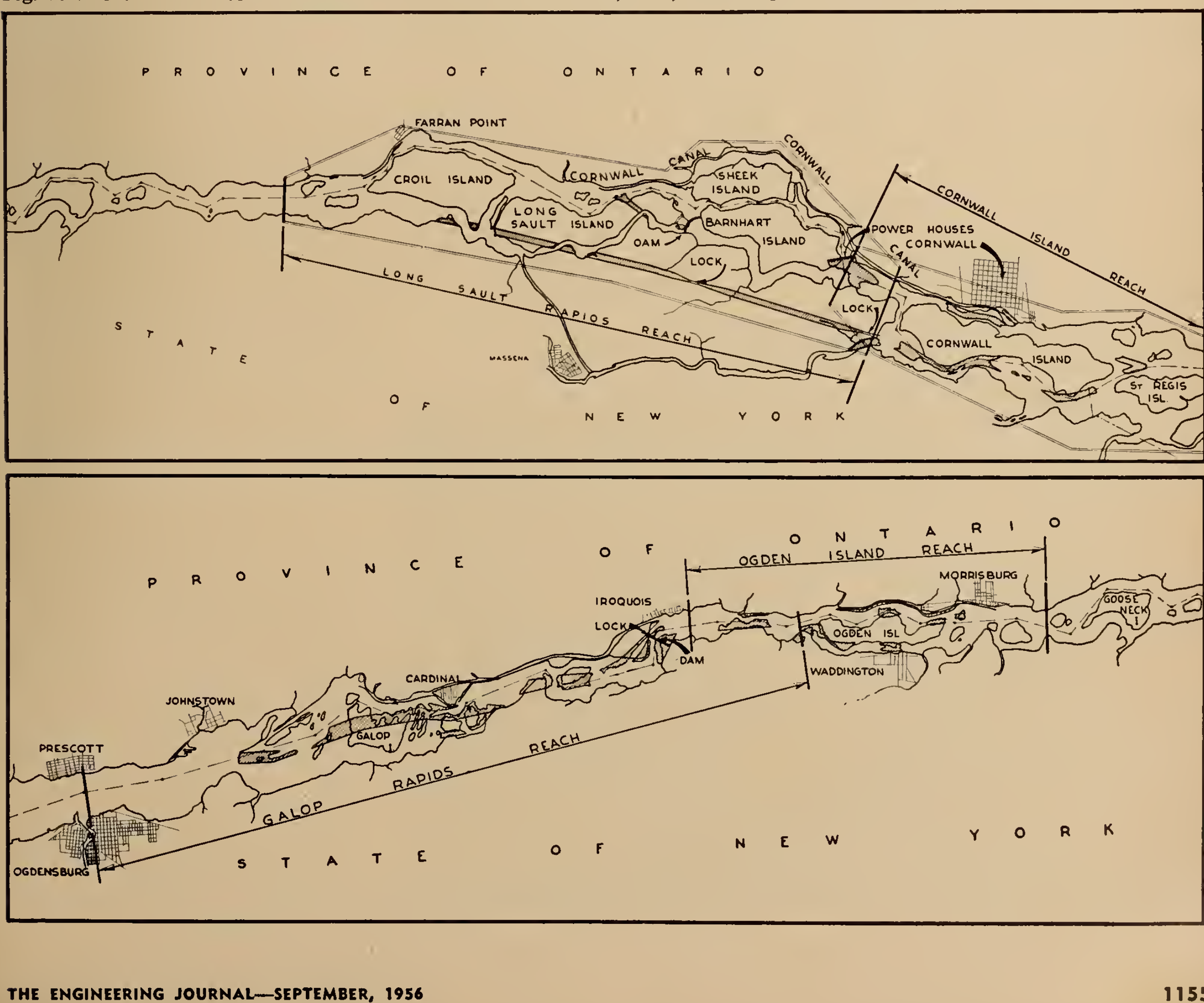
(b) To find the best location and alignment for the new Iroquois lock and approach channels.

(c) To help work out a construction program to prevent serious alterations in river discharge characteristics during the construction period.

(d) To determine the effect of proposed improvement features on water levels and flows.

Of these, only the first two are

Fig. 1. The St. Lawrence River between Prescott and Cornwall, Ont., indicating the various reaches.



directly related to Seaway design and will be elaborated upon more fully.

The problems of determining the most economical location for upstream channel excavation and of best alignment for Iroquois lock are related to the extent that it is desirable to maintain a straight navigation channel wherever possible. Where a straight alignment is not practicable a wider channel must be provided, and the minimum radius of curvature has been set at 5000 feet. For the Galop Rapids reach, where considerable channel excavation is required in the interest of power development, an extensive model study program has been carried out to develop an improvement plan which satisfies both power and navigation interests.

A proposed plan for works to be constructed by the Canadian Seaway Authority, including Iroquois lock and the approach channel upstream as far as Toussaint Island, was supplied to Ontario-Hydro by the Seaway Authority. This plan was reproduced in the Galop Rapids model together with the plan proposed by power interests for improvement of the entire reach upstream as far as Prescott. To determine the adequacy of provisions made by this plan for navigation the following information was obtained:

(a) Water depths and the direction and velocities of currents in lock approach channels as well as in the navigation channel upstream as far as Prescott.

(b) The effect on flows of proposed spoil bank areas for material to be excavated from lock approach channels.

(c) Water levels governing sill and coping elevations at Iroquois lock.

(d) The range of lifts at Iroquois lock which will obtain under various operating conditions of the St. Lawrence Power Project.

In working out details of the improvement plan for the Galop Rapids reach, it has been necessary to provide for control of Lake Ontario levels in accordance with a generally adopted scheme of regulation. At the time of writing this paper, such a scheme, suitable for design purposes, has been agreed upon by all parties concerned and model tests are in progress to determine final adjustments required in the improvement plan for the Galop Rapids reach.

To complete the story on models for the Galop Rapids reach relating to Seaway design, one other study will be mentioned briefly. This was made by the U.S. Army Corps of Engineers at the Waterways Experiment Station at Vicksburg, Miss., during the period 1943 to 1945 in connection with a scheme of river improvement very similar to that developed in the Islington model. Basic data compiled for the earlier model, as well as much of the test data obtained, were helpful in the more recent studies.

Fig. 2. Model of Cornwall Island reach at the National Research Council laboratories in Ottawa, Ont.

(2) Ogden Island Reach

The river immediately downstream from the Town of Iroquois, termed the "Ogden Island Reach", is characterized by narrow channels with velocities rather higher than the maxima specified for power and navigation. The required model was built and tested by Ontario-Hydro at their Islington laboratory, model scales being 1 to 100 and 1 to 500 in the vertical and horizontal directions respectively.

Information supplied by this model was as follows:

(a) The most economical locations and cross sections of channel excavations required to satisfy the needs of power and navigation.

(b) The proper balance of excavations in north and south channels at Ogden Island required to maintain flow distribution as in the natural state.

(c) The delineation of spoil dump areas for excavated material.

(d) The effect of temporary and permanent construction works on water levels.

(e) The development of a construction program such that the present 14-foot navigation will not be disrupted during the construction period.

The model study for this reach has been completed with the development of an improvement plan essentially satisfactory to both power and navigation interests. This plan calls for excavations at Point Three Points; in north and south channels at Ogden Island, and the removal of the Morrisburg canal bank, as indicated roughly in Fig. 1.

(3) Long Sault Rapids Reach

A model of the Long Sault Rapids reach was also built by Ontario-Hydro at the Islington laboratory, and reproduces the river channel from a point upstream from Croil Island to Massena Point downstream from the Barnhart Island Power House, as shown in Fig. 1. Model scales are the same as those used in the Galop Rapids and Ogden Island models.

The main purpose of this model was to develop a program for diversion and closure operations involved in the construction of Long Sault Dam and Barnhart Island Power House. At the time of writing this paper the diversion and closure problems had been successfully worked out, and the model was being used to

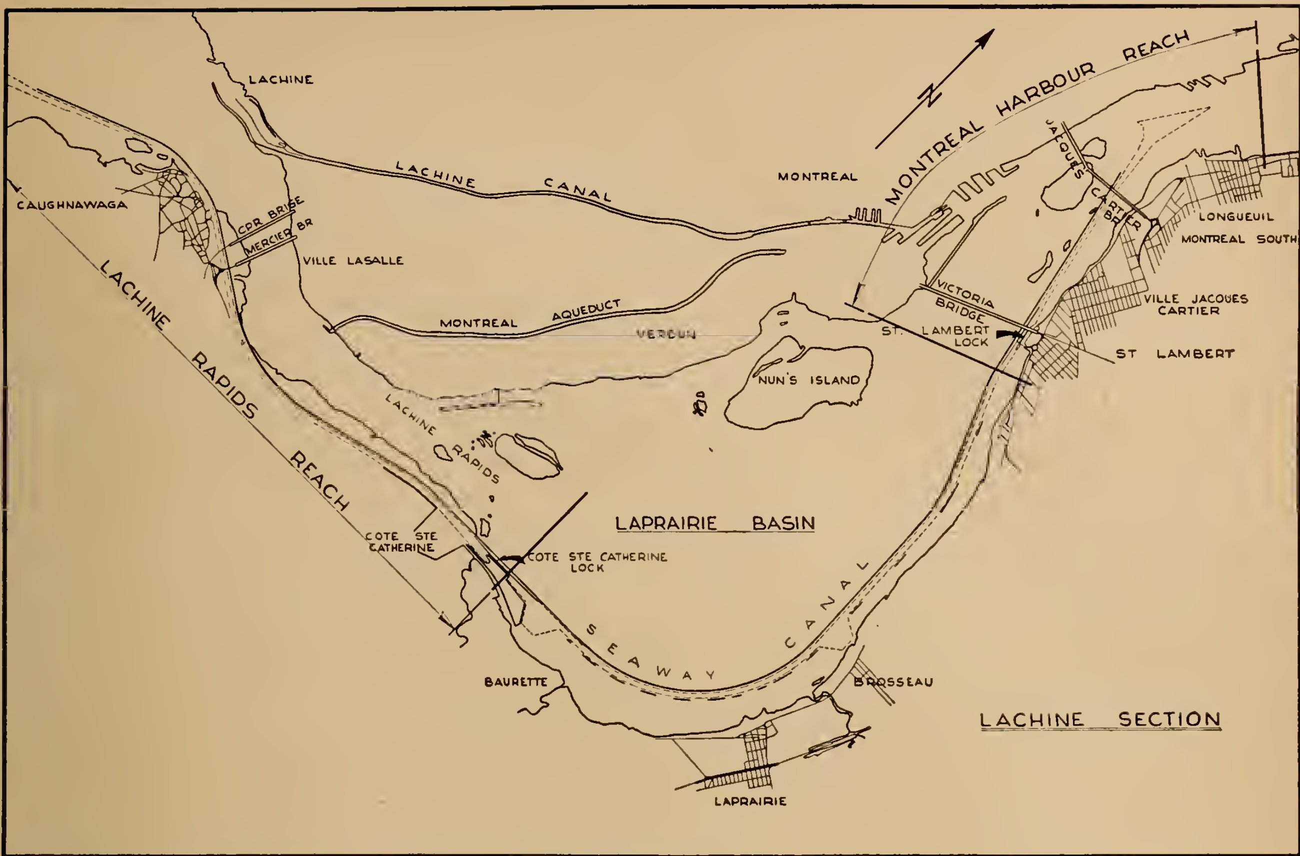


Fig. 3. The St. Lawrence Seaway; general plan of the Lachine section.

study the direction and velocity of currents which will exist in the reservoir south of Croil and Long Sault Islands at the head of the navigation channel.

(4) Cornwall Island Reach

Three models have been used in working out an improvement plan for the Cornwall Island Reach of the St. Lawrence River. Two of these were constructed by the U.S. Army Corps of Engineers at the Waterways Experiment Station at Vicksburg, Miss., and the other at the National Research Council Laboratories in Ottawa, Ont., for the Canadian Seaway Authority.

Of the Vicksburg models, one reproduces the river from Massena Point to approximately the middle of Cornwall Island at an undistorted scale of 1 to 100. The other reproduces the entire reach from the foot of Barnhart Island to the foot of St. Regis Island. (Fig. 1), with vertical and horizontal scales of 1 to 100 and 1 to 300 respectively.

The undistorted scale model was used to work out corrective measures for high-velocity cross currents in the navigation channel opposite the exit to Polly's Gut. These corrective measures will be in the form of rock dykes and a spoil bank located opposite the exit to Polly's Gut and along the shore line below Massena Point.

The distorted scale model of the entire reach was used to obtain the following information:

(a) The most economical locations and cross sections for excavations required to provide channel depths and flow velocities required for navigation;

(b) The delineation of spoil bank areas in the river channel south of Cornwall Island;

(c) The most economical form of compensating works required to maintain the natural state distribution of flows in north and south channels at Cornwall Island;

(d) The effect of channel improvements in the Cornwall Island Reach on water levels in the tailrace at Barnhart Island Power House.

At the time of writing this paper a satisfactory improvement plan for the South Cornwall Island channel had been developed with the aid of this model. Proposed compensating work in the form of a short length of excavated channel north of Cornwall Island was also developed in the Vicksburg model.

The Cornwall Island Reach model built at Ottawa for the Canadian Seaway Authority has been used to study various improvement plans in the interests of power and navigation. With reference to power development, it has been used extensively to determine the effect of various factors on water levels in the tailrace at Barnhart Island Power House. The factors referred to include:

(a) Various excavations in the tailrace area at Barnhart Island Power House.

(b) Various improvement plans for the downstream river channels.

(c) The regulation of water levels in Lake St. Francis at various elevations.

Data from these studies were supplied to the power interests on an exchange basis for model test data on navigation channels obtained from Ontario-Hydro models.

Information obtained from this model in the interest of navigation includes data on water depths and the direction and velocity of currents in proposed navigation channels in both the north and south channels at Cornwall Island. At the time of writing, the model was being used to develop an improvement plan for the North Cornwall Island channel to be used in place of the compensating excavations worked out in the Vicksburg model. This work is being done in support of the contention of the Canadian Seaway Authority that excavations in the North Cornwall channel should take the form of an improvement for navigation in anticipation of the future development of Seaway locks on the Canadian side of the river at Cornwall.

Figure 2 is a photograph of this model taken from a downstream location with the south channel in the foreground. Gauging stations are indicated by metal posts erected to support point gauges, while metal strips used to represent roughness may be seen in the beds of channels. This model was prefabricated in sections approximately two feet square and assembled on concrete blocks laid on the laboratory floor.

(5) Lachine Rapids and Montreal Harbour Models

A contract has been let by the Canadian Seaway Authority to Neyrpic, Canada, Limited for the construction and testing of models of the Lachine Rapids and Montreal Harbour sections of the St. Lawrence River channel. The general location of the reach to be reproduced in each model is indicated in Fig. 3.

Figure 4 shows a floor plan of the laboratory being built to house these models, indicating how the models will be fitted in and the general dimensions of the building required. The scales of both models are to be 1 to 125 and 1 to 200 in the vertical and horizontal directions, respectively.

Information relative to Seaway design required from the Lachine Rapids model is as follows:

(a) The effect of Seaway works on flows and water levels in the vicinity of Caughnawaga. If an increase in water levels as a result of Seaway construction is indicated, the model will be used to determine the extent and most economic location of compensating excavations,

(b) The directions and velocities of currents at the entrance to the Seaway channel at Caughnawaga. If undesirable current conditions are indicated, the model will be used to develop corrective measures,

(c) The effect on water levels in Lake St. Louis of older construction works, such as the bridges at Caughnawaga and the present Lachine Canal entrance pier.

The Montreal Harbour model will be used to obtain the following information:

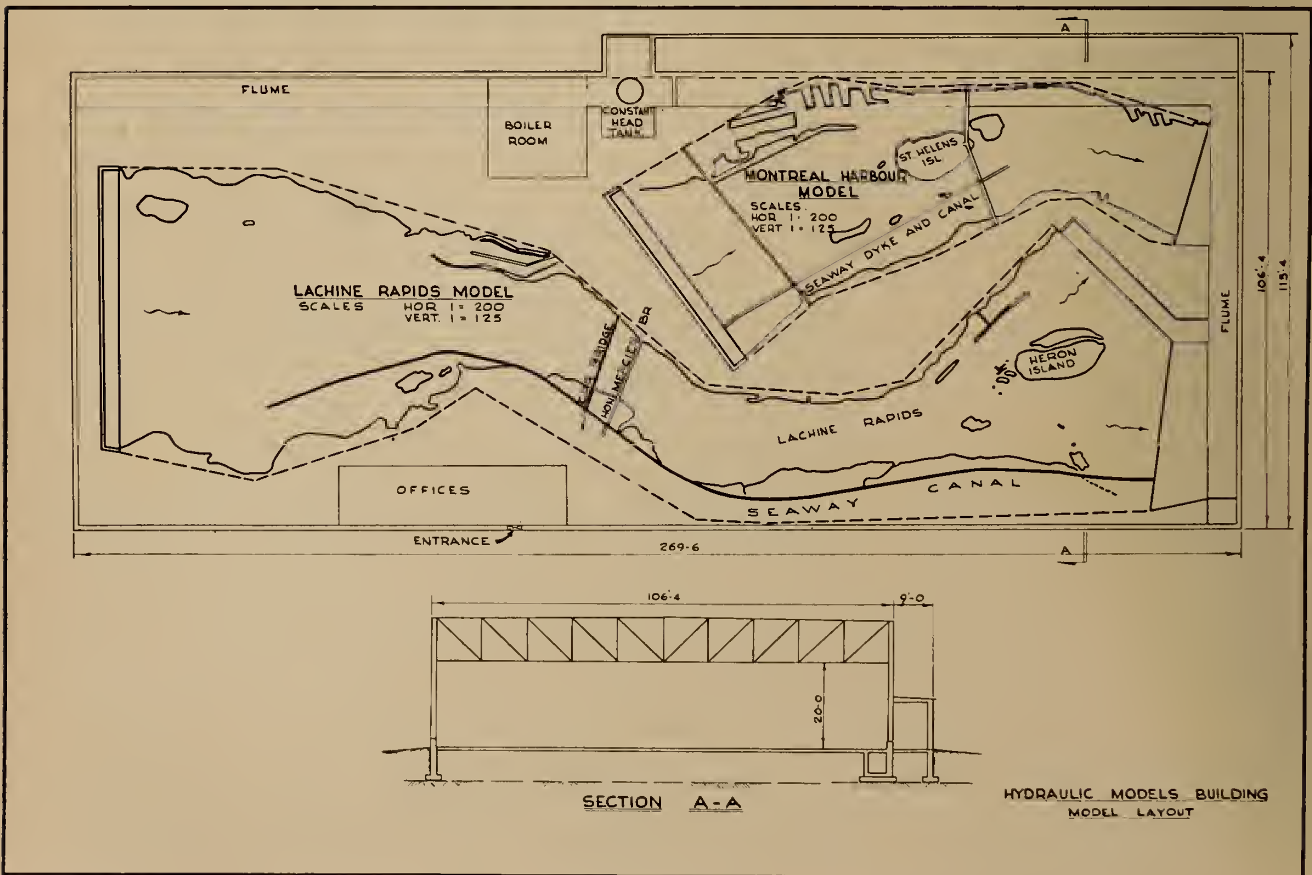
(a) The effect of Seaway works on flows and water levels in the Longueuil—St. Lambert area, and the most economic location for compensating excavations if these are required.

(b) Current directions and velocities at the canal entrance below Jacques Cartier Bridge. If undesirable current conditions are indicated, the model will be used to develop corrective works.

(c) The effect on water levels in Montreal Harbour of previous works dating back as far as 1870. These include excavations at various locations, the construction of Mackay Pier and other harbour works, and Jacques Cartier bridge.

It is understood that the Lachine

Fig. 4. Floor plan of the hydraulic models building, showing the model layout.



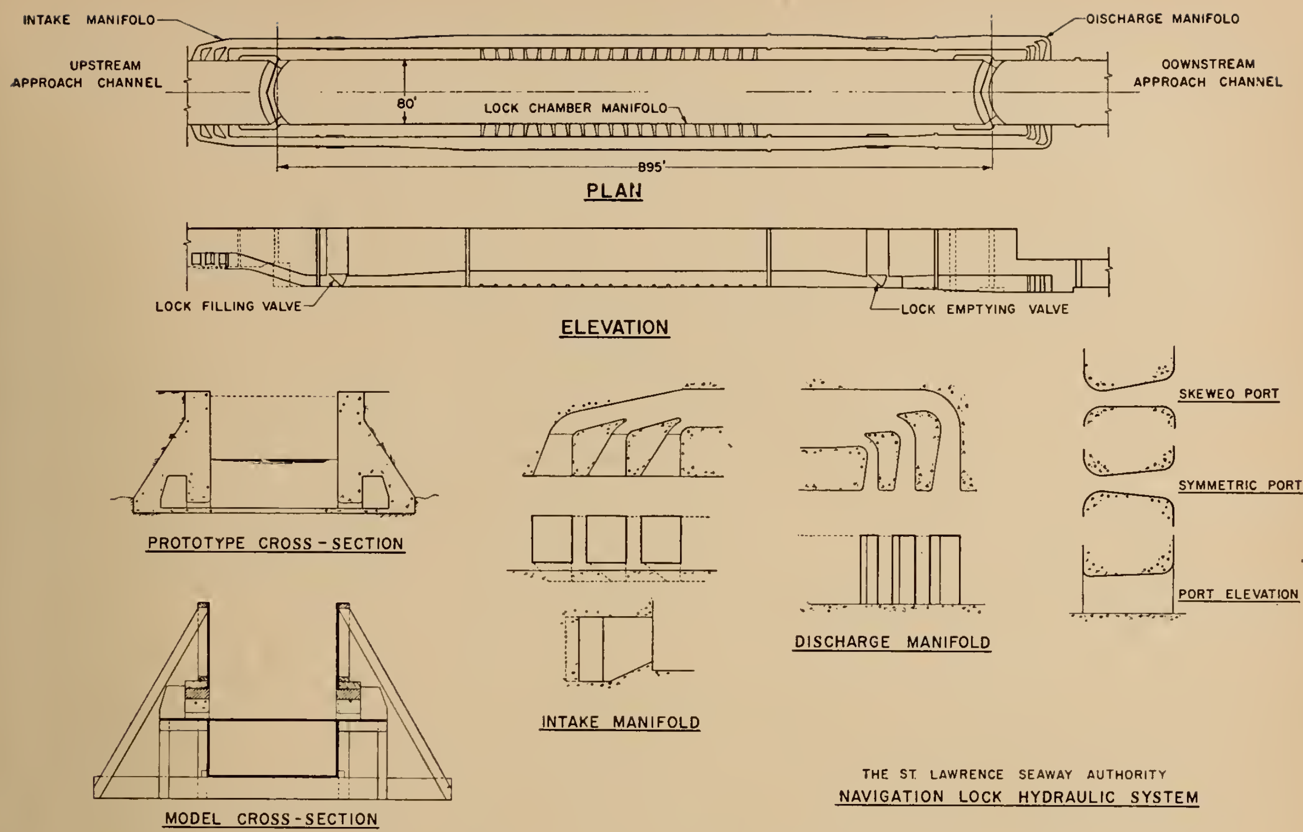


Fig. 5. Plan and elevation of filling and emptying system for use in Seaway locks.

Rapids and Montreal Harbour models may be placed at the disposal of the Quebec Hydro-Electric Commission for the study of plans for power development in the Lachine section of the St. Lawrence River. They may also be placed at the disposal of municipal planning groups wishing to develop improvements such as harbour extensions, bridges and recreational facilities in the Montreal area.

In summary, it may be stated that river models are playing a large and indispensable part in planning and design for the St. Lawrence Seaway project. They have proven to be efficient tools for solving complex design and construction problems and have made a notable contribution to the development of an integrated plan of river development which is in the best interests of both power and navigation.

Hydraulic Structure Models

Hydraulic models have been used to obtain design information on filling and emptying systems for Seaway navigation locks, and on the operating characteristics of guard gates. Models of both locks and guard gates were constructed by the U.S. Army Corps of Engineers at the St. Anthony Falls Hydraulic Laboratory at Minneapolis, Minn., and also for the Canadian St. Lawrence Seaway Authority at the National Reasearch Council Laboratories in Ottawa, Ont. As will be more fully explained later separate models were required by the United States and Canada to develop special design features to take best advantage of foundation conditions encountered at the different lock sites. Co-operation between the Corps of Engineers and the Seaway Authority in the matter of hydraulic structures design has taken the form of an agreement on governing dimensions for locks and an exchange of ideas on lock design and model work. In this connection, it is acknowledged that the U.S. Army Engineers, because of their very considerable previous experience in the design and construction of navigation locks, were able to contribute important leads to lock design improvements, particularly during the early stages of model study work. There has been little exchange of information on guard gates since the Corps of Engineers have designed a vertical-lift, fixed-roller type of gate, while the Seaway Authority design consists of a pair of vertically-mounted sector gates.

Dealing first with lock models built for the Canadian Seaway Authority, the chief purpose of these has been to develop improvements in the filling and emptying system selected for use in Seaway locks. This system, shown in plan and elevation in Fig. 5, was chosen as the simplest, most economical arrangement which could be made to perform satisfactorily in large locks with lifts ranging up to about 50 feet as required for the Seaway project. It consists, essentially, of intake manifolds, lock chamber manifolds, and discharge manifolds (see enlarged details, Fig. 5), joined by culverts through which flow is controlled by sector-type valves. Since all ports and conduits are located in the walls of the lock and approach channels, this is known as a "side-wall" system.

To fill a lock, the downstream or emptying valves are kept closed while the upstream, or filling valves are opened. Water from the upstream approach channel enters through the intake manifolds and flows into the lock through ports of the lock chamber manifold. During a lock emptying operation, filling valves remain closed, while emptying valves are opened. Water leaves the lock chamber by flowing through lock chamber ports in the reverse direction to that taken during a filling operation, and is emptied into the downstream approach channel through discharge manifolds. Under maximum lift conditions, more than 3,000,000 cubic feet of water will enter or leave some Seaway locks during filling or emptying operations. The locks are designed for filling or emptying in less than eight minutes, requiring maximum flows of about 10,000 c.f.s. in the lock hydraulic systems. Improvements in lock design are concerned with the reduction of disturbances caused by these flows in the lock chamber, and in upstream and downstream channels.

Construction began on the first lock model for the Seaway Authority during the summer of 1953. At that time the United States Government had not completed plans for participation in the Seaway project, so this model represented a lock which was to be constructed on the Canadian side of the St. Lawrence River near Cornwall. The original model was modified early in 1955 to represent a lock to be located at Cote Ste. Catherine on the south shore of Laprairie Basin near Montreal. At the time of writing this paper, the model was undergoing a second modification to reproduce one of the locks to be constructed at the downstream end of Beauharnois power canal. A scale of 1 to 30 has been used for these lock models.

A cross section of the Cote Ste. Catherine lock model, indicating some construction details, is shown in Fig. 5. All culverts and manifold are removable to facilitate design changes. The chamber space below culvert level was used in the Cornwall lock model because of the great depth to rock foundation at the Cornwall site. A false bottom just below culvert level represents the floor of the Cote Ste. Catherine lock.

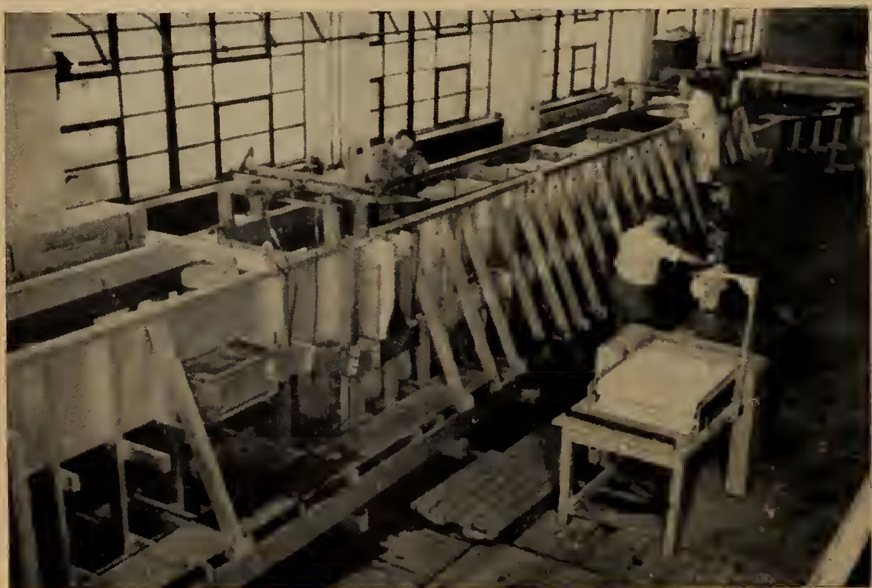
A pen-type recording instrument built by the National Research Council gives a continuous record of water levels in upstream and downstream approach channels and in the lock chamber as well as a record of filling and emptying valve motion. Hydrodynamic forces on a model ship in the lock chamber are transmitted to strain gauges and recorded by a chart recording oscillograph.

Figure 6 is a photograph of the Cote Ste. Catherine lock model taken from an upstream location. Instruments used to record model test data are shown on the right.

Figure 7 gives a qualitative graphical representation of the mechanics of flow in a lock filling system, and will be used to explain improvements in design developed through model studies for St. Lawrence Seaway locks. A simplified system is used for this purpose with only three ports in the lock chamber manifold, whereas 20 ports will be used in each wall of the Cote Ste. Catherine lock chamber.

At the beginning of a filling operation, when filling valves start to open, water in the lock chamber manifolds receives an accelerating impulse from water under higher pressure upstream from the valves. The magnitude of this impulse is proportional to valve opening rate. Due to inertia of water in the culverts, acceleration is greatest along the shortest paths between the valves and lock chamber. Flow through upstream ports builds up much more quickly, therefore, than that through downstream ports, as illustrated by the rising portions of port discharge curves shown in Fig. 7. When water in the culverts is in motion each port of the lock chamber manifolds has the effect of a sudden expansion in culvert area. Loss of water through the port results in a sudden drop in flow velocity and a corresponding rise in pressure as shown by the graph of culvert pressure head. Friction loss in the culvert between ports is less than the pressure rise at each port, with the result that culvert pressure and port discharge tend to increase in the downstream direction. This condition is intensified when deceleration of water in the conduit system begins, due to rising water level in the lock chamber. Due to inertia of water in the culverts, deceleration also is greater along the shortest paths between the lock chamber and upstream channel. As a result of increasing culvert pressures downstream caused by deceleration and the expansion effect of ports, discharge through upstream ports drops off before maximum discharge is attained at downstream ports. Discharge from downstream ports soon becomes greater than that from upstream ports, and remains so for the balance of the filling operation. Rapid deceleration of water in upstream portions of the conduit system may result in a reversal of flow in upstream lock chamber ports, as indicated by port discharge curves in Fig. 7.

Fig. 6. Model of the Cote Ste. Catherine lock at the National Research Council laboratories. Recording instruments are shown in the foreground.



The build-up of flow at downstream ports may be reduced slightly by proper port design. Graphs of discharge and head-gain coefficients are shown in Fig. 7 for ports of the type used in Seaway locks. These curves indicate that the discharge coefficient increases, and the head gain coefficient decreases in the upstream direction for all excepting the downstream two or three ports. However, this effect of port design on discharge is much too small to prevent a shift of maximum flow to downstream ports.

Effects of the above described phenomena on lock filling and emptying characteristics are:

(*a*) Discharge through upstream ports at the beginning of a filling operation causes water level to rise in the upstream end of the lock chamber. This

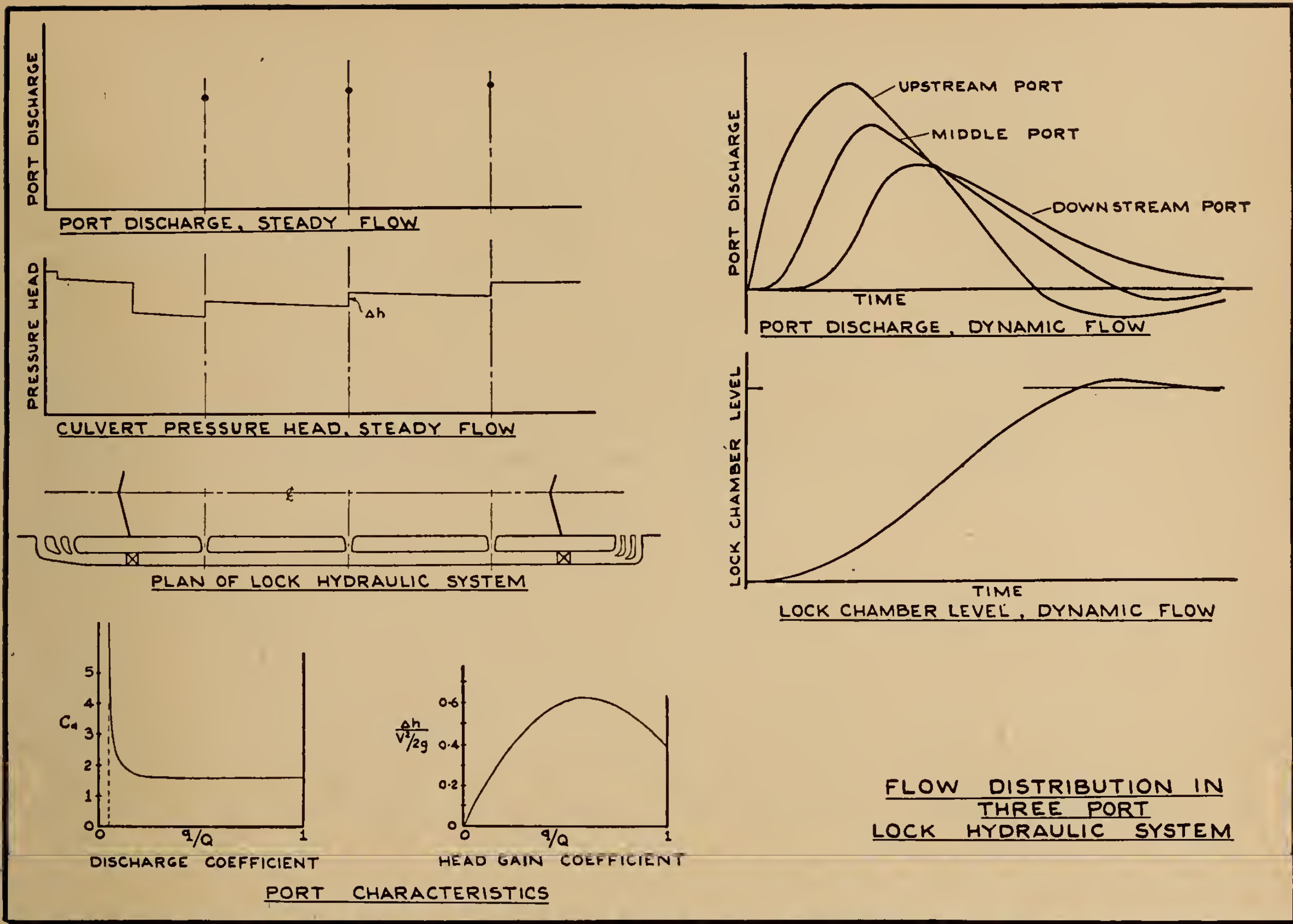


Fig. 7. Graphs of discharge and head-gain coefficients for ports of the type used in Seaway locks.

sets up a surge wave which travels from end to end of the lock for the remainder of the filling operation.

(b) The shift of maximum flows to downstream ports causes water level at the downstream end of the lock chamber to remain generally higher than that at the upstream end during the latter portion of a filling operation.

A ship in the lock chamber during a filling operation is forced first toward the downstream gates, then toward the upstream end of the lock. Forces on a ship are greatest during early stages of the operation because ports are then discharging under maximum differential head, and because water in the lock chamber is shallow, and therefore subject to greatest disturbance from port discharge.

The first lock model had lock chamber manifolds of the usual design, consisting of culverts of uniform cross section running full length of the lock, and symmetric, venturi-shaped ports. A number of modifications were made in this design with the aid of models which resulted in significant improvements in lock performance. The first of these modifications was an enlargement in the culverts of lock wall manifold as shown in Fig. 5. These were expanded from an area of 168 square feet at the filling and emptying valves to an area of 294 square feet throughout the length occupied by lock wall ports. The increased culvert area gave lower flow velocities, reducing the acceleration and deceleration effect in culverts as well as the pressure rise at ports. This resulted in a more uniform distribution of flow through lock wall ports which speeded up the lock filling operation and lowered forces on a ship in the lock. The accompanying table of test results interpreted from lock model data indicates the improvement in lock performance brought about by enlarging the wall culverts. It also shows the very important effect of valve operating speed on lock performance.

Test Results from Lock Model Data

Wall Culvert Area (sq. ft.)	Valve Opening Time (min.)	Lock Filling Time (min.)	Maximum Hawser Force (24,000-ton Lake Freighter) (Tons)
168	2.0	8.15	23
294	2.0	7.10	17
294	4.1	8.15	7

A second modification, developed in the Cote Ste. Catherine lock model, was a change in lock chamber port design from a symmetrical to a skewed shape as indicated in Fig. 5. A few upstream ports were skewed to direct flow toward the downstream end of the lock. This arrangement directs initial port discharge away from the upstream end of the lock chamber, thus reducing surge and the resulting initial downstream force on a ship. All remaining ports of the lock chamber manifold were skewed to direct flow toward the upstream end of the lock chamber. This reduced the build up of downstream water level and tended to set up a downstream surface current in the lock chamber, thus

Fig. 8. Model of one leaf of a sector gate, showing framing details.

reducing upstream forces on a ship during the latter portion of a lock filling operation. By installing the proper proportion of upstream and downstream directed ports, upstream and downstream forces on a ship during a filling operation were made approximately equal, and the maximum force was substantially reduced. The use of a skewed port arrangement in lock chamber manifolds resulted in an improvement in lock performance comparable to that obtained with an enlarged culvert section.

Other modifications in design of the lock hydraulic system were made for the purpose of decreasing lock emptying time. The emptying time for Cote Ste. Catherine lock was reduced by as much as one and one-half minutes by increasing the throat area of lock chamber ports by nearly 40 per cent. The corresponding reduction in lock filling time was approximately 0.6 minutes. Another reduction in emptying time of 0.3 minutes was obtained by modifying the discharge manifolds. The original discharge manifold design contained four ports separated by three vanes. The ports were so designed that there was a continuous expansion in flow through the 90 degree bend from the culvert to the lower approach channel. This resulted in considerable separation of flow from downstream sides of the vanes. An improvement in this condition was obtained by producing a slight contraction in flow in the bend section as shown in Fig. 5.

A somewhat modified form of side wall filling and emptying system was developed for the American locks. Although the lock chamber manifolds are very similar to those designed for Canadian locks, ports of intake and discharge manifolds are located in the floors of upstream and downstream lock approach channels. The reason for this difference in design is the greater depth to foundation rock at American lock sites which makes it possible to install intake and discharge works below channel grade level without excessive rock excavation.

In summary it may be stated that the hydrodynamic forces affecting flow in a lock hydraulic system, and the relation between these forces and those on a ship in the lock chamber are too involved for satisfactory mathematical solution. Over the past twenty years lock model studies have brought many improvements in lock design, and studies for Seaway locks constitute another step in this process. There is little doubt that future model studies supplemented by extensive mathematical investigations will produce further very substantial advances.

Guard Gate Models

The purpose for which guard gates are to be used requires that they be capable of closing under any condition of flow which may exist in the Seaway channel due to failure of a downstream structure. Models were used to determine the hydrodynamic forces for which these gates and their operating machinery must be designed in order that safe closure may be made in flowing water.

As previously mentioned, the U.S. Army Corps of Engineers has designed a vertical-lift, fixed roller type of gate, whereas the Canadian Seaway Authority has elected to use a sector gate design. As in the case of locks, the chief reason for this difference in American and Canadian design is the greater depth of overburden on foundation rock at the American site. A vertical lift submerging gate, therefore, provides the more economical construction in the American channel.

The U.S. Army Corps of Engineers design calls for a gate roughly 83 feet wide by 46 feet high to be lowered into a slot in the channel floor when not in use. A hydraulic model was built to a scale of 1 to 33-1/3 to study forces on the top and downstream side of the gate when it is raised in flowing water.[1]

[1] For further details see Engineering News Record, 1955, Oct. 27.

Guard gates designed by the Canadian St. Lawrence Seaway Authority consist of two leaves in the form of 60-degree sectors cut from a cylinder approximately 98 feet in diameter and 41 feet high. These gates fit into recesses in the channel walls and are moved outward into the channel when closed. The gates swing on hinges located at the apex of the sector and rest on rollers located near the circumference.

A 1 to 20 scale model was built to study operating torque due to hydrodynamic forces on gates of this type when they are closed in flowing water. Figure 8 is a photograph of the model of one gate leaf showing the framing and general construction. Figure 9 is a view, looking upstream, of the completed model in operation with each gate 5 degrees open, and Fig. 10 is a view of the model taken from an upstream position.

The torques required to hold a gate leaf in position with various flows in the model were measured for gate openings of up to 50 degrees, and model flows ranging up to 14 c.f.s. Torques were read from a deflection gauge attached to a calibrated torque arm which was used to hold a gate leaf in position.

In the original model, based on the Strait of Canso lock gate design, the skin plate was wrapped around the inner or mitring nose of the gate and extended back along radial frame members a distance of about three feet. It was found that water flowing between the gates tended to cling to the radial portions of the skin plates as indicated in Fig. 11,

Fig. 9. Downstream view of the sector gate model in operation.

similar to the action of air flowing over the upper surface of an aeroplane wing. Differential pressure on the radial plates due to high velocity flow on one side and relatively calm water on the other produced large closing torques on the gates. This torque varied with gate position, being a maximum at a 30 to 40 degree opening.

The original design was modified, the change consisting essentially of the removal of about two feet from the radial plate section. This modification reduced gate closing torque by about 40 per cent. The radial plates were then removed almost entirely, leaving sharp edges at the gate mitring noses. This reduced gate closing torques to approximately 38 per cent of those measured for the second gate design. The remaining maximum closing torque, estimated at 1220 kip feet under the worst operating conditions expected at the prototype guard gates, appeared to be partially due to circulation of water through gate members downstream from the skin plates.

In the model only top and bottom hinges at the apex of the sector were used, and these were made as frictionless as possible so that only torques due to hydrodynamic forces were measured. This torque fluctuated erratically in all gate positions, and the quoted torque value of 1220 kip feet is the maximum indicated. Rollers used to support the prototype gates near their outer circumferences are expected to dampen out the torque fluctuations. Maximum torque values measured in the model should not, therefore, be attained in the prototype.

In addition to their use as guard gates, sector gates are also to be installed in Iroquois lock in place of mitre gates as used at other locks. Since the lift at Iroquois lock will be less than five feet most of the the time after the pool above the Cornwall power house has been raised, this lock can be filled and emptied safely through the gates, eliminating conventional filling and emptying conduits. The model was used to obtain gate discharge coefficients for lock filling and emptying computations. These coefficients were also used to compute the rates of increase in gate discharge corresponding to different rates of gate opening. From this information it was possible to compute the height of surge together with forces produced on a ship by these surges in the lock chamber corresponding to various gate opening rates. It was then possible to recommend gate opening rates to be used in lock filling and emptying operations.

The mathematical aspects of model study work have been purposedly avoided in this paper so that a broader general picture of the use of models in Seaway design and planning could be presented. This broader picture could not be entirely complete at the present time since some models are still in operation while others are merely in the planning stage. It is to be hoped that, as Seaway work progresses, other papers will be forthcoming on various details of model work and the conformity between model and prototype performance.

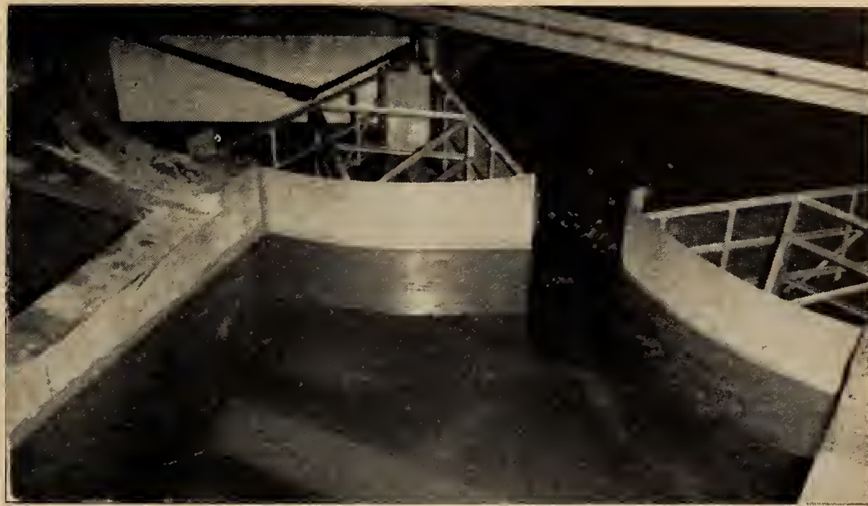


Fig. 10. Upstream view of the sector gate model in operation.

Fig. 11. Sector gate model, showing flow pattern downstream from the mitring nose.

Discussion of technical papers in this issue is published on the following pages. The Editor invites written discussion of other technical papers that are published in *The Engineering Journal.*

DISCUSSION

of Technical Papers

GENERAL DESIGN OF THE ST. LAWRENCE SEAWAY

D. M. Ripley, JR.E.I.C. *The St. Lawrence Seaway Authority*

The Engineering Journal, 1956, September, p. 1134

G. H. Kohl, M.E.I.C.[1]

Mr. Ripley is to be congratulated in presenting in the short time available a very comprehensive description of the St. Lawrence Seaway.

A decade ago Canada foresaw the need for improvement in the canals in the Montreal-Prescott reach which became more urgent with the development of iron ore in northern Quebec but it was only in 1952 that the international difficulties were overcome and the project could be commenced. The actual construction began in 1954.

1926 Report — Mr. Ripley has referred to the 1926 report on the project including the development of power and it is indeed a tribute to those responsible for its preparation that the project as now being carried out is basically the same as then proposed for navigation and power.

U.S. Participation — Until 1954 Canada was proceeding to construct the project alone, from Montreal to Lake Erie, utilizing the channels to be constructed in the International Rapids reach by the power entities but in that year the United States exercised their right to partake in the work in the international section and undertook to construct a canal around the Long Sault dam. This relieved Canada of part of the cost of the deep waterway but increased the length of this canal by some five miles. As Mr. Ripley has said Canada bears now two-thirds of the cost of the Seaway but of course will share to a proportionate extent in the tolls. I have been somewhat repetitive here but perhaps these points bear repetition.

Excavation Quantities — The quantities of excavation indicated in Mr. Ripley's paper are impressive, and if to this is added the work being done by the power entities in the International Rapids section it is found that close to 200,000,000 cu. yd. must be removed, which alone would entitle this project to rank amongst the largest modern engineering undertakings. The construction program indicates this excavation to be substantially completed by the summer of 1958, when the schedules call for raising the power pool.

Dykes-Cofferdams—Wherever possible excavation is being removed by land based equipment in many cases working from or behind protective dykes.

These dykes are constructed by end dumping. In the Lachine section, friable shale has been used faced on the wet side with till. In the Cornwall—Chimney Point section the natural dense till from the excavation is utilized. This till weighs up to 150 lb./cu. ft. with natural moisture of about 7 to 9 per cent. It is difficult to excavate, scrapers are ineffective, and resort has been had in most cases to drilling and blasting and removal by shovel or dragline. Although this has made for high excavation costs, this material has been found very suitable for secondary cofferdams. It has been dumped in water up to 20 ft. deep and with velocities up to about 5 ft./sec. and compacted only by the passage of equipment. No rip-rap is required except at critical points.

When excavation within the dyke has been completed, and the draglines have excavated to grade on the river side of the dyke, they are removed by the same draglines. Much work which was originally planned to be done by dredging is being excavated in this manner at a considerable saving in cost.

In its natural state this till stands on steep slopes (about 1/1) and work has been carried on in one case, immediately adjacent to the Massena Canal, 64 ft. below water level in this material.

Excavation Equipment — The excavation equipment assembled on both sides of the border for this combined power and seaway undertaking, which is planned to be substantially completed in four years, at present includes: 143 shovels and draglines (shovels to 6 cu. yd.; draglines to 15 cu. yd. capacity); 260 dozers; 500 heavy trucks, up to 30 cu. yd. capacity; 11 dipper dredges, 6-12 cu. yd. capacity.

The earth moving equipment in the International Rapids reach alone is valued at $40,000,000.

Channels Provided by Power Entities — The part played in the Seaway by the power entities, Ontario Hydro, Hydro-Quebec, and the Power Authority of the State of New York, is of interest.

At Beauharnois the 15 mile power canal is to be used for navigation. From Croil Island to Canada Island near Morrisburg the raising of the river levels by the power dams will provide sufficient depths for navigation.

At Ogden Island a hydraulic channel is being provided on the south side to carry 40 per cent of the river flow and to reduce the maximum velocities in the navigation channel on the north side to the required 4 ft./sec.

In the vicinity of the Iroquois dam, and at Toussaint Island and Sparrowhawk Point, channels are being substantially straightened out, while at Galop Island the main channel passes through the centre of the island with hydraulic cuts north and south of Lalone and Lotus Islands.

[1] Chief Engineer, Canadian Section, St. Lawrence River Joint Board of Engineers, Montreal.

Ice Cover — With these channels completed and ultimately with power developed at Isle Heron a fairly continuous ice cover may be expected to form from Lachine to Lake Ontario with the exception of a few short stretches of open water in the vicinity of Iroquois dam and in the Galop channel. The reduction in the formation of frazil ice should consequently be substantial with beneficial results in winter water levels.

River Control and 14-foot Navigation — Once the natural weir near the head of Galop Island has been breached, control of the river will pass to the Iroquois dam, which will then be operated to maintain so far as possible the normal outflows and levels of Lake Ontario, until completion of construction.

Also, during construction, 14-ft. navigation must be maintained in the International Rapids reach, and the work has been integrated with great care by the power entities and scheduled accordingly.

I am going to ask Mr. Ripley to tell us of some of the problems involved in maintaining 14-ft. navigation during the construction period.

S. Hairsine, M.E.I.C.[2]

Mr. Ripley has given us an excellent word picture on the development of the St. Lawrence Seaway project and of the problems involved in its construction. One point that impresses me is the reduction in the number of locks between Cardinal and Montreal harbour which, as he states, will be reduced to 7 from 21, with a resulting saving in passage time from Kingston to Montreal of several hours. Actually the time saved will presumably be between Montreal harbour and the locks above Cardinal, Ontario, and will be more noticeable on upbound passages because downbound vessels now run the river from above Cardinal locks as far as the entrance of the Cornwall canal, if the water on the lower sill of the river lock at Cardinal is 2 feet greater than the draught of the ship. This saves about 5 hours time for downbound vessels, 30 minutes of which is a saving in lockage time. By comparison, the approximate times required to navigate this distance between Cardinal and the entrance to the Cornwall Canal are —

Downbound — 3 hr., 19 min.; an average speed of about 9.67 m.p.h.

Upbound — 8 hr., 19 min.; an average speed of about 3.75 m.p.h.

2 Electrical and Mechanical Engineer, The St. Lawrence Seaway Authority, Montreal.

At the present time, upbound vessels making this passage have to move through 4 locks upbound compared to one lock when downbound. When the Seaway is completed, both up bound and downbound vessels will have to pass through only one lock, requiring about 10 minutes lockage time, and with the pool below the lock raised to normal elevation to reduce the current velocities to less than 4 feet per second, the passage time for vessels travelling in each direction will be about the same, or about 7 miles per hour. Perhaps Mr. Ripley would like to tell us something more about, say, the times required for vessels to travel through the existing 14-foot lower main line canals and the anticipated times required to pass through each section of the new canals.

The Author

In his discussion Mr. G. H. Kohl has raised a very important question regarding the continuance of present or so-called 14-ft. navigation during the construction of the St. Lawrence Seaway and Power Projects.

There is no problem in this regard in the river below Cornwall, Ontario. In the Lachine section the new canals and locks are entirely separate from the present system and the same is true for the Soulanges or Beauharnois section. The new navigation facilities in these sections will be ready for shipping by the opening of navigation in 1959. Aids to navigation will be established and the changeover may be made with no delays. The old canals will continue to function until no longer required by industry located along the canals, particularly at Montreal.

In the river between Prescott, Ont., and Cornwall the situation will be quite different. In this section the present 14-ft. canal system will be flooded out when the pool upstream from the powerhouses is raised, also, shipping will be subjected to some relatively minor inconveniences during construction. The chief problem is one of raising the pool elevation and keeping to a minimum the delays to vessel movements. It is now expected that the pool will be raised in September 1958, which is in the middle of the navigation season, so that delays of any duration would be undesirable.

It is proposed to handle the change-over in the International Rapids section roughly as follows. By late 1956, construction in the river near Iroquois will have progressed so that navigation must use the canal in both directions between Iroquois and Cardinal instead of the river below lock 28 for downbound shipping as at present. The Department of Transport have provided passing points and additional tie-up facilities in the canal in anticipation of the increased traffic. No appreciable delay to navigation is expected.

Shortly after April 1957 the water level above Iroquois dam will be gradually raised and the river brought under regulation. The regulation "rule" at that time will be as in the state of nature. This means that natural Lake Ontario levels and outflows will be kept while under artificial control. The raising of the water level above Iroquois dam will keep pace with the enlargement of the river upstream, particularly at the Galop Island cut. The canal banks of the present system will be raised where necessary to retain the water in the canal reaches at present levels. During 1957 the seaway lock at Iroquois may be brought into service for 14-ft. navigation. At that time the water levels above the Iroquois lock will be close to the ultimate while the water level below the lock will be at natural condition or slightly lower. This means that the lock may be required to operate at a head of about 24 feet and it has been designed to do so. The limitation of the use of the Iroquois lock for 27-ft. navigation during this period is the limited depth on the lower sill. As the pool is raised above the powerhouses the lock will be available for vessels of full seaway draught.

Until July 1958 the river and canal sections between Iroquois and Cornwall will be used as at present. A diversion canal and dyke closure structure are being constructed at the north end of the Barnhart Island powerhouses and these facilities will be put into use in November 1957. The main dyke may thus be properly constructed across the present Cornwall canal, and when the time comes to raise the pool, stop logs may be quickly placed in the closure structure, thereby closing off the 14-ft. canal.

The two locks on the U.S. side will be ready for seaway shipping when closure is made and the pool raising begins. It is essential that a continuous flow of water be maintained in the river at all times to protect the downstream power and navigation interests and it is proposed, therefore, to raise the pool by a transfer of water from Lake Ontario. The quantity of water required to fill the pool (500,000 acre feet) will not affect Lake Ontario to an appreciable extent. At the present time it appears that a rapid raising of the pool to elevation 235 will present the least difficulty to navigation and the delay that will result will not be more than four days. This proposal for changeover procedure depends on the stage of Lake Ontario at the time the pool is to be raised.

Reply to Mr. Hairsine

As Mr. Hairsine has said, the average time now required for a downbound vessel to travel from the head of the Galops canal to the head of the Cornwall canal, by river, a distance of some 30.73 miles, is 3 hours and 19 minutes. Upbound vessels require 8 hr. 19 min. for the same distance.

The average time required for a vessel to pass downbound to Montreal harbour through the remainder of the distance, according to D.O.T. statistics, is 23 hr., 43 min. and is made up of the following:

(1) Cornwall canal — 11 miles; 5 hr. 40 min. for an average speed of 1.95 m.p.h.

(2) Foot of Cornwall canal to head of Soulanges canal — 31 miles, 3 hr. 59 min. for an average speed of 7.75 m.p.h.

(3) Soulanges canal — 14.67 miles, 6 hr. 35 min. for an average speed of 2.23 m.p.h.

(4) Foot of Soulanges canal to head of Lachine canal — 16 miles, 2 hr. for an average speed of 8 m.p.h.

(5) Lachine canal — 8.74 miles, 5 hr. 30 min. for an average speed of 1.59 m.p.h.

With the improvements made in the design of the lock culverts, it will be possible to reduce the present filling and emptying times of the locks by some 50 per cent. This, together with the reduction in the number of locks on the Seaway from 21 to 7, and the improvements with canals and channels which will permit greater average speeds, accounts for the some 12 hours saving in passage time between Montreal and Kingston.

figures will be generally the same for British and American machines.

The hydraulic design of gates and hoists furnishes still another example of successful joint international undertaking. In this connection (in fact throughout the hydraulic design of the entire development) the work of the HEPCO laboratory at Islington has been invaluable in determining the optimum contour and ventilation of the bottom girders of the gates so as to reduce hydraulic downpull and consequently hoisting capacity to the practicable minimum.

As a result of such outstanding laboratory work and the constant close cooperation between the two engineering staffs, together with the competence, energy and vision of the officers of the two Commissions, the overall project design reflects a general unity and coherence with only such differences in minor detail as would naturally be expected to arise from the individual preferences of Canadian and American engineers.

MECHANICAL DESIGN FEATURES OF THE ST. LAWRENCE POWER PROJECT

O. Holden, M.E.I.C., and P. Pemberton-Pigott

The Engineering Journal, 1956, September, p. 1143

George R. Rich,[1]

The authors have presented an interesting and valuable paper with pertinent data conveniently summarized for reference and comparison. The engineering design of the project affords an outstanding instance of international cooperation between the constructing entities, The Hydro-Electric Power Commission of Ontario and The Power Authority of the State of New York.

At the earliest inception of the planning work all interested European and American manufacturers of turbines and generators were invited to attend an open meeting with the combined staff of HEPCO and PASNY to establish principal substructure dimensions, general waterway outlines, and turbine speeds and ratings that would be acceptable to all concerned as a basis for competitive bidding and yet would not place any undue restriction upon the design practice of any prospective bidder. For example the turbine runner diameter and detailed contour of the waterways were two of the design features left open to the individual manufacturer as elements of competition. The desired agreement was readily reached at the conference with the result that the American and Canadian halves of the Barnhart Island powerhouse are substantially identical in the structural, mechanical, and electrical features.

With respect to the author's Table I, "Turbine Data", it should be explained that: (1) it is standard practice in the United States to base efficiency acceptance of propeller turbines upon the stepped-up performance of laboratory model tests; and (2) in the United States turbine manufacturers have a trade agreement not to guarantee efficiencies greater than 90 per cent. This accounts for the obvious discrepancy between the guaranteed performance of the British and American turbines. Present plans contemplate prototype tests of all turbines by the Gibson method and it is anticipated that these prototype performance

1 Partner, Uhl, Hall & Rich, Boston, Mass., U.S.A.

R. H. Findlay, M.E.I.C.[2]

I would like, in the first place, to congratulate the authors on their paper. In the course of the next year or two, undoubtedly, many papers will be given on the design, construction, and operating features of this equipment. The authors have shown considerable reserve in limiting their remarks to brief outline descriptions of the equipment involved. Their paper, therefore, forms a very good introduction to the series of more detailed descriptive papers which will follow.

W. G. H. Holt, M.E.I.C.[3]

An inspection of the plans of the various hydraulic regulating gates will show that they are all of welded construction except the Canadian head gates which are riveted. Before we submitted our tender on these gates, we considered both alternatives. In fact, three different welded designs were worked out, one with a normal thickness of skin plate, one with a minimum allowable thickness of skin plate based on a membrane theory, and one with an extremely thick skin plate with an absolute minimum of stiffeners.

2 Consulting mechanical engineer to Dominion Bridge Company Limited, and the St. Lawrence Seaway Authority, Montreal.

3 Mechanical engineer, Eastern Division, Dominion Bridge Company Limited, Montreal.

No appreciable economy was apparent between these designs. What finally decided the issue was that it became clear that, on a quantity of 48, a greater saving would be realized by riveting than by welding.

In Table III of the speaker's paper, it will be noticed that the Canadian head gates and the Iroquois control gates have self-lubricating bronze bushed wheels, whereas the wheels for the balance of the gates are equipped with anti-friction roller bearings.

We have used graphite insert bronze bushed gate rollers with nickel chrome steel pins almost exclusively for the past forty years, with negligible replacements. Recently, a gate was pulled out of its slot which had been literally submerged 27 years and the bearing and pin were in good working order. Canadian utilities practically always specify self-lubricating bushings.

Roller bearings have been used extensively for gate work in other quarters but we feel there is an awkward sealing problem to keep the water out of the bearing grease; if water were to get in, it would be ruinous to the roller bearing. This especially concerns us in the case of head gates which are left submerged in water.

Exponents of anti-friction bearings always point out the great saving that can be realized in the capacity of the hoist because of the low coefficient of friction of roller bearings. There is not as much to be gained here as would appear at first thought. Take, for example, the hoists for the Cornwall headgates. Considering combined weight of gate and friction, the hoist capacity could be reduced about 50 per cent, but taking into account the hydraulic downpull, the capacity may only be reduced about 25 per cent.

Even though we have built gates with roller bearings because of the reasons just mentioned, and also the paramount fact that a roller bearing assembly is far more expensive than a plain bearing assembly, we have a preference for plain bearings.

It was mentioned that the holding brake on the head gate hoist is normally energized through a rectifier. This is a recent development and was made possible through the introduction of low cost selenium rectifiers. Formerly, a solenoid brake with a combination a.c.-d.c. coil was used when it was desirable to lower on a battery circuit.

Table IV of the speaker's paper gives much data regarding the gantries, cranes and hoists. Whereas the motors are all normal machines designed for crane duty, there seems to be some variety in the control equipment for these machines. The selection of the different types of control was dictated by various factors.

Four different types of control for the hoists will be found.

(1) Squirrel cage motors with across-the-line starters and fan lowering brakes. This type of motor is used on the head gate hoists because the rotor can readily be made to withstand the 2½ times synchronous speed when overhauled for fast, fan-controlled lowering.

(2) Wound rotor motors with manual drum controllers and mechanical load lowering brakes. Manual drum controllers are the most economical. They are available up to 100 h.p. size. The mechanical load lowering brake, in conjunction with the motor, governs the equivalent lowering speed to a little under synchronous speed.

(3) Wound rotor motors with magnetic control and mechanical load lowering brakes. This type of control gives superior performance but is more expensive. It must be used for motor sizes above 100 h.p. The mechanical load lowering brake functions as previously described.

(4) Direct-current variable voltage motors with magnetic control and regenerative braking for lowering. With this type of control, the light hook speeds can be made about twice the full load speed, thus considerably reducing the operating cycle time. This is particularly advantageous on large capacity hoists. Better inching is procurable when required for accurately placing heavy loads. There is also an inherent load limiting characteristic.

Practically the same reasoning applies to the trolley and bridge travel motions, but load lowering brakes are naturally omitted because there is no overhauling torque. Semi-magnetic or full magnetic control is required for adequate control of four motors at one time when mounted on each of four trucks of a gantry crane.

Conclusion

Our speakers have mentioned how, architecturally, the Canadian and American powerhouses are identical. It is phenomenal how different the designs of some of the components of the combined powerhouse really are. In my opinion, the main reasons for these differences are:

(1) The vast background of operating experience of the Canadian utility which guided them in designing their own equipment.

(2) The concept of the Canadian utility that 50 per cent of the value of the handling facilities provided at a power dam is for purposes of installation.

The Authors

The authors would like to thank the contributors to the discussion for their constructive and interesting comments. Two points are raised that are interesting to note as they highlight two fundamental design issues.

Mr. Rich's comments on the turbines are interesting and the dimensions fixed to enable the general powerhouse substructure design to proceed certainly permitted a wide variance of proposals from the turbine manufacturers.

Mr. Holt's comments on the gate bearings are, from our point of view, very interesting as they are backed by Dominion Bridge's many years of gate design and manufacture. With reference to the fabricating method used to make the various gates it should be noted that the ice sluice drum gates to be installed at the powerhouse are of partially welded and partially rivetted design. They too will be equipped with self-lubricating graphite insert bearings.

The most interesting comment of Mr. Holt's concerns the Commission's tendency to design for installation and to place a high value on the handling equipment during the construction period. This undoubtedly arises from the fact that the majority of the Commission's powerhouses have been built by their own construction division. The fact that the design staff work closely with the construction forces and the operating staff is bound to have an effect on the design and selection of equipment to be installed at a development.

In conclusion the authors would like to take the opportunity of thanking all those who helped in compiling the data, checking the wealth of detail, etc. which, by necessity, must be included in a paper of this type.

THE USE OF HYDRAULIC MODELS IN THE ST. LAWRENCE SEAWAY PLANNING AND DESIGN

D. M. McIntyre, M.E.I.C., *St. Lawrence Seaway Authority, Montreal*

The Engineering Journal, 1956, September, p. 1154

W. J. Weymark, M.E.I.C.[1]

The comments in this paper by Mr. McIntyre are the first presentation before an engineering body of the details of procedure used in planning and design of the St. Lawrence Seaway and Power Project. It is to be hoped that further details pertaining to specific features will be made available in the near future, so that the engineering profession will gain the benefit from the advancements achieved in engineering this tremendous project.

As noted in Mr. McIntyre's paper, models were indispensable in the design of the various features of the St. Lawrence Seaway-Power Project, and selection was not on the basis of relative economic advantage or as an adjunct to other engineering techniques but rather in several instances, as the sole basis on which design of hydraulic features of the various structures was based. This stems from the diverse interests, international and national, reflected in the basic reference document, the Order of Approval of the International Joint Commission, and the number of controlling boards and committees established to supervise and advise on the development and operation of the project. Consequently, models presented the only method by which presentation and solution of the various problems could be made. Because of the complex nature of the various problems that were investigated, it is note-worthy that tremendous advances were made in the use of models in carrying out engineering studies related to large scale hydraulic projects.

Although Mr. McIntyre did not treat with the basic considerations or procedures used in design and operation of hydraulic models, it is considered that this was not essential as basic relationships of similitude on which models are based and studies conducted are well established. However, as is well recognized in conduct of such investigations, achievement of complete similitude, geometric, kinematic and dynamic, is impractical, nor is it mandatory since pertinent transference ratios may be applied to relate prototype behaviour. This procedure was adopted by the various groups conducting model tests.

Perhaps some comments should be requested on techniques developed in the design of some of the models, especially those by the Ontario Hydro and the National Research Council for the river channel models; also, their achievements made in developing special instrumentations using recent electronic applications should be presented for record purposes.

The river channel models, those constructed and operated by the Ontario Hydro and National Research Council, and the one under construction by the Seaway Authority in Montreal, are all of the fixed-bed distorted-scale type. Although the primary problems studied related to determinations of flow patterns, velocities and current direction; governing water surface elevations and depths are features which are usually considered not amenable to distorted model investigation. This limitation was overcome, however, within acceptable tolerances through the use of appropriate modifications.

The following are some of the outstanding problems which were analyzed: *(a)* determination of controlling water surface elevations in the various reaches of the river related to the proposed method of regulation of Lake Ontario; *(b)* the relating dimensions of hydraulic and navigation channels in compliance with the requirements of the governing criteria set out in the International Joint Commission Order of Approval; *(c)* preservation of existing flow splits under improved conditions in various reaches of the river; and *(d)* the determination of the sequence of construction for the various structures in line with the requirements of the Order of Approval which specified that, during the construction period, (i) Lake Ontario levels were not to be adversely affected, (ii) continuance of 14 ft. navigation would be assured, and (iii) downstream interests were not to be affected.

It is to be appreciated that all the studies have not been completed at this date in regard to river channel improvements, or for river control during construction and operation. It is noteworthy to review, also, the purpose of the intensive tests to be conducted in the Seaway Authority model at present being constructed in Ville LaSalle which involve Seaway and power problems in the vicinity of Montreal.

Perhaps special mention should be made of some of the pre-project studies and work which played an important part in the design of the models and related investigations. New techniques were used by the Ontario Hydro in obtaining field data and determining backwater characteristics which were used in the fabrication and verification of the various models, and comment should be made on the availability of long-term records of flows and levels in the various parts of the St. Lawrence River and Lake Ontario collected by various Canadian and U.S. governmental bodies. All of these contributed to the successful investigation of the various hydraulic problems in the models.

Although Mr. McIntyre limited his comments pertaining to the structural models used in developing hydraulic design of the Seaway Authority structures, it should be noted that many types of models were used in investigating hydraulic structures of the project. These included a glass flume for spillway and conduits, and natural scale models for the locks, dams, energy dissipators, gates, powerhouse units, and ice sluice investigations. The studies for the power entities were conducted by the Ontario Hydro; those for the Seaway Authority were undertaken by the National Research Council, McGill University, and the Ontario Hydro. The SLDC had tests conducted at St. Anthony's Falls, Vicksburg, and Ontario Hydro.

In specific reference to the test conducted by the National Research Council for the Seaway Authority, relating to the design of lock structures, it is apparent that several noticeable advances were made. These resulted in improved performance characteristics relative to previous lock designs and effected economies in the cost of construction.

As Mr. McIntyre has pointed out, the critical considerations, from a hydraulic standpoint, in the design of lock structures are those relating to: *(a)* the design of ports and conduits, *(b)* provision of uniform flow conditions in the lock chamber and, *(c)* development of adequate gates and

(*Continued on page 1184*)

[1] St. Lawrence River Joint Board of Engineers, Montreal.

ABSTRACTS

BASED ON CURRENT LITERATURE AND EVENTS

INTERNATIONAL ATOMIC CO-OPERATION

Engineering, 1956, v. 181, n. 4707, May 25

If the most profitable use of atomic energy is to be made throughout the world, it will be necessary to devise effective means of distributing and exchanging knowledge and nuclear materials. This pressing need for co-operation has spawned a large number of different plans, some of which seem to overlap, and at least two international organizations carry out or co-ordinate research. Perhaps the most important consideration in connection with these schemes concerns the supply of nuclear fuels, since these are the *sine qua non* of any atomic power programme and must precede any decision by a private company to undertake nuclear power station construction.

Agencies for the supply and exchange of nuclear materials have been planned by three principal bodies: the Organisation for European Economic Co-operation; the Messina or "Little Europe" group, comprising the members of the European Iron and Steel Community (France, Belgium, the Netherlands, Luxembourg, Italy, and Germany) whose agency is to be known as Euratom; and the United Nations, which at the end of April published a draft statute for an international atomic agency. The statute, which has been approved by a twelve-nation committee including Britain, the United States and the Soviet Union, will come before a general conference of the United Nations and its specialized agencies in September.

Shortly after the publication of this statute an announcement was made concerning the Brussels plan for a collective European atomic energy commission. The plan, which provides for the establishment of the agency Euratom, may be the basis of a treaty and is expected to form part of a more comprehensive "federal" scheme of economic co-operation, which already covers coal and steel.

The commission is to set up a research centre and a college, and is likely to build a uranium 235 separation plant as one of its initial projects. The agency will have first claim on nuclear fuels produced by member countries (the Belgian Congo has considerable ore deposits) and these will remain under its control whether hired or purchased.

The diversity of plans for international co-operation in the field of atomic energy seems at first sight confusing, but there is as yet no reason to prevent all schemes from proceeding simultaneously. Either Euratom or the O.E.E.C. proposals, or both, could fit into the United Nations project, much as individual countries would take part, though Euratom could probably more easily be accommodated in this way.

It can be regarded as almost certain that, in the case of nuclear energy, the pressure of the "have-not" nations — who vastly outnumber the "haves" — will ensure that some effective system of distributing atomic knowledge, equipment and materials will finally emerge.

ULTRASONIC MACHINING OF BRITTLE MATERIALS

Electronics, 1956, v. 29, n. 1, January, p. 132.

Slicing or cutting germanium, silicon, quartz, ferrites, glass-bonded mica and other materials at high speed by impact grinding results in greater precision and makes possible a great variety of shapes.

Impact grinding offers a number of advantages, the most important of which are:

(a) The cutting tools are rugged and usually inexpensive.

(b) Attaching tools to the machine is simple. The setup is readily changed from one tool to another, providing great versatility.

(c) The operating principle ensures sharp edges on every cut, as well as perfect duplication of the tool shape in the workpiece.

(d) Since tool shape is duplicated in the workpiece, there are no restrictions on the shape to be cut. Tools can be round, square, triangular or any other shape.

(e) Because lapping grades of abrasive are used to do the cutting, a fine surface finish is produced which requires a minimum of subsequent surface lapping.

Designers of magnetic cores for high-frequency transformers, electronic computer switches and microwave transmitting devices can now explore the advantages offered by the electrical and magnetic properties of ferrite crystals.

By means of impact grinding, this material can readily be shaped in one piece with sharp corners and precisely oriented sides. Moreover, the core is not subjected to stress during machining.

Glass-bonded mica, like other hard abrasive materials with a strong grain structure, is difficult to machine by conventional methods. By the use of impact grinding this material is readily machined with no danger of hidden damage.

The transducer design problem is the central one in impact grinding. Cutting rate varies directly with frequency and amplitude of vibration, and so it is desirable to have these as high as possible.

Further development of ultrasonic impact grinding equipment will be directed toward the achievement of higher machining speeds and larger areas.

Higher speeds will require higher power (more amplitude) which will require stronger materials. Larger areas will also require higher power, but may also enforce the use of lower frequencies. Sonic impact grinders operating at high power levels in soundproofed rooms may prove both necessary and entirely practical.

Much investigational work remains to be done on the actual mechanism of cutting, reduction of the tool wear by variations in tool design, and methods of supplying abrasive.

GAS TURBINE TEST BUILDING AND PROPANE FUEL PLANT

One of the few gas turbine test shops in which six turbines can be tested simultaneously on various types of fuel has been built at Lincoln, England, by Ruston and Hornsby, Ltd., who also produce industrial gas turbines.

Particular attention has been paid to the use of cheaper lower-grade fuels, such as natural gas, sewage gas, blast furnace gas, producer gas, gas oil, residual fuel, creosote pitch, carburetted water gas tar, and pulverized peat. Long-term development is being undertaken on the more promising of these fuels. Work is also being done to develop turbines which can burn two fuels, e.g., gas oil and natural gas, simultaneously in varying proportions.

Coal tar fuels are of particular interest in the United Kingdom, and for these a refractory-lined combustion chamber has been developed.

The test shop was largely designed around the company's standard 1300 b.h.p. turbine, but two of the six test beds can handle much larger units. Beds are also available for heat-exchanger sets, arranged so that most site conditions can be reproduced on test.

A large area of the shop is lined with acoustic fire-resistant tile which lessens reverberations in the working area. Heating is by high-pressure hot water radiant panels, and the heat from the turbines under test can be fully utilized. All services are placed below ground level.

Filtered atmospheric air is used for the inlets. Twin exhaust ducts lead from each turbine to a permanent outside stack, which is made of mild steel. These stacks are used to test various external finishes, particularly at the high temperatures obtained when no heat exchanger is fitted.

In view of the importance of high calorific value gaseous fuels, such as natural gas which is abundantly available in many parts of the world, a plant has been installed to provide a mixture of propane and air to simulate the various gases which may be used at site.

Bottled methane was previously used to some extent, but was expensive and not readily available. To meet the need, liquid propane (25 tons) is stored in two pressure vessels. The propane is supplied by road tankers fitted with transfer pumps.

A gas mixture can be supplied to the turbine room at heating values between 600 and 1200 Btu./cu. ft. Liquid propane flows from a storage vessel to a steam-heated evaporator, and vapour delivery is controlled at a constant pressure of 150 p.s.i.g. The mixing station is a pneumatically operated automatic ratio control system with a rapid response to load variations. Protection is afforded against the propane-air mixtures exceeding explosive limits, and a high velocity exhaust system prevents accumulation of propane in service trenches.

This industrial gas turbine installation at Cortemaggiore, N. Italy, operates on natural gas. The set has run for over 6000 hours; continuously for 3500 hours.

THE MANAGER'S SPAN OF CONTROL

Harvard Business Rev., 1956, May-June.

The trend in American business towards narrowing the "distance" between the top executive and the members of the organization he supervises has put too much of an overload on the manager, with damaging results to efficiency and morale, says the author, Lyndall F. Urwick. A superior's authority should extend over no more than six subordinates whose work interlocks, he believes. His challenging advocacy of narrowing the span of control *under today's conditions* should be of interest to every reader — particularly since he is the man who first applied the idea to business some 18 years ago.

THE MAHI BRIDGE IN INDIA

The Mahi Bridge near Vasad (in Baroda, India) shown in the accompanying illustration is now nearing completion. The prestressed concrete construction consists of 16 spans each of 110 ft., giving a total length of 1760 ft. Each span consists of two 110 ft. span pre-cast beams 9 ft. deep, with a poured in place reinforced concrete deck slab 9 in. thick.

To avoid the need of falsework because of the height above the river, the prestressed beams were transported and placed by a pair of specially made erection girders 182 ft. long which travelled out by cantilevering to the next pier and thereafter supported the pair of prestressed beams to be rolled out on tracks on them. The process was then repeated, as shown in the diagram. The photograph was taken just when the erection girders had completed their work and they may just be discerned in the last span.

The prestressing steel in each beam consisted of 15 No. 1⅛ in. dia. Macalloy high tensile bars (known as Stressteel bars in North America) supplied by McCalls Macalloy Ltd., of Sheffield, England, the total length of high tensile bars being approximately five miles. Hindustan Construction Company of Bombay were responsible for the construction. Mr. M. V. Joglekak, M.I.C.E., chief engineer, and Mr. Donovan Lee, M.I.C.E., consulting engineer, London, were responsible for the prestressed concrete design and the design of the erection girders.

WHAT A RESEARCHER DREAMS ABOUT

Railway Age, 1956, v. 140, n. 11, March 12, p. 46.

Instead of reviewing past and present research, the writer does a little dreaming about what lies ahead in track and structures research.

Rail is the primary component in our rolling way. It receives the wheel load and transmits it to the track or to the structure. No substantial change in the cross-section design of the rail is foreseen. It is functional for the purpose it serves. The present 115, 132, and 140-lb. RE designs are ideally proportioned for use in jointed track.

Potential improvements in rail metallurgy, however, are intriguing. Wheel bearing pressures and the internal shearing stresses and direct stresses resulting therefrom are a problem from the standpoint of the development of fatigue failures, of which shelling and detailed fractures from shelling are typical examples.

We know too little about the fatigue strength of steel. The writer believes that physicists will develop steel having much greater fatigue strength than that of which the rail is now composed.

The present batch method of making steel heats, ingots and rails is cumbersome. Probably not too far ahead is a continuous melting furnace with subsequent casting and rolling of the rail in a continuous ribbon.

Immediately ahead we must explore the apparent advantages in high-silicon rail. We must determine its receptivity to welding, either for joining rails into continuous lengths or building up battered rail ends, and to heat treatment of the rail ends.

Plastic Crossties

The presently used treated wood crosstie is doing a wonderful job. Nevertheless, it has certain disadvantages.

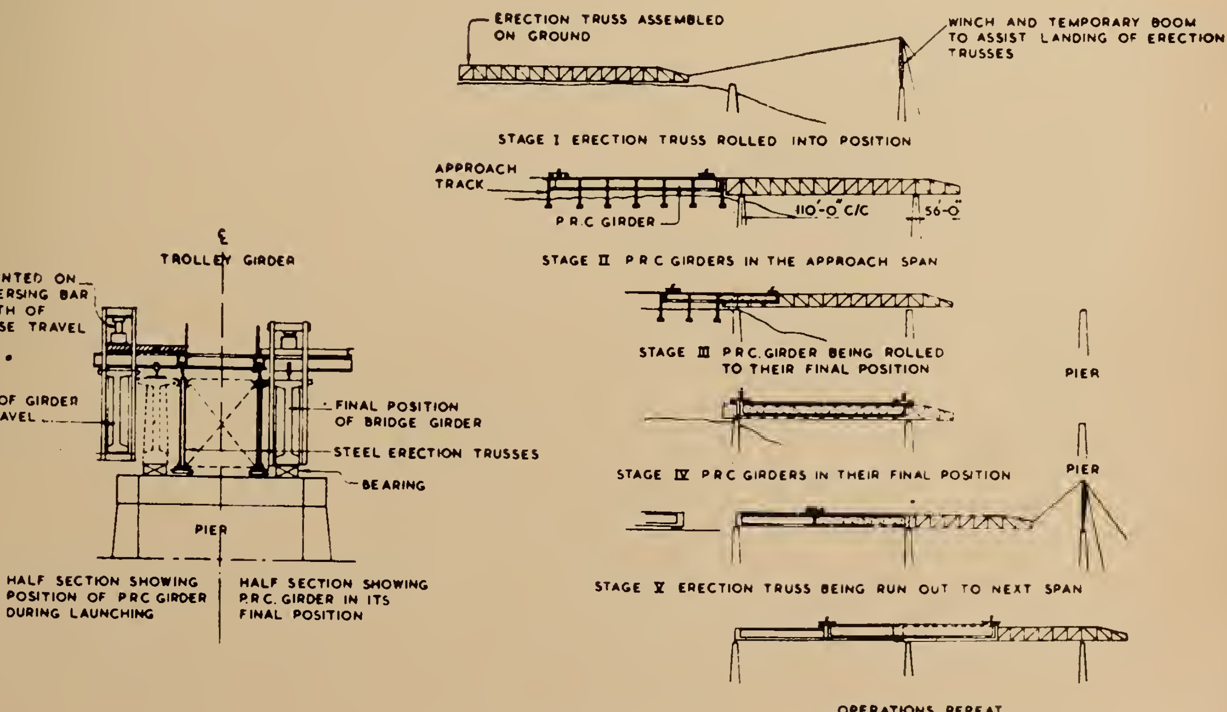
What other materials can we consider for ties, materials over which we can exert control during the manufacturing process? Neither steel nor concrete possess the inherent qualities, which include compressive and flexural strength; resistance to oil, water, various fungi, and brine; sound absorbing and electrical insulation properties; frictional resistance with the ballast; light weight and economy in first cost.

Plastics are now available that have all of these requisites except moderate cost. The dream includes a research chemist developing a competitively-priced plastic, suitable for a crosstie, from some of our more abundant materials.

The design might correspond to the trough section of the steel tie used abroad, and the provision of a

The Mahi Bridge, India, nearing completion.

Diagrammatic representation of the construction of the Mahi Bridge.



canted rail seat and restraining shoulders on the tie itself, with perhaps clamps similar to the GEO construction for securing the rail to the tie, thus dispensing with the need for tie plates and anchorage.

Different Kind of Ballast

Ballast is a component of track structure upon which far too little research has been done, probably because one of the prime requisites has been the availability of a satisfactory material. Is the present ballast, utilizing loose pieces and particles of a durable material, ideal for the purpose?

Recognizing the desirability of a dry subgrade it does not seem logical to provide for the passage of water to the subgrade. This water should be interested on the surface of the ballast section and drained away before reaching the subgrade. A further advantage would be to prevent other substances from filling the voids in the ballast, which results in a pocket forming around each tie, producing erosion and a sloppy track appearance.

Therefore, the ballast section should be a cohesive mass and ties should not be tamped, disturbing the already compacted tie bed. Instead the void between the compacted tie bed and the underside of the tie, formed bv elevating the rail, should be filled by pumping.

No Desire for a Nightmare

The dream does not include an entirely new design of the track structure, since it should not become a nightmare, as it might if a different design were envisioned.

Much has been accomplished in research into roadbed stabilization, but we have only scratched the surface of what can and will be done.

One might stabilize the present heterogeneous supporting structures by mechanical compaction, chemical treatment, and electromosis, ultimately to attain a stable roadbed, with little trouble from slides, subsidence, heaves, and slippage.

Control of vegetation on right of way and roadbed is expensive maintenance. Much progress has been made in the use of chemicals and oils for this control.

All-welded Bridges

Most railroad bridge structures now have a long life and we should have to look many years ahead for radical and extensive changes in structures. Concrete is resistant to corrosion and eliminates maintenance painting. It lends itself to attractive designs and, with prestressed or post-stressed reinforcement, can much more effectively resist flexure than ordinary reinforced concrete. It seems certain in the dream ahead that a large portion of railway structures will be of concrete.

Probably far more use will be made of all-welded steel structures than at present. Labour cost for welding is now the principal deterrent. With increased knowledge of welding techniques and weld strength; and use of automatic welding procedures, all-welded construction of new bridges may be the general practice.

Corrosion and painting costs are two important disadvantages of steel bridges. Corrosion resistant steels are at present too expensive for bridge construction, but one may envision the economical production of structural elements with outer surfaces of corrosion-resistant alloys.

ANALOG COMPUTERS FOR THE ENGINEER

Electronics, 1956, v. 29, n. 6, June

Development of new aircraft, guided missiles and automatic control systems for industry further nourishes a $10 million business in the U.S. Manufacturers offer electronic computers of varying size and complexity, ranging from desk-top to room size.

There are about 400 analog computers presently in use. The industry derives much of its present impetus from defence production. Computers are also used by petroleum companies, atomic energy plants and laboratories and other research and development activities. Vast potential applications lie in the field of industrial process control, automobile design and other metal trades products, even in automatic highway traffic control. Sales estimate for 1956 approaches $8 million.

Though computers are available at under $1,000, a commonly used rule of thumb for pricing is $1,000 an amplifier, including associated equipment. They can cost $250,000 and up, depending on research and development costs. The average computer uses 36 to 48 amplifiers, while one with 72 amplifiers or more may be considered large. One class of computer is the network analyser used by electric utilities to solve problems in the distribution of electric power. A relatively few companies manufacture general purpose problem-solving computers. A tabulation accompanying the article lists manufacturers, models, description of computer, price, accuracy, power used, size and other characteristics.

LIGHT GAS TURBINE

Engineering, 1956, v. 181 n. 4707, May 25

Aero-engine and large-scale industrial applications of the gas turbine have tended to overshadow its development as a light-weight prime mover, so that its more modest use in fire pumps, auxiliary generators and similar equipment is often overlooked. However, with the advent of the gas-turbine car the position may be changed. Recognizing the need for a light simple engine, Mr. D. D. Budworth, of David Budworth Limited, Harwich, Essex, has developed a small 45 to 60 h.p. gas turbine, approximately 16 ins. in overall length and weighing only 45 lbs., without reduction gearing, for applications ranging from pumping to the propulsion of high-speed boats.

Since the prototype was started in 1950 gradual refinements in all the component parts have been made, but it was not until last year that the full output of 60 h.p. was achieved. As with all gas turbines the engine is now capable of a very great temporary increase in power over that at which it is rated.

The turbine unit consists of an annular combustion chamber surrounding a radial compressor and turbine mounted back-to-back on the same shaft.

A low-pressure fuel system is used, such that the fuel pressure is only a few lb. per sq. in. higher than that of the combustion chamber.

Any distillate fuel may be used and the consumption of gas oil is between 10 and 12 gallons per hour.

Canadian Developments

NEWS OF MAJOR ENGINEERING DEVELOPMENTS IN CANADA

St. Lawrence Seaway and Power Project

At the end of July 1956, with less than half the construction period elapsed and with all but a very few contracts awarded by all four 'Authorities' and work under way, seaway officials give assurance that construction is 'up to schedule'. Though progress on some contracts is ahead of schedule, on others it has not been up to expectations. Some of the work awarded late in 1955 and in 1956 has not yet reached the stage where progress begins to pick up speed and catch up on the inevitable delays in getting started.

The construction industry bore the brunt of steel shortages due to the steel strike, particularly in plate and structurals. But with much of the permanent steel equipment and material on order since last year, excluding steel for bridges, the possible effect of the strike on seaway work should be limited. Structural steel for the new bridges at Montreal and Cornwall, and for modifying four existing bridges at Montreal, might be retarded as much of it must be imported.

It is probably still too early to assess how much the overall cost will exceed official estimates. Many early contracts were underbid due to severe competition and the desire of many contractors to cash in on the publicity value of being associated with the project. This resulted in losses to successful bidders and a few defaults. On the more recent awards, due to a greater volume of work offering and thus less competition, bids were fewer and prices more realistic.

However, the continuing upward trend of the construction cost index inevitably lessens the chances that total cost will come within estimates made in 1949 or even under those made two years ago.

Employment by all four authorities as of the end of June exceeded 13,000 men. This total will grow considerably during the peak summer months.

Progress By Ontario Hydro

Throughout July good weather favoured construction work in all sections of the project. The total force employed by Ontario Hydro and the various contractors totalled approximately 4,100 persons.

Concrete was placed around the draught tube forms for Unit No. 1 and much progress was made on the power-house foundations during July, Rock excavation was completed for 4 units and well ahead for the remaining 12 units. Placement of concrete by the end of the month in the U-abutment, wing wall, ice sluices, and for the bases of five generating units amounted to 177,000 cubic yards. Concrete in place for the entire project exceeded 235,000 cubic yards, and excavation passed 17 million cubic yards.

Assembly of the second wooden draught tube form was completed for unit No. 2 in July. Preparations were being rushed for placing concrete around this form. The two forms will be used successively for each of Ontario Hydro's 16 generating units. Work in the U-abutment section of the power-house was completed during the month. All three gantry cranes operating there were moved into positions for placing concrete for the power units.

Aided by favourable weather, the dike contractor made outstanding progress in placing material on sections 2 and 3 of Cornwall dike. Some 14,000 cubic yards of material were being placed and compacted each day when weather conditions were suitable. About 24 per cent of the earth fill had been placed. This four mile dike, 40 ft. to 60 ft. high will carry part of the proposed scenic highway. Sixteen tractor-hauled, 16 and 20-yard scrapers are in use.

At the Cornwall dike closure structure, concrete placing was slightly in advance of schedule. The blocks of concrete for the wing walls were almost up to ground level from the excavation. A total of 52,000 cubic yards of concrete had been placed. Canal excavation was being continued at the west end for diversion of Cornwall canal. This canal must be ready for the 1957 navigation season. When traffic is diverted the dike will be built across the old canal. Though the closure structure is being built for 27-ft. draught, the diversion canal is being dug only 14 feet deep.

Good weather favoured work on the relocation of the double track of the CNR and the rebuilding of No. 2 highway between Cornwall and the Iroquois-Cardinal area. The railway contractors had laid a total of 32 miles of single track. Principal track laying extended from Cornwall west and from Cardinal east. In the Cardinal area, tracks had been ballasted. Grading was in progress in Sections A and B to Mile 26, near Morrisburg. In Section C, which continues to the Cardinal area, nearly all grading had been completed.

All clearing for No. 2 highway relocation had been completed. About 80 percent of the grading had been completed in the Moulinette west section and was ready for paving.

Channel improvement work was speeded up during the month in both Galop and Chimney Island sections. The contractor at Galop Island had removed an estimated 4,500,000 cubic yards of earth, and 165,000 cubic yards of rock.

First houses were moved into new town No. 2 during July. These homes were transported by a special float and placed on new concrete block foundations in the town site. At Iroquois, house moving operations were completed. Water mains and sewers for the new shopping center were almost completely laid. The steel work had been completed on the shopping center and the roof was over the entire center. Twelve houses were moved during the month in Morrisburg.

In all rehabilitation areas, work was accelerated. The laying of sewers, water mains, and construction of basements in new town No. 1, and new town No. 2 were well advanced. Progress was made on the sewage plants and the pumping stations of new towns No. 1 and No. 2.

Progress By NYSPA

July construction continued to forge ahead rapidly as working conditions remained good. Concrete in place by July 31 exceeded 560,000 cubic yards; excavation for all features had passed 21 million cubic yards and employment averaged 5,900 for the month. With July progress, the project as a whole was over 35 per cent complete.

Nine gate guides and sills were in place at Long Sault dam, piers were approaching their final height and the spillway bucket was over half completed. Two gantrys are set up in the dry ready to roll onto the deck of the dam. Concrete in the structure totalled 200,000 cubic yards. Excavation for cut "F" was 81 per cent complete and cofferdam "E" cableway was being erected. Cofferdam "DU" was being constructed as piles for cofferdam "A" were being removed.

Rock excavation for all 16 units was practically completed on the Barnhart power-house. Concrete placement at end of July totalled 166,000 cubic yards. Excavation for the switchyard and placement of embankment in the south forebay dike continued.

Iroquois dam was in its final stage 1 construction as gate sections were being placed and cofferdam cells were being removed. Embankment placing continued behind the east abutment and excavation progressed within the cofferdam area. Concrete placement totalled 88,000 cubic yards.

At Massena intake, 83,000 cubic yards of concrete had been placed to July 31. Construction of the dike was well underway and pipe laying for the Massena-Alcoa water supply was on schedule and two-thirds completed. Intake will open in 1957.

Excavation under the five channel improvement contracts was 30 per cent completed, as work at south channel of Galop Island progressed to 80 per cent completion. At Sparrowhawk Point, excavation was in progress on both Toussaints Island and on the mainland.

Bids were opened for clearing the reservoir areas between Point Three Points and Red Mills and specifications were being prepared for all remaining reservoir clearing, as well as the relocation of state highways 37 and 37B.

Approximately 65 per cent of the survey work was completed for the Barnhart - Plattsburgh transmission line. Studies are continuing by Alcoa for docking facilities. This marine terminal will permit ocean going vessels to deliver alumina from one of their Gulf Coast bauxite refineries and would also make possible water transportation to and from Massena and other Great Lakes ports.

Progress by SLSDC

At the Robinson Bay lock, now renamed the Eisenhower lock, earth excavation was complete for the lock structure but not for the approach channels and guide walls. Rock excavation was down to bed grade for the lock structure and concrete was being placed for foundations under lock walls.

Somewhat similar progress had been attained on the Grasse River lock. Here less trouble had been experienced with excavating the stiff marine clay found at the Eisenhower lock, but slides had occurred last spring, causing some delays.

On the Long Sault channel, besides the 15-yard coal stripping dragline known as 'The Gentleman', three additional 13½-yard machines were operating. Clearing was proceeding in readiness for building the 10 miles of canal dike.

Progress by SLSA

Though work on the Iroquois lock appeared to be somewhat behind schedule, most of the earth excavation was completed; the upstream approach channel was done, and a start had been made on pouring the lock approach walls. The bottom pours were made for six sections or about 300 feet of length and steel frame for moving wall forms was in place. Rock excavation was down to grade on the lock proper and was under way for the downstream gate.

Dredging contracts for the channel through Lake St. Francis were proceeding on schedule, while the 4-million-yard dredging contract with Marine Industries Ltd., in Lake St. Louis was actually ahead of schedule.

At the Beauharnois locks, Atlas-Winston Ltd., contractor for the first stage, had opened up about 1200 feet of the highway tunnel under the locks. The tough sandstone being encountered in digging the rock foundations made it necessary to change drill-bits every 12 hours. The excavation contract calls for completion in October this year. Work on the contracts for the locks themselves, awarded in June, had barely been started.

At the lower end of Lake St. Louis, Miron-Frères-Mannibec Construction had just started on two miles of overland channel containing three million yards, for completion by August 1958. On the adjoining contract downstream, Northern Construction-Stewart had recently started on their 3-mile, 7½-million-yard overland channel contract near the Mercier bridge. Below it Miron Frères Ltée. had completed their ¾-miles of overland channel and rock cushion last spring, eight months ahead of schedule.

Immediately downstream from the Miron contract is the Côte Ste. Catherine lock. Awarded to Canamont Construction-Canit Construction last year, its four million yards of excavation and the placing of concrete in the lock is due for completion in July 1958. Washouts delayed the work in early stages, but the contractor was catching up with the schedule by working three shifts. Pouring of concrete had been commenced on the lock floor and walls.

Below the Côte Ste. Catherine lock are some 10 miles of channel and dike due for completion by August 1958. Northern Construction Co. has 3.7 million yards to move on 3 miles of channel, while Walsh-Canadian Co. has 7 million yards over a four-mile length. Work was close to schedule on these two jobs, with excavation four miles apart at present and due to meet this fall.

On the St. Lambert lock, McNamara - Pigott - Peacock - McQuigge, in joint venture, had excavation completed for the lock itself and several foundation blocks poured for the lock walls. On the downstream approach channel, excavation was down some 70 feet below top of dike for about 2500 feet of length. The upstream approach channel was not yet started. Completion is called for by August 1958.

The same joint venture group has the contract for 1½ miles of channel between Victoria and Jacques Cartier bridges, to be completed by June 30, 1957. This work was 43 per cent done last fall and was still well up to schedule.

Below the Jacques Cartier bridge

Miron Frères Ltée have a mile of channel for completion by November 1957. Excavation was down to channel bed below the Jacques Cartier bridge, while upstream it was down to grade for part width over most of the distance between the bridges. Approximately half of the contract had been completed.

Downstream from the Jacques Cartier bridge, Marine Industries Co. Limited have a 3-million-yard dredging contract to complete by August 1958, on the last stretch of channel adjoining the St. Lawrence ship channel, with turning basin. Awarded last March, work on this contract was already well under way.

Atlas Construction Co. has the contract for widening, strengthening and raising piers 1 to 11 of the Jacques Cartier Bridge, to permit ramping the approaches to the new high level span over the navigation channel between piers 9 and 10. The existing bridge spans are being raised an inch at a time as the piers are enlarged and raised.

Gantry placing concrete for first section of the mile-long walls of Iroquois locks. Crane swings bucket of concrete over forms. Work is now well advanced.

SLSA Contract Awards

Contracts were awarded on June 29 for Beauharnois canal locks as follows: construction of upper lock and approaches, to United Waterways Constructors, Ltd., Montreal, for $14,440,000; construction of lower Beauharnois lock and approaches, to Canit Construction Co. Ltd., Montreal, for $11,199,925.

On June 8, a contract for some two miles of excavation for the seaway channel adjacent to Lake St. Louis, together with accompanying dike, was awarded to Miron et Frères Ltée, and Mannibec Construction Co., of Montreal. Bridge and Tank Co., Ltd. of Hamilton were awarded a contract for supply and erection of Côte Ste. Catherine lock bridge and Iroquois lock bridge, at a price of $810,221.

These contracts bring the value of some 45 contracts awarded by SLSA in various sections of the seaway to $122 million, involving excavation over a distance of some 21 miles. To complete the channel requires excavation of a total of some 48,400,000 cubic yards of earth and rock. Dredges will remove a total of some 12,700,000 yards of overburden, rock and gravel from Montreal harbour, Lakes St. Louis and St. Francis, from shoals and reaches along the way, and from the Welland ship channel.

A contract for permanent raising of the Jacques Cartier bridge and replacement of a 248-foot deck span by a new through truss span, was awarded on July 16, to Dominion Bridge Co. Ltd., at a price of $6,895,750, for completion by October 31, 1958. The only other bidder quoted a price of $8,123,295. Purpose of the modification of the bridge is to provide a minimum clearance for shipping of 120 feet above high water level in the channel, to be located between piers 9 and 10.

The work includes replacement of an existing 248-foot deck-truss by a new through-truss span, elevation of 14 spans at the southern end, and will follow the raising of existing piers to suit. It also involves raising the existing southern abutment, building a 65-foot abutment to the south, and a new steel deck girder span between the two.

The new through-truss bridge span over the channel will be erected on falsework beside the present span, and the operation of replacing the new for the old span will be accomplished with a total interruption of between four and six hours.

To maintain uninterrupted vehicular traffic during construction, two temporary Bailey bridges and platforms will be installed on each side of the bridge between span 3 and temporary roadway embankments to be built at the south end of the bridge. The contract calls for purchase of some 822 tons of structural steel, and about 2500 cubic yards of concrete for decks and abutments.

Other contracts awarded in July were: a pipeline to supply municipalities of Longueuil and Jacques Cartier, to Miron et Frères Ltée, for $535,200; deepening some four miles of the Welland ship canal to 27 feet, to McNamara Construction Co. Ltd. and Canadian Dredge and Dock Co. Ltd., of Toronto, in joint venture, for $11,623,200; 106 electrical cubicles for power supply at five seaway locks to Northern Electric Co. Ltd., at $313,165.

Cornwall Bridge

At a meeting of officials of the two seaway authorities concerned with navigation, held in Montreal on July 19, it was agreed that a high level highway bridge would be built over the south channel of the river at Cornwall. The division of cost, estimated at about $5 million, will be based in proportion to the length of the structure in each country. Can-

(*Continued on page 1180*)

Looking downstream at Galop Island south channel; excavation complete and area flooded. Cleaning up at downstream end is seen still in progress.

Stage I construction at Iroquois dam (left). A gantry crane may be seen being assembled in the foreground.

Looking north at stage I construction of Long Sault dam. First apron block is at right end of the structure. (below, l.)

Construction of concrete approach wall to Iroquois lock, most westerly of the new Seaway locks. Wall is 47 ft. high.

A Pictorial Record of the Seaway and Power Projects

Long Sault Dam construction seen through the legs of one of the permanent gantry cranes (right).

Wooden forms for draught tubes are seen in position beneath the first two generating units of the Canadian powerhouse (centre left). Forms will be re-used for total sixteen units.

Placing and compacting till is in progress behind the "U" abutment section of the powerhouse main dam (centre right).

Panoramic view of the powerhouse site shows excavation and concrete-placing operations in the dewatered area behind the downstream cofferdam which runs between Barnhart Island and the Canadian shore in the background (bottom picture).

Relocated in the foreground is the new Iroquois townsite. The old town is on the north shore of the river.

Large crater near centre of picture at left is excavation for the Cornwall diversion canal closure structure.

Dredging near Spencer Island, where channel improvements are being made to provide suitable depths and velocities. Capacity of these dredges is 6 cubic yards per lift.

Photographs in this section courtesy of The St. Lawrence Seaway Authority; Ontario Hydro; Power Authority of the State of New York; Uhl, Hall and Rich.

Looking upstream at Victoria bridge opposite port of Montreal showing channel excavation and dyke.

Placing form of concrete at entrance to St. Lambert lock, near Montreal.

Placing base for lock walls at St. Lambert lock site (bottom left).

Excavation for Beauharnois locks (bottom right). Here, tough sandstone has made excavation difficult.

St. Lawrence Seaway

(*Continued from Page 1175*)

ada will build the substructure, while the United States will build the superstructure.

The negotiations took place because of the necessity for removing the south span of the existing Roosevelt road-rail bridge to make headroom for the passage of vessels. The original U.S. plan for a two-purpose bridge at Polley's Gut on the western tip of Cornwall Island was part of a proposed six mile relocation for rail and road traffic which would also have crossed the Grasse River lock.

It was the only feasible alternative to a prohibitively expensive two-purpose high level bridge. But New York Central's preference for abandoning their line from Helena, N.Y., to Ottawa made a high level highway bridge much more attractive financially. The railway will apply to the Transport Board and to the Interstate Commerce Commission for Authority to abandon its line from the United States to Ottawa.

NYSPA Chairman Robert Moses immediately protested the decision in telegrams to the International Joint Commission and the Ontario Hydro, claiming the plan would delay the seaway opening and delivery of power by a full year.

Great Lakes Channel Dredging

The Corps of Engineers, U.S. Army, will soon be launching a huge channel deepening job on the Great Lakes that may tax the dredging industry's capacity to the utmost. The overall project, involving 44 million yards at an estimated cost of $150 million, was authorized by Congress last spring. It includes considerable dredging yet to be done on St. Mary's and Detroit Rivers under the Rivers and Harbors Act of 1946.

The three main areas for channel deepening are: St. Mary's River and Soo locks; St. Clair River and Lake St. Clair; and the Detroit River. The total job is divided as follows: 16 million yards of hydraulic dredging; 24 million yards to be removed by dipper or bucket dredges, and 4 million yards of ledge rock.

Though not primarily a part of the seaway project, basically the Great Lakes channel deepening is vitally connected with the seaway. The program will compete strongly with the seaway for dredging capacity and equipment. But speed will not be an important factor. Completion will probably be called for by 1962. Mostly medium size dredges will be used. In general, upbound channels will be deepened about six feet, downbound and two-way channels from two to four feet. Present plans are to take bids first for the Amherstburg channel on the Detroit River.

Moderate Tolls, More Investment Needed for full Benefits

"Improvement of the St. Lawrence will justify itself because Canada is growing rapidly, and because navigation is a by-product of the power developed. But there is no reason to think of it as an immediate source of huge profit." This is what J. L. McDougall, professor of economics, Queen's University, recently told the Canadian Manufacturers Association in addressing their 85th annual meeting held in Toronto in June.

There would be a development period in which the economy would gradually alter as it absorbs this new facility into its natural life. If unduly high tolls are set up in early years it may hinder rather than help in that process.

Great as our investment will be before the project is finished in 1958, he warned, we must be ready within reason to make further investments, in additional accommodation for grain in the lower St. Lawrence, and in whatever may be required to keep traffic moving through the Welland canal. Otherwise we shall fail to draw the full benefits possible from the money now being spent.

Grain transfer elevators at Canadian lower lake ports will become obsolete. To even the flow of grain through the lower St. Lawrence there must be additional construction at and below Montreal to take the place of this 20 million bushel capacity. Unless big 'lakers' can unload and turn around quickly there, costs will pyramid and we may be little better off with the new canals than we were with the old, he predicted.

The grain movement . . . has always been highly irregular. Allowance must be made for very high peaks, especially in the fall. Canada was only one country selling grain among a number and it must stand ready to make delivery quickly or sales would be lost, he observed.

A substantial movement of iron ore upbound would mean a better balancing of cargo movement, but it would create a problem too, the speaker pointed out. All movement expected through the new canals from Prescott easterly originates in or is destined to Lake Erie and above. Thus it must be superimposed upon traffic now moving through the Welland canal, which is now approaching saturation. We probably should be prepared for a substantial investment to increase its capacity if there is to be any real hope of significant additions to the volume to be handled through it.

Ecole Polytechnique

The Ecole Polytechnique, the faculty of applied science and engineering of the University of Montreal, will be in new quarters within 18 months, according to information received from Henri Gaudefroy, M.E.I.C., dean of the faculty.

New building for Ecole Polytechnique, Montreal.

With the help of a $6-million grant from the Quebec Government, announced in June 1954, the faculty is enabled to erect and establish itself in a new building on the campus of the University, leaving behind the now overcrowded classrooms and laboratories on St. Denis Street, which this French Canadian engineering school has been using since 1905.

The university anticipates an increase in enrolment in this faculty to 1500 students, within the next ten years, doubling the present enrolment. This progressive step will have a far reaching effect on the development of the engineering profession in the Province of Quebec. It is a step toward the solution of a very pressing problem: the great shortage of French speaking engineers in Canada, and toward meeting the demand of young men for technical and engineering education.

The problem of space at Ecole Polytechnique was noted many years ago. Preliminary investigations were made in 1948, at the time of the 75th anniversary of the school. It was realized then that the solution of this problem could only lie in the erection of a building on a new site. In 1952, preliminary studies were made of a building providing adequate facilities for the estimated large increase in enrolment. As a result, Premier Maurice Duplessis promised forthcoming help. The announcement made in June 1954 gave the green light. Final architectural details were worked out and during the winter of 1954-55, excavation was started.

The responsibility of the construction program was given to Gaston Gagnier, a Montreal architect. The engineering team was made up of Lalonde and Valois, consulting engineers in structures, Pierre-Paul Vinet, M.E.I.C., head of the Department of Mechanical Engineering for heating and ventilation, and Fernand Leblanc, M.E.I.C., head of the Electrical Engineering Laboratories, for electrical services and lighting. The contract was given to Quemont Construction of Quebec and Montreal owned by Arthur Laplante, M.E.I.C.

The new building more than doubles the space presently occupied on St. Denis street. It will have a floor space area of 460,000 sq. ft. and a cubage of six million cu. ft. It is being built on Mount Royal to the southeast of the University of Montreal and, as the illustration shows, contains a north wing, 460 feet in length, to be occupied by administration offices, the library, student quarters, and most of the classrooms. The south wing, running parallel some 200 feet to the south, will be 590 feet long, accommodating the heating plant, the departments of mechanical engineering, hydraulics, metallurgy, and part of the department and laboratories in chemistry and chemical engineering, physics and geology. Two transverse wings joining the main wings will provide space for the electrical engineering department, soil mechanics, public works and civil engineering, and will be also partly devoted to the laboratories of chemistry, physics and geology.

The accommodations provide additional space not only for classrooms, but will permit much expansion in the different laboratories both for teaching and research. It is a very sound policy in view of the rapid technical developments which will undoubtedly increase the importance of scientific experimentation in the solution of technical problems to come. The space being provided, the Board of Governors will see that it is properly used and will authorize the purchase of a large amount of new scientific apparatus.

From the architectural point of view the building will fit in with the present university buildings. The brick facing will be the same, but plans incorporate the latest improvements and allow a very modern architectural treatment.

Ecole Polytechnique was founded in 1873. During the past fifty years many extensions were built to the original building, and the school has developed at a very fast rate.

It is expected that the establishment on Mount Royal will mark a new era in the expansion and development, due to the added space and facilities, these coming at the time of spectacular technological advances in all fields of applied science.

Beaumont Power Development

The shores of the St. Maurice River a few miles above La Tuque, Que. are gradually taking on a different look as men and machines push ahead with work on The Shawinigan Water and Power Company's new 256,000 kilowatt hydro-electric development at Rapide Beaumont.

Construction crews of Shawinigan Engineering Company, a subsidiary of the power company, moved into the area this spring to start work on the modern, semi-outdoor type project which is scheduled to deliver power from the first of its six generating units late in 1958.

A modern construction camp on the river bank, with accommodation for some 800 men and containing a hospital, offices, workshops and dining hall, has been largely completed. Bulldozers were busy during the early summer clearing an access road to the site over which construction materials can be moved from a railway siding built near Fitzpatrick.

As well, to run the construction machinery a temporary 33,000-volt power line has been erected from La Tuque power-house 10 miles away.

At the construction site itself 540,000 cubic yards of rock are being excavated from the river bank to form a by-pass channel through which the waters of the St. Maurice will be diverted during construction of the dam and power-house. At present, about 30 per cent of the by-pass which will be over 1,000 feet long, 125 feet wide and an average of 80 feet deep, has been excavated.

Since the new development will raise the river level some 110 feet the CNR transcontinental main line which follows the west bank of the river at this point will be diverted to the eastern shore for a distance of some nine miles. A new bridge, just over three miles above Rapide Beaumont, will replace the present one located downriver from the site. Cofferdams for piers of the new bridge have just been completed and sinking of steel caissons is under way. A cable-way has been erected at the bridge site to transport material and erect steel. Grading of the new railway road bed on the east bank has just been started by Kennedy Construction Limited and Campbell Brothers and Thompson Limited, working in a joint venture as contractors for Shawinigan Engineering.

Cost of Shawinigan's Beaumont development, including a new 230,000 volt transmission line to Trois-Rivières, a little more than 100 miles to the south, is expected to reach $56,000,000.

Beaumont Power Development. White lines show approximate location of the by-pass channel through which the St. Maurice River will be diverted.

Canadian Pipeline Projects

Westcoast Transmission

Progress on the Westcoast Transmission pipeline, which had been retarded somewhat in the Fraser Valley and Sumas Prairie sections by rain and wet ground last spring, which cut progress to ½ mile daily, is attaining a two-mile-a-day clip under more normal conditions. Early in July the company had 372 miles of pipe on hand, or enough for 1956 construction. Final deliveries of pipe ordered from Britain will be completed by October first. Mannix, Ltd., has the contract for building the 45 miles of 18-in. and 20-in. line from Huntingdon to serve Vancouver area.

Across the International Boundry, the Pacific Northwest project had most of their pipe laid by July first. Steel pipe for this pipeline is being supplied by the Kaiser Steel Co.

Inland Natural Gas Co., Westcoast's distributors for interior British Columbia communities, had completed air surveys for the major portion of their $28 million distribution system. By mid-July, helicopters had covered the route from Osoyoos to Savona and 25 miles had been staked in the Kamloops area. Right-of-way purchase will be well advanced this year, with clearing underway this fall.

Kamloops rate payers had voted on a franchise for Inland, the city council had approved the agreement, and approval had been obtained from the Public Utilities Commission. Inland Gas Company officials were reported to be unconcerned over the steel strike, as pipe was ordered early this year. Financing will be completed in September. Ford, Bacon and Davis, Canada, are engineers and supervisors for the pipeline.

Trans Canada Pipelines

By mid July contracts had been awarded for four of the seven 'spreads', with Canadian Bechtel Ltd. and Majestic Contractors actually at work. Canadian Parkhill Stringing, Ltd., has the stringing contract for the entire section to Winnipeg. Despite heavy July rains in Saskatchewan, good progress was being made. By the end of July, 56 miles of right-of-way had been cleared and graded and 39 miles of pipe strung on spread 1 to the Saskatchewan border. On spread 2 through Saskatchewan, 75 miles of right-of-way had been cleared and graded and pipe strung for 17 miles. Construction offices had been opened at Swift Current, Regina and Brandon, and Canadian labour was being used as far as possible.

Trans Canada officials expect progress of one mile per day from each of the seven spreads when all are in action. Ninety days is believed to be sufficient for laying the pipe, and on this basis if there should be no hold-up in the deliveries of pipe by September first, the line could be completed by the December first deadline.

By late July, however, with steel shortages cutting drilling activity sharply, U.S. observers close to the steel situation believed effects from the steel strike might be felt more deeply after the strike settlement, with long delays on deliveries in the third quarter, and elimination of half of fourth quarter allocations.

Trans Canada would have had a bigger pipe stockpile on hand but for the shutdown early in May of the Tennessee Coal and Iron Co. platemill, which turns out plate for National Tube Mill at Orange, Texas, —one of the pipe suppliers. Early in August Trans-Canada officials, denying reports that no gas would reach Winnipeg and Brandon before the summer of 1957, stated they were "hopeful, but not assured", that the Prairie Section would be completed by the year-end deadline. It all depended on the steel situation.

With FPC approval of the import of Canadian gas by Tennessee Gas Transmission still many months away, possibly not before 1958, Trans Canada must arrange its financing on the strength of Canadian sales contracts only. Only by doing so will the company be able to repay its government loan and redeem its present stock from Government trustees before the April deadline provided for in the loan agreement. T. S. Atkinson, former general manager, Royal Bank of Canada, who was recently made a director of Trans Canada, now heads a finance committee working on a financing plan on the basis of Canadian markets.

Great Northern Gas Utilities has received certification to distribute gas in the Brandon area by the Public Utilities Board of Manitoba. This will be the largest distribution system built and serviced by Great Northern between Sault Ste. Marie and Fort St. John. To be built at a cost of $1½ million it will distribute gas at the lowest rates obtaining in the province. And Northern Ontario Natural Gas is planning a $32-million distribution system to serve its various markets in Northern Ontario.

Alberta Gathering System

Alberta Gas Trunkline Co. is obtaining a $3,690,000 loan at 4½ per cent from the Alberta Government to finance the building of its gathering system this year. $2½ million was advanced July 1, with the balance to come in August and September. Bailey Selburn Oil and Gas Co. Ltd., will drill five wells in the Bindloss field. 'Baysel' will supply 7 million cubic feet per day or a third of the first year's requirements to Winnipeg, from this field, in which it holds a 56½ per cent interest.

Welland Mill Soon In Operation

Welland Tubes Ltd., the company that will produce pipe in sizes up to 30 inches diameter for the Trans Canada and Crown Pipeline Companies, commenced erection of structural steel on their mill building at Welland, Ontario. The building, 684 feet long, 317 feet in width at one end and 260 feet wide at the other, covers about five acres. Rolling of the first 878 miles of 30- inch pipe will commence early in 1957.

Products Pipeline Projected

A products pipeline system, from Alberta to eastern Canada, is awaiting approval from the Board of Transport Commissioners and the Alberta Conservation Board. This project, to be integrated with the Trans Canada pipeline, would move large quantities of liquid hydrocarbons from the 'wet gas' fields of Alberta, which are removed from the gas before it enters the gas pipeline. Being a 'common carrier', this pipeline would also move refined gasoline from Edmonton refineries to Winnipeg.

Besides the natural gasoline recoverable from wet gas fields, such as Pincher Creek, to be delivered to refineries along the route, propane and butane would be carried in liquid state under pressure and sold as heating fuels to distributors and industry along the route.

Exclusive of its own gathering system in Alberta, the 8-in. and 6-in. pipeline itself will be 800 miles long from Alberta to Lakehead, and will be provided with underground and above ground storage facilities along the route. Terminating at the Lakehead cities of Fort William-Port Arthur, it calls for the addition of eight or more specially built pressurized Great Lakes tankers to move the fuel from Lakehead to eastern markets along the Canadian side of the Seaway.

Hydro Carbons Pipeline, Ltd., a subsidiary of Canadian Hydro Carbons, Ltd., and Superior Propane Ltd., is sponsor of the project. The former propose to build the line as far as Winnipeg. The estimated cost of the combined project, including the eight tankers, is estimated at from $55 to $60 millions.

Northern Research Laboratory

The northern research laboratory of the NRC Division of Building Research at Norman Wells, was opened on June 23.

The Advisory Council of NRC toured the northern part of Canada beginning at Uranium City on June 20 and returning to Edmonton on June 28. The purpose of the tour was to give the senior officials of NRC an opportunity to gain first-hand knowledge of northern problems. They inspected scientific and engineering developments in Uranium City, Yellowknife, Whitehorse and Fort Simpson.

The words "National Research Council" actually refer to the advisory Council of 21 members. Most of these men are eminent scientists from all across Canada; others represent labour and industry. They are responsible to a committee of seven cabinet ministers. The members of Council, serving without salary, select the NRC staff, award scholarships and grants in aid of research, and are responsible for the general direction of the laboratory work.

The National Research Council's laboratories are organized in nine divisions at Ottawa and two regional institutions, the Prairie Regional Laboratory at Saskatoon and the Atlantic Regional Laboratory at Halifax.

Design of Frobishers Yukon Project

The economic feasibility of the Frobisher-Ventures Ltd. metallurgical and power development in Northern British Columbia and the Yukon is now confirmed, according to a progress report recently issued by Frobisher Ltd., one of the participating companies. This $700-million project is expected to reach the design stage during the current year, while construction on the first stage, namely, development of 337,500 kw. of power on the South Nass River may be commenced by 1958.

The much larger Yukon - Taku scheme, announced some five years ago, to harness the Yukon's system of inland waterways and to develop close to four million horsepower, has been temporarily stalled due to international complications. Construction of this vast project is not likely to be undertaken until Canada and the United States forge out an agreement on an international power policy.

In spite of this delay however, the Frobisher company evidently feels confident of its eventual approval. Design for both the smaller Nass development and the larger Yukon-Taku project is being commenced this year on the dams and the turbines, with orders to be placed in 1957.

The Nass project can either be operated independenty or integrated with the big northern unit. Frobisher has already spent some $1 million on engineering studies to determine the dependable flows, pick out sites for the dams and for field surveys, test-pits and diamond drilling for foundations.

Would Take Seven Years to Complete

The Yukon-Taku is a power and ore-smelting and refining undertaking of startling proportions, using waters of the Yukon River as a source of cheap power. Originally conceived by Thayer Lindsley, past president of Frobisher Ltd., and Ventures Ltd., it would take some seven years to complete. $270 millions would finance the initial stage of development of 880,000 horsepower, together with the incidental smelters and refineries. Ultimately the scheme would utilize some 4 or 5 million horsepower.

In brief outline, a dam on the north flowing Yukon River some 800 miles north of Vancouver, as first proposed would divert part of its flow southward into a vast lake-studded watershed east of the coastal range of mountains, extending south-eastward more than 200 miles to a point about 80 miles south of the Yukon-British Columbia boundary line. Water stored at an elevation 2200 feet above sea level would drop through tunnels south of Atlin Lake to the generating plant. From here power would be transmitted 45 miles to Taku, where smelters and refineries would be built at tidewater on an ocean inlet from the Lynn canal a few miles east of the Alaska Panhandle border.

Patterned After Kitimat

Following the example set by the Aluminum Company of Canada at Kitimat, of bringing ores by ship to the site of cheap electric power, Lindsley planned metallurgical and chemical industries on a scale never before seen. Nickel and cobalt concentrates would be brought from Indonesia and New Caledonia. Iron ore would come from British Columbia and Alaska, other ores from South America, West Africa and Uganda. He visualized Taku as another Swansea, Wales, where Welsh coal has been the magnet for drawing world-wide ores to coal fired smelters there for over a century.

At the end of Taku Inlet salt water penetrates to within a short distance from the Canadian border. On Canadian soil at Tulsequah, B.C., Canadian surveyors found what appeared to be a promising industrial site, that could be made accessible to shipping by dredging out the Taku River for a distance of a little more than 10 miles. But engineers for American metal interests allied with the project preferred alternative sites further down the inlet on Alaska territory, partly with a view to avoiding collection of customs duties, by Canada on ores entering Canadian territory, but mainly to build up a profitable American industry in U.S. territory with access to cheap Canadian hydro-electric power.

First hearings were held in August 1955 at Atlin, B.C., a small interior British Columbia village with a population of around 500 residents, many of them Indians. British Columbia's Controller of Water Resources, A. M. Paget, presided. Residents conceded that the major development of raising the level of Atlin lake by 20 feet was in the best interests both of the province and the district. They were assured they would be adequately compensated for their properties and would be supplied with electric power. Company officials promised a

Continued on page 1324

General Design of the St. Lawrence Seaway.

D. M. Ripley, JR.E.I.C.

(Continued from page 1142)

route are favourable for seaway construction. In the Montreal area, bedrock consists of Lorraine and Utica shales; at Caughnawaga these formaitons give way to Trenton limestone. Bedrock is Potsdam sandstone at Beauharnois and dolomitic limestone at Iroquois. The overlying soils are mostly glacial in origin and consist of a very dense till, which occurs in deposits up to 100 feet in depth, and scattered deposits of marine clay principally near Beauharnois. The sedimentary rocks are excellent for foundation for the lock structures and rock fill. The glacial till is a satisfactory material for dyke construction but presents many excavation problems due to its extreme density.

Concrete aggregates for the lock structure at Iroquois are being produced from a clean dolomitic limestone being quarried about three miles west of Iroquois. Three contracts were let recently for concrete aggregates for Beauharnois, Cote Ste. Catherine, and St. Lambert Locks. These aggregates will be produced from local sources. In general, all concrete aggregate must meet all A.S.T.M. and C.S.A. Specifications.

Construction Materials and Estimated Cost

The accompanying table of materials going into the project will furnish some idea of its magnitude.

The estimated cost of the Canadian and United States features is $320,000,000. This amount is made up of $215,000,000 for the works being constructed by the St. Lawrence Seaway Authority and $105,000,000 by the Saint Lawrence Seaway Development Corporation.

Table of Materials for Seaway Construction

		Canada	U.S.
Dry Excavation:	Rock	16,000,000 cu. yd.	60,000 cu. yd.
	Common	36,000,000 cu. yd.	25,000,000 cu. yd.
Wet excavation:	Rock	7,000,000 cu. yd.	270,000 cu. yd.
	Common	15,000,000 cu. yd.	4,600,000 cu. yd.
Fill and dyke construction		11,500,000 cu. yd.	10,100,000 cu. yd.
Concrete		2,000,000 cu. yd.	1,030,000 cu. yd.
Reinforcing steel		14,000 tons	2,500 tons
Sheet steel piling		6,000 tons	6,150 tons
Structural steel		27,000 tons	11,235 tons

Progress and Completion Date

Progress in the seaway construction to date has been satisfactory. Twenty-four general construction contracts aggregating $75 million have been awarded by the Seaway Authority for practically every type of construction that will be carried out. Major contracts yet to be awarded relate to the construction of the Beauharnois Locks, the Caughnawaga—Cote Ste. Catherine canal, dredging near Cornwall and steel structures such as bridges and lock gates.

The completed seaway is scheduled to be in use with the opening of navigation in 1959. The Iroquois Lock and the United States locks at Robinson Bay and Grass River as well as other seaway facilities upstream from Lake St. Francis will be ready to operate in time to permit generation of power at the Barnhart Island Powerhouses in July 1958.

Acknowledgment

As with all large-scale projects, The St. Lawrence Seaway represents the culmination of many years of patient and careful study, and we engineers of the Authority are not unmindful of the contribution of those engineers of the governmental and other agencies who fashioned the firm ground work for the project during those years of discussion and negotiation.

The Seaway Authority is most appreciative also of the co-operation and assistance extended to us by the engineers of our counterpart the Saint Lawrence Seawav Development Corporation and those of the Hydro-Electric Power Commission of Ontario and Hydro-Québec.

THE USE OF HYDRAULIC MODELS IN THE ST. LAWRENCE SEAWAY PLANNING AND DESIGN (Discussion)

(Continued from page 1168)

valves. On the basis of the model tests, the resultant design apparently gives a short balanced filling and emptying time; ports which permit relative steady flow conditions during filling and emptying, with a low order of hawser forces; and development of a satisfactory valve and gate design in which the effects of different site conditions were taken into consideration. If there is time, perhaps Mr. McIntyre or a representative of the National Research Council would comment further on the development of the port design used for the locks under construction relative to that used previously at Welland, and the differences between the intake and discharge systems adopted by SLDC and SLSA in the design of locks. Comment would also be appreciated on the design of the lock gates, contrasting SLDC selection with the ones developed by the Seaway Authority. In this regard, it might be considered that the only similar features between the referenced Welland lock built 25 years ago with the new structures, are the effective inside lock dimensions.

It seems fitting to close this discussion with reference to the close cooperation which has prevailed throughout conduct of the model tests between the various agencies; i.e., the work conducted by the Ontario Hydro, National Research Council, Vicksburg, and such institutional facilities at the Universities of Toronto, McGill, and Minnesota. The spirit of cooperation and free interchange of information, data and facilities is a hallmark in engineering. This has played an outstanding part in the development and construction of the St. Lawrence Seaway-Power Project.

Month to Month

News of the Institute and the Profession

COMMENT AND CORRESPONDENCE
ELECTIONS
AND TRANSFERS

A Chat With the Employer

The following article has been prepared by the Field Secretary L. F. Grant. He was prompted to write it by the many instances he encountered in his travels wherein young engineers had pleaded for a better professional recognition from their employers. (Ed.)

Everybody knows there is a shortage of engineers. One of the contributing reasons for it is that so many young engineers get out of engineering to become salesmen. What are the reasons for this? In some cases higher pay, but undoubtedly in some other cases a feeling of frustration because they are treated as super labourers rather than as professional men. Beginning with the young engineer whom you will be engaging shortly or have engaged, are you going to treat him as a professional person? Are you going to show him how your organization works, the place engineers fill in it, and more particularly, the place he himself will fill?

Are you going to let him think he is designing a gadget, or are you going to show him that he is helping to produce some great machine or structure that will benefit the user, and that the company's success and to some extent his future, depend upon how well this is done?

One company has a practice of having heads of departments address the young engineers, each afternoon during one week when they first join the company, telling them the place of his department in the organization of the company, and finally what the company is trying to do and some of its problems. Surely the young engineers in question are more likely to feel part of the team than they would without such talks.

In his obligation to the profession the young engineer has undertaken not to grudge his time, thought or care towards the perfection of what he is producing. He is ready for the inspiration that comes from feeling he is doing something worth while, and is not just a cog in the machine. If you wish him to continue his work as a professional man with a professional man's sense of obligation to his work and to his employer, you must treat him as such. If you compel him to punch a time clock, or treat him as a super labourer, you should not be surprised if he adopts a labour point of view.

This is not primarily a matter of salary, it is much more a matter of attitude. True enough the young man does not always appreciate this. Is it not your business to make him appreciate it so that his value to you may be increased? The attitude of these young men to your company a year, five years, or ten years hence will be very much influenced by how they are treated when they first enter your employment.

UPADI Meets Again

The Union of Pan-American Engineering Societies will hold its fourth meeting in Mexico City on October 7th to the 12th.

It is expected that the Institute will be represented by a strong delegation, which will include the president.

This Pan-American organization, known familiarly as UPADI, is made up of representatives of engineering organizations in eighteen different countries, sixteen of them being in South America, plus the United States and Canada.

The American member is the Engineers' Joint Council, whose membership is made up of the leading engineering societies in the United States, including the four founder societies.

Past president James A. Vance is a director of the organization, representing the Engineering Institute of Canada. He has attended previous meetings in Cuba, New Orleans and Brazil. He plans to attend the 1956 meeting.

Vern King of Woodstock also has attended the same three meetings that Mr. Vance has attended and it is hoped and expected that he too will be with this year's delegation. Dr. I. R. Tait of Montreal and C. M. Anson of Sydney also will be there to represent the Institute.

It is not part of UPADI's program at the moment to present technical papers at these conferences. The business is related to engineering problems of an international nature and the promotion of better international

Cover Picture

The cover picture is reproduced from an artist's impression in "The St. Lawrence Seaway, The Realization of a Mighty Dream", published by Distillers Corporation-Seagrams Limited.

Based on engineers' drawings and aerial photography, the picture indicates what the International Section will look like when work has been completed.

This area of a few hundred square miles will contain two giant storage dams, a huge power-house and two ship canals.

relations among the engineers, and the engineering organizations.

Following the meeting a detailed report will be made in the *Engineering Journal* covering the business transacted and other features as well.

IAESTE Report, 1956

With the summer now definitely "round the bend" it is possible, and timely, to take a look at the results of our fourth year of participation in IAESTE. Once more, and maybe for the last time, we should explain to readers that those letters stand for the International Association for the Exchange of Students for Technical Experience. The Institute is continuing to act as the Canadian agency for arranging these exchange visits.

Again, for the benefit of those who may not be familiar with IAESTE, it is an international association of nations for the purpose of arranging employment abroad for engineering students during the summer preceding their final year. This year 21 nations are participating, and it is expected that nearly 6000 students will have had jobs found for them in other countries.

By comparison the extent of the Canadian share in this plan appears to be small. However, judging by last year's figures, the volume of European students coming to Canada this season is satisfactory and shows a 100 percent increase. We have had 91 land on our shores from abroad, from 7 countries, and representing nearly all branches of engineering. Last year we were hosts to 46. This is good, and indicates a rate of growth that is about as rapid as the Institute and the Canadian Committee are presently equipped to handle. The jobs were made possible through the co-operation of 35 Canadian firms, or other employing organizations such as public works departments.

But it is supposed to be an exchange, and movement of our own students in the opposite direction continues to be disappointing. Only 9 have taken advantage of the plan this year, distributed as follows:—France 3, Sweden 2, Germany 2, Great Britain 1, and Switzerland 1. The snag, so far as the young Canadians are concerned, is still the matter of financing. They are unable to earn enough dollars, or their equivalent, to pay for their train and steamship travel without running into a deficit. Many a likely Canadian inquiry dies at this point in the preliminary conversations. We are glad to report, however, that some cure for this situation appears to be in sight, as a result of a visit from the IAESTE secretary for Great Britain, Mr. James Newby.

We had Mr. Newby with us, in the Montreal and Toronto area, from July 3-20, and his presence and enthusiasm for the plan were most encouraging. Those who watch "Tabloid" on television will remember seeing our visitor interviewed in Toronto, and heard him explain his mission so capably. Besides renewing his contacts here with industry and university life, he came over with the idea of starting to establish some Canadian industrial bursaries—for the definite purpose of assisting our own IAESTE students with their travelling expenses. Present indications are that Mr. Newby was successful, even beyond his own expectations, and funds available next year through this medium should make a big difference in boosting Canadian undergraduate participation.

It is safe to say now that IAESTE in Canada is established on a solid foundation, that it will continue to grow in size and importance, and that it should expect the support of every Institute member. Further information concerning the plan is readily available from E.I.C. headquarters, Montreal.

E.I.C. reception for James Newby and the IAESTE Committee. From left, Mr. Newby, R. L. Dunsmore, vice-president of the Institute; Henri Gaudefroy, chairman of the committee; R. E. Jamieson, dean of engineering, McGill University.

Thirty Years of Service

V. C. Blackett has just been re-elected to the position of secretary-treasurer of the Moncton Branch. With this appointment he completes thirty years of service to the branch in that capacity.

This is indeed an unusual record for a person serving in a voluntary office. The Moncton branch is indeed fortunate to have such steady service in this all-important office.

It is of real assistance to a branch, particularly a smaller one, when a member is willing to serve as secretary-treasurer for a substantial period of time. It takes a year or two for one to catch on to all the details of the office and frequently it is a loss when an experienced man retires to make way for a new man.

Another way of looking at it is that the work is a form of training for a young man and therefore it may be desirable that more persons be given an opportunity to profit thereby. However, in small branches it becomes difficult to find a continuing stream of persons who will serve. Under these circumstances Mr. Blackett's performance has been most valuable to his branch.

This period of service was brought to the attention of the Council of the Institute and it was agreed unanimously that a resolution of appreciation should go forward to him.

Appointment at Headquarters

A new appointment on the headquarters staff of the Institute is that of H. P. Gatin as assistant general secretary. He was among the applicants for the position, which was advertised in the February *Journal.*

Mr. Gatin has been administrative assistant to the general manager with

H. P. Gatin, M.E.I.C.

the Saskatchewan Power Commission, Regina, for the last three years.

Brought up in Manitoba, Mr. Gatin attended school in Western Manitoba, and with the beginning of World War II joined the Canadian Army, Active. He served with the R.C.A. and the R.C.E.M.E. until the end of hostilities. For the next five years he attended the University of Manitoba, working with the Manitoba Power Commission during the summer months. After graduation in 1950, in electrical engineering, he accepted an appointment with the Saskatchewan Power Corporation, first as special studies engineer, then as operating supervisor. Since becoming assistant to the general manager, Mr. Gatin has had considerable experience in management and administrative committee work within the organization and has also been active in community and welfare work around the province.

An asset in his new work, he is fluently bilingual.

Mr. Gatin's addition to the headquarters staff was caused primarily by the retirement of Colonel H. G. Thompson, which was announced in the August *Journal.*

The duties relinquished by 'Spike' Thompson have been taken over by E. C. Luke, who now becomes the senior assistant secretary.

The Kelvin Medal

Sir John Cockcroft, K.C.B., C.B.E., F.R.S., who has directed Britain's Atomic Energy Research Establishment for the Ministry of Supply since 1946, has been awarded the Kelvin Medal in recognition of his distinguished service to engineering.

His outstanding contributions have been toward the advancement of pure and applied physics, particularly in the field of nuclear physics, and in the solution of the engineering problems of the peaceful uses of atomic energy.

Tenth winner of this major award for scientists and engineers, Sir John was born in 1897, and was educated at the University of Manchester and Cambridge University.

He was Jacksonian Professor of natural philosophy at the University of Cambridge from 1939 to 1946. He is an honorary Fellow of St. John's College, Cambridge.

Through the war years, from 1941

Sir John Cockcroft

to 1944, he held the responsibilities of chief superintendent of the Air Defence Research and Development Establishment of Great Britain. Canadian scientists will recall that Sir John directed the Atomic Energy Division of the National Research Council of Canada from 1944 to 1946. In 1952 he was appointed chairman of the Defence Research Policy Committee, and scientific advisor to the Ministry of Defence.

Dominion Council Meets

The Dominion Council of Professional Engineers held its annual meeting at the Bessborough Hotel in Saskatoon on May 30 to June 1. Here is the group of distinguished engineers: Front row, L. O. Cass, L. R. Durkee, of NSPE, Seattle; N. Stewart, C. N. Murray, President-elect E. J. Durnin, President Georges Demers, W. O. Richmond, Past-President W. L. Sagar, C. T. Carson, G. A. Blackburn. Centre row, J. A. Merchant, M. C. Sutherland-Brown, W. G. McKay, W. R. Staples, R. Bing-Wo, A. E. McDonald, N. S. Bubbis, C. A. Knight, Pierre Bournival, E. D. Brown. Back row, J. H. Legere, J. L. McDougall, C. S. Landon, Bruce Williams, president of NCSBEE, E. Lee Cameron, R. A. Phillips, J. G. Dale, I. R. Tait of E.I.C.; J. B. Mawdsley, of C.I.M.M.; J. J. Hanna, T. M. Medland, J. M. Muir.

Among the honours conferred on Sir John, one of the most notable was the Nobel prize for physics (with E. T. S. Walton) in 1951. A foreign member of the Royal Swedish Academy, foreign honorary member of the American Academy of Arts and Sciences, and winner of the Hughes Medal of the Royal Society, he has also received the United States Medal of Freedom (Golden Palms) and the J. A. Ewing Medal of the Institution of Civil Engineers. In 1950 the French government conferred on him Chevalier de la Legion d'Honneur.

Sir John holds honorary D.Sc. degrees in a number of universities including Oxford, London, Sydney, Canberra, Manchester, Cambridge, and honorary LL.D. degrees at Toronto, Glasgow and Melbourne.

Chosen a Fellow of the Royal Society in 1935, he was in 1944 named Commander of the Order of the British Empire, and created a Knight in 1948. Three years ago he was invested as Knight Commander of the Bath.

Sir John is the author of various papers on nuclear physics in proceedings of the Royal Society, and on technical subjects for the journal of the Institution of Electrical Engineers.

The Kelvin Medal, founded in 1914, principally by British and American engineers of nineteen societies is an international memorial to commemorate the achievements and lifework of Lord Kelvin in those branches of science which are especially applicable to engineering.

The Kelvin Award Committee consists of the presidents of the following engineering institutions, after they have considered recommendations from similar bodies in all parts of the world; the Institutions of Civil, Mechanical, Electrical, and Mining Engineers, the Iron and Steel Institute, the Institution of Naval Architects, of Mining and Metallurgy and the Institution of Engineers and Shipbuilders in Scotland. The Engineering Institute of Canada is one of the organizations asked to make or support nominations for the Medal.

Lord Kelvin, mathematician, natural philosopher and engineer, the most famous British physicist of the nineteenth century, was born in Belfast in 1824, and was for over fifty years professor of natural philosophy at Glasgow University.

Although founded in 1914, the Kelvin award was not presented until 1920 due to difficulties encountered during World War I. Since its inception the medal has once been awarded to a Canadian. Dr. C. J. Mackenzie, chairman of the Atomic Energy Control Board, retired president of Atomic Energy of Canada Limited and former president of the National Research Council was the ninth scientist so honoured in 1953. Dr. W. C. Unwin, British physicist, was the first to receive it, in 1920. The name of Marconi, the inventor of radio was added to the list in 1932. Other award winners include Dr. Elihu Thomson, American physicist, in 1923; Sir Charles Parsons, British inventor of the steam turbine in 1926; Andre Blondal, French physicist, in 1929; Sir John A. Fleming, British engineer, in 1935; Sir J. J. Thompson, British physicist, in 1938. A further delay in the award of the Medal occurred during the Second World War, and for 1947 the Committee decided on an award to Air Commodore Sir Frank Whittle, Hon.M.E.I.C., inventor of the jet engine. In 1950 the committee's choice was Professor Theodore von Karman, aeronautical engineer at the California Institute of Technology.

Toronto Civil Engineers

The annual report was issued this summer for the Joint Area Committee for Toronto civil engineer members of the Engineering Institute, the American Society of Civil Engineers and the Institution of Civil Engineers.

The report, included in the Branch News section of this issue, shows four meetings at which subjects of civil engineering interest were treated. The attendance was good, averaging approximately 100, or 12½ per-cent of potential.

The response of the members in Toronto and the results of the committee's special negotiations to arrange cooperation among groups with common interests would tend to encourage similar activities where they may be necessary. The Institute commends this heightened concern with specialized technical advancement.

Contributions to Colonel By Memorial

At the first meeting of the new Council of the Institute on May 24, it was reported that twenty-one branches had made substantial contributions to meet the cost of erecting the fountain in Ottawa in memory of Colonel By of the Royal Engineers.

While it is known definitely that other branches are contemplating contributions when their programs begin in the fall, it is thought it would be of interest to members now to know of the branches that have already contributed and the amounts.

It would be interesting to members to know also that seven members of the Institute each contributed $123,00 to the fund.

The support of the branches is indeed encouraging. There is no doubt that the Ottawa Branch will be very happy to have this information and to know that the project which originated with them met with the approval of so many other centres across Canada.

It was always the idea of the Ottawa committee that the memorial was a national one and had nothing particularly to do with the city of Ottawa. Ottawa itself, is the capital of the Dominion, and therefore it is reasonable that projects of this kind in that city should be regarded as national in character. Contributions from these twenty-one branches indeed indicate clearly that the same idea is held right across the country.

Herewith are the details as to the branches and their contributions, and may it be pointed out again that some of those branches whose name are not here now have indicated their intention of making a contribution later.

Belleville	10.00
Border Cities	10.00
Eastern Townships	25.00
Fredericton	10.00
Kitchener	10.00
Kootenay	25.00
Lethbridge	10.00
Lower St. Lawrence	15.00
Moncton	15.00
Newfoundland	20.00
Nipissing and Upper Ottawa	25.00
Northern New Brunswick	20.00
North Eastern Ontario	10.00
Saguenay	50.00
St. John	10.00
Sarnia	12.50
Saskatchewan	50.00
Sudbury	30.00
Toronto	150.00
Vancouver Island	15.00
Winnipeg	50.00
	$572.50

Calling European Engineers

Recently the office of the Institute has been informed that at least fifty qualified engineers, graduates of recognized Institutions in Europe, are now in Canada doing work of a non-professional nature.

It is suggested that the reason they are doing work of this class is because of language difficulties, remoteness from large centers and desire to work and to make no fuss.

In view of the serious shortage of engineers it would indeed be a serious thing if these men were unwillingly doing work below their capacity. With this in mind this article is being published to suggest that any such person who desires a position of greater engineering responsibility should write immediately to the general secretary of The Engineering Institute of Canada, 2050 Mansfield Street, Montreal 2, Quebec.

There is a great scarcity of engineers in all fields and if any of these people are properly qualified there is little doubt but that they can be placed advantageously and without delay.

Do We Want the Students' Conference?

From time to time the question has been raised whether we should continue to hold a students' conference in connection with the annual meeting. Are we repaid in any recognizable way for the time, energy, and money spent in bringing these young men together?

The following three letters have been received recently at Institute headquarters, and are rather typical of the student delegates' reaction. They answer the above questions eloquently.

Dear Doctor Wright,

I wish to thank you and your staff on behalf of the University of Toronto Engineering Society for the hospitality shown to Keith McIntyre and myself at the students' conference and annual meeting last week.

Many ideas were exchanged and plans made between delegates that should prove of value to the respective student societies. It is my personal conviction that more plans were made than indicated by the minutes because they were worked out after the conference had ended and were not concerned with the E.I.C., directly.

Contact with the other student engineering societies aroused enthusiasm within me for the strengthening of inter-university bonds, and the contacts with the senior members of my chosen profession deepens my respect for the profession more than I can adequately express. I hope to be able to convey some of these feelings back to the students at Toronto.

MICHAEL A. LAUGHTON,
Delegate,
University of Toronto

Dear Sir,

I should like to thank the Institute through you, for making it possible for me to attend the annual convention in Montreal. The student's conference was a good opportunity to meet and talk with student bodies across the country, and I feel certain that much benefit will result from it, both to our own organizations and to the Institute. The technical papers, speeches and tours which followed gave a good insight into the profession into which we students are entering and showed well the part which the E.I.C. plays in this profession.

What impressed me most of all, however, was the warm hospitality which was extended to us. No matter how busy you all were, you always seemed to find time to talk to us and make sure that our stay was an interesting and enjoyable one.

Thank you once again,

E. J. FORHONEN,
President,
Queen's Engineering Society

Dear Doctor Wright:

I wish to thank you and the Engineering Institute of Canada for making it possible for me to attend the conference in Montreal.

The conference was a tremendous experience for me and I am deeply grateful to you. The E.I.C. has much to offer to the young engineer as well as everyone concerned with it.

This coming year at Tech I hope to get across to the students the importance of this organization. Even now I am telling everyone I meet of this great wish to thank you on behalf of my wife and myself. I hope that in the years to come I shall be able to repay the E.I.C.

JOHN E. ANDREWS,
President,
Student's Union,
Nova Scotia Technical College

I.E.E.—E.I.C. Agreement Revised

The terms of the reciprocal arrangement between The Engineering Institute of Canada and the Institution of Electrical Engineers for the waiving of entrance fees in some circumstances have been revised this year. This arrangement, which was first announced in the *Engineering Journal*, September, 1954 issue, applies to members of one Institution when resident in the country of the other and elected to its membership.

The effect of the revision is to cover members of all grades and, in particular, Students of the Institution who might qualify as Junior Members in The Engineering Institute of Canada. The following is the revised arrangement:

No entrance fee will be payable

On election to The Engineering Institute of Canada, if the applicant

Is a member of The Institute in good standing, permanently resident in Canada, and

Makes application within twelve months of his taking up residence in Canada or, if already resident there, within twelve months of the first appearance of this notice.

On election to the Institution, if the applicant

Is a member of The Engineering Institute of Canada in good standing, permanently resident in Great Britain including Northern Ireland, the Isle of Man and the Channel Islands, and

Makes application within twelve months of his taking up residence in Great Britain or, if already resident there, within twelve months of the first appearance of this notice.

It has been agreed between the two Societies that where election to the host Society is in a grade of membership for which no entrance fee would in any case be payable, the oversea entrant shall, provided he is still a member in good standing of his mother Society, pay no entrance fee to the host Society when he is transferred to a higher grade of membership, irrespective of the time at which such subsequent transfer takes place, or of his grade of membership at that time in his mother Society.

Industry and Education

Engineers, chemists, physicists and other pure and applied scientists have been in short supply for some years. There is a possibility that they may be even scarcer before enough become available. Failure to secure as many recruits as it would like from recent university graduating classes is perhaps the impelling motive behind industry's increased interest in scientific and technical education in particular and in all college education in general. Additional impetus is provided by the realization that Russia's technical and scientific manpower is growing in numbers at a rate greater than that of the West.

Industry's interest in education originated longer ago than most of us realize. One of the oldest industrial scholarship schemes is that of the Canadian Pacific Railway Company, now in its fortieth year. Under this scheme two C.P.R. employees or sons or daughters of employees are sent to McGill University each year by the company and maintained there until they receive their first degrees, i.e., for four or five years. Thus there are eight or ten of these scholarships in existence at any one time. Graduates are not bound to accept employment with the company; in fact, only a minority have done so.

No doubt the incentive to establish an industrial scholarship is tinctured largely by self-interest and by the feeling that charity might as well begin at home. Each sponsor hopes that it may eventually receive into its business family a fair proportion of those to whose educational expense it is contributing.

There are disadvantages in drawing scholarship material from a limited field, say the employees of a particular company, and other disadvantages in binding graduates to enter the service of the concerns whose scholarship holders they were. A limited field of selection means that the scholar chosen will not always be of the high calibre desired. At times, there may not be any qualified candidate. To feel that one must go to work for one's sponsor may be a very real handicap; it may divert the student's interest from a career for which he is eminently fitted to one for which he has no overwhelming talent and in which he will do less well and be less happy.

Corporations Accept Responsibility

However, most of today's corporations, especially the larger ones, have a keen realization of their responsibilities to the community and are becoming less and less restrictive in their demands. They are content to contribute to a worthy cause and to leave it to the good sense of the recipients to use their contributions wisely. This policy is reflected by the conditions under which most industrial scholarships are now awarded. Industry puts up the money and the university chooses the scholar, whose future is mortgaged by no commitments.

Over the past few years industry seems to have come to the conclusion that its major recruiting headache is not so much finding graduates with bachelors' degrees for its scientific and technical staffs as it is in filling posts whose occupants should possess graduate degrees. Masters and doctors are conspicuously scarce, especially in some fields of great and increasing importance. It is natural, then, that some concerns should have revised their scholarship schemes to apply to the graduate student and that others have instituted new schemes for the same purpose.

As an example of how these "fellowship" schemes work, let us look at that of the Shell Oil Company of Canada, instituted in 1945. We hold no brief for this particular scheme — there may be better ones — but it appears to have worked well and we happen to have the data at hand.

Fifty-five fellowships have been awarded to date. Seven have been available each year and there will be an eighth in 1956-57, tenable at the University of New Brunswick. The seven existing fellowships are distributed among the University of British Columbia, the University of Alberta, McMaster University, the University of Toronto, Queen's University, McGill University and Laval University. They are tenable for a year by a candidate aiming at an M.Sc., M.Eng. or Ph.D. degree in chemistry, chemical engineering, geology, geophysics, mechanical engineering or physics. Fellows are chosen by a committee composed of representatives of the company, the National Reseach Council and the universities. Each fellow receives $1,200 for fees and living expenses during an eight-months' session, $1,800 if he works the full year.

In addition to direct grants to fellows, the universities at which they are studying will receive $500 each for them from 1956 on. This grant-in-aid is designed to help make up the difference between fees and the real cost of education. We do not know of any case where a Canadian student pays more than about half of what he costs his university. The difference is universally made up by drawing on investment income, sorely needed for other purposes.

Besides these eight fellowships, Shell supports two for study in Great Britain. These amount to $4,000 each, spread over two years. They are currently held by a graduate of the University of Manitoba at Oxford and by a graduate of the University of British Columbia at Cambridge.

Perhaps the outstanding feature of these fellowships is the recognition that any student is a financial liability to his university and the provision of grants-in-aid to make him less so. Some schemes also provide small sums for the purchase of equipment and supplies, for the payment of technicians, for publication costs and the like.

There are many scholarships and fellowships similar to Shell's. All aim at turning out more and better engineers and physical scientists. What help is available for the boy or girl who wishes to become a lawyer, teacher, doctor or dentist, or who wishes to go into commercial life? Unfortunately, not much. Every university has some scholarships and fellowships of its own tenable in various fields, but there are never enough and they are often not well distributed; there are too many in some areas of learning and too few in others.

Often founded by well meaning benefactors with a hobby, or an axe to grind, they may be hedged about with almost impossible conditions of award. A good example is one for a French-Canadian student intending to proceed into the ministry of a particular Protestant sect; we hear that it has been awarded only once in nearly fifty years.

And such scholarships and fellowships are generally too small to be of great help today. Founded when the dollar was worth a dollar in gold and when both fees and living expenses were low, they were most useful then. We once heard an old graduate remark that he had an $80 scholarship during the full four years of his course and that it paid his fees and most of his living expenses. Today it might pay 20 or 25 per cent of a student's tuition only.

There are a few scholarships and fellowships for medical and dental students, supported by pharmaceutical concerns and the like, but they are not at all numerous. The odd school commission offers help to those intending to be teachers, usually with the string tied to it that the holder shall work for the commission for some minimum period after graduation.

Help is required here — in the liberal arts particularly — as much as in engineering and science, but industry has been slow to realize that an improvement in the educational level of its rank and file non-technical and non-scientific staffs might in the long run redound as much to its advantage as improvements on the technical and scientific side, to which it stands pretty well committed.

Help From The Government

The universities and colleges of Canada, large and small, with the possible exception of those supported directly by the provinces, simply cannot give the ever increasing flood of capable students the training of all kinds which they want and must have if we are to progress scientifically, technically and culturally, unless educational resources are increased. There seem to be only two possible sources of additional income for our institutions, government and industry.

There is little or no hope of large gifts from the Rockefellers and Carnegies of the future; there won't be any such people. Our tax laws discourage the accumulation of large fortunes and if one is fortunate enough to leave a large estate on one's death, the bite of succession duties sometimes leaves hardly enough to support the widow and children in decency. There will continue to be private gifts to education, but not on the scale of the past.

Most educators dislike the idea of government subventions, fearing that they may be the thin end of the wedge of political domination. So far as we know, our limited experience of them in Canada does not show them to be particularly dangerous, but they might become so in future.

If industry is to contribute more freely to the support of education in Canada, it would be well if that support were a little better organized. Scholarships, fellowships, and grants-in-aid are all very well, but the universities and colleges need money for the expansion of facilities, the replacement of buildings and equipment, the institution of new courses to keep up with the times and particularly to establish a more equitable scale of salaries for their teaching staffs.

Campaigns for Universities

A campaign seems to be the favourite device for raising funds for capital expenditure. A large number of people give their time and energy to the business of soliciting gifts, another large number takes care of the endless paper work involved. There is much enthusiasm and excitement as the campaign nears its end and it becomes apparent that it is going to be a success, and corresponding gloom and depression if it promises to be a "bust". All work is not finished when the campaign is over; pledges must be collected periodically and slow payers prodded. There will be some who will not keep their pledges. A good deal of energy is wasted and there is always conflict with other campaigns; over fifty are scheduled in Montreal alone in 1956.

It is only fair to say that industry has always been a generous contributor to such campaigns, but we have been told that many concerns would prefer to contribute a smaller amount each year than to make one large donation every five or ten years.

This leads us to suggest that the Canadian Manufacturers Association, our most comprehensive organization of industries, might poll its members to inquire how much each is prepared to contribute annually to an educational fund over a term of, say, ten years as a minimum. Having collected several million dollars (we hope!), the CMA would then distribute it once a year to the qualified universities and colleges. A list of eligible institutions would have to be set up. This should not be too hard a job, though it might be accompanied by some pretty acrimonious discussion.

A more difficult task would be to determine the basis of distribution. Some of the factors to be considered would be number of students, type of instruction — a medical school obviously needs a greater income per student than the small liberal arts college — and other sources of income.

These donations from industry should be given without any strings attached. The recipients can be trusted to use the money wisely. They are not and cannot be extravagant; ask any faculty member who has tried to get an appropriation for a pet project. For one that is granted, there are a dozen refused for reasons which seem good and sufficient to the holders of the purse strings.

Alternative Plans

Suppose the universities and colleges do not accept government subventions if offered, and industry does no more for education than it is now doing, plus the modest increase to be expected with growth, what are the alternatives?

One of our major universities has already announced that it proposes to hold its registration down to relatively modest figures by raising standards of scholarship all along the line from entrance to graduation. This will make little difference to the outstanding student, but what about the merely good one? After all, few are geniuses, yet we like to think we contribute something to the good of mankind and most of us do. The merely good student might find himself denied a college education if this policy were universally adopted.

We think that requiring very high academic ability for the privilege of entering college and staying there is of doubtful value. We would like to see standards raised to the point where withdrawals for academic reasons were reduced to the minimum and so, we think, would the universities. Our engineering schools are making some progress in this direction. It must be remembered that a good many withdrawals from college are because students discover they are not college material, others for family or financial reasons and still others as the result of disciplinary action. No scholarship standards, high or low, will salvage those who withdraw for these or similar reasons.

We would not set academic standards any higher than necessary to guarantee, so far as this can be done, that every student who worked faithfully would graduate and not by any means all with honours, either. We have seen too many poor students who managed to get through college and who subsequently became able and prominent in their own fields and leading citizens, to have implicit faith in academic standing as the only means of judging ability.

Apparently other Canadian universities are planning to raise their

(Continued on page 1326)

Aviation Writers' Association

Being Part 3 of an Account of the Annual Meeting.

Most of the morning of Friday, June 1, was taken up with a business meeting but the luncheon and the afternoon belonged to General Electric.

J. S. Parker, general manager, Aircraft Gas Division of General Electric gave quite an address after luncheon. His subject was "The Heat Barrier Under Attack" and he surely put it and a lot of other things under attack before he had finished.

He started out by saying: "In recent months, I have become disturbed by an undercurrent of opinion, which has, in a sense, infiltrated all discussion and opinion of airpower. This undercurrent is not restricted to those of us intimate with airpower, but rather it has taken hold nationwide. Although it is a behind-the-scenes type of opinion, it still pervades all intelligent conversation or written matter concerning airpower.

"I am referring to the subtle joining of two rather common — but unlike — words as being synonymous. These two words are 'airpower' and 'problems'.

"I have attempted to analyze that sudden realization. I came to the conclusion that everyone closely concerned with airpower has been so conscious of its importance to the free world's security — and so immersed in the search for progress in the air — that no one has had time to discuss successes adequately. The search is continuous and sometimes frantic to reach one more success in the race for 'higher, faster, farther'. While self analysis and self improvement are critically needed, we still must acknowledge current progress.

"You and I know that the best in airpower is essential. I sincerely believe and advocate that those of us concerned with airpower must do more than face up to the challenges posed. And you, the members of the Aviation Writers Association, can do more than any other group concerned to establish a healthy public attitude towards airpower. Certainly, there are problems, but we have no right to be complete skeptics.

"Certainly, the possibility of failure stares us in the face, but doesn't it always? Remember this, the combined efforts of the military and industry have never failed, and this is no time to believe they will.

"The key to the 'best' in airpower is, without question, constant and extensive research and development. We all know what superhuman efforts were needed after research and development funds were drastically reduced following World War II. It set us back approximately five years. This cannot and must not occur again.

"Today, one of the primary targets of attack is a not-too-aptly titled one . . . namely, the 'heat barrier'. I state 'not-too-aptly titled' since, first, it is not a barrier, and secondly, it is not a new problem. The team of Daedalus and Icarus had a slight heat problem some centuries ago, when Icarus lost his wings flying too close to the sun — and those who traverse the skies have faced heat problems in one form or another ever since.

"The 'barrier' idea is also false! It is not one hurdle to cross. Rather it resembles a long avenue without street lights. We are all trying to string the wire and implant the light fixtures one by one so that we can see our way.

"We know the ogre of the too high temperature pretty well. We know what happens to many of the various components of the airframe and engine. For example, we know that at certain mach numbers high friction temperatures cause a nightmare of failures: electronic tubes start to malfunction . . . nylon and rayon fittings disintegrate . . . fuels begin to boil away . . . and metallic components common to all aircraft begin to lose their required properties. As we go faster there tends to be a dissociation of air particles which results in strange phenomena such as metal burning before it melts, transient condition buckling failures and so on. These failures are not all in the future; some are occurring now in supersonic areas. We are already exceeding normally limiting temperatures of many materials."

Mr. Parker went on to tell of the great expenditures in plant and equipment made by his company. He emphasized their confidence that some day success would attend their every effort. He gave some interesting facts and figures, such as the following:

"Temperature limits of turbine bucket are critical to jet engine operation. This is an area of high priority, for a very understandable reason: higher turbine inlet temperatures mean greater engine thrust out of the same jet engine package. A jump of 200 degrees Fahrenheit from 1500 to 1700 degrees increases thrust 10 per cent. And if we can increase the temperature to 2000 degrees, we have an increase in thrust of approximately 40 per cent. This could mean, for instance, that a basic production jet engine might have 40 per cent more thrust with a 2000 degree bucket. As the envelope re-

Hamilton Air Force Base, Calif. The new vertical plotting board recently installed in the 28th Air Division Air Defence Control Centre serves to plot the positions of all aircraft flying within the Division's operational area.

mains the same, the implications are obvious.

"For the future, a great percentage of our work in metallurgy has centered on a certain group of high temperature metals, that include: molybdenum, columbium, chromium, cobalt and nickel. All offer promise of growth to meet the needs in turbine buckets, turbine wheels, various hot-end sheet metal parts, and high-temperature bearings."

He concluded on a note of optimism and confidence.

"I have every confidence that the capabilities of the aviation industry's research and development efforts in metallurgy and in the related areas pertinent to the so-called "heat barrier" problems will soon put them behind us. I am so confident that I don't hesitate to predict the advent of manned aircraft flying at speeds in excess of 2000 miles per hour as an operational condition within a few short years. I have no hesitancy in predicting altitudes for aircraft above 100,000 feet.

"These new operating parameters will be in good part, the direct result of improved metals, incorporated in both airframe and powerplant. These metals will be able to withstand temperatures from minus 400 degrees to something akin to 4000 degrees in the combustion area."

This writer came away with the feeling that Mr. Parker knew a lot more than he was telling, and that some of these problems would be "licked" by General Electric or someone else shortly.

Banquet

The annual banquet was staged for Friday night. The main speaker was General Thomas D. White, vice-chief of staff, U.S. Air Force. He talked about the desirability, if not the necessity, of closer collaboration between the three armed services. Apparently this collaboration is not present now to the degree that is desired. The same things may exist in Canada but if so they are surely kept better hidden from the public than they are in U.S.A.

After explaining that he deplored these inter-service arguments and would take no part in them, he said, "Controversy can rock the national defense boat at a time when we need continued stability."

He spoke strongly on the need of unification in the services, saying—

"I believe that our military services will move toward more complete unification. We need a military organization that will help us all to be free of conflicting service loyalties and confusing influences.

"One step could be to more closely integrate existing forces. The continental Air Defense Command is an example of what I mean. Units of the Army, Navy and Air Force are united in a common effort — the air defense of the United States. Further integration of our forces into joint commands oriented toward one mission might be effective.

"Another step toward more complete unification would be the free transfer of men between the services. Perhaps this would allow the men in each of the three services to think a little more objectively about the requirements of defense and less about gaining or keeping weapons, and missions for their own particular branch.

"With the passing of time, the roles and missions of all the services seem to overlap more and more. Conceivably, if these trends continue the day could come when, for all practical purposes, all three services would have the same weapons, the same capabilities and limitations, and all attempting to do the same jobs. If that happens, perhaps we certainly would find it advisable to standardize uniforms and streamline the organization."

To the Canadian, and doubtless to many Americans too, this was a startling thing to hear — and yet on pondering the matter later it appeared more and more reasonable. Maybe we would do well to think about such things for Canada.

His closing paragraph summed up the whole purpose of the talk. He said: "I have mentioned the 'long pull' in defense several times tonight. All of us who are directly concerned with defence, and I include all the industries which support the military as well as the Army, the Navy, and the Air Force, and particularly you communicators who link us all together — each of us must remember that if the long pull is to insure continued peace — we must pull together."

Last Day

Saturday, the last day of the conference, proved to be one of the most interesting and pleasant. The sponsors of the breakfast were Hoffman Laboratories and the speaker was Colonel J. Francis Taylor, Jr., Air Navigation Board, U.S. Department of Commerce. He spoke on "The Status of Tacan" (Tactical Air Navigation) and he thought well of it. It seems there are some differences of opinion as to the qualities of Tacan compared to another type of air navigation system. There was no doubt in Colonel Taylor's mind as to the superiority of Tacan.

Solar Power

The air borne portion of Tacan is manufactured by the Hoffman Laboratories and is one of their principal products but they have many others in the electronic field. H. Leslie Hoffman, President, spoke at some length about other products. One is the silicon solar cell which gives practical amounts of electrical power directly from the sunlight. To demonstrate the work of the cell he referred to the plane model standing nearby where four propellers were rotating solely from solar power.

He observed that this was only a model and would not fly, but he was sure that some day a plane would rise and fly with only power from the sun. Also he believed that solar shingles on the roof of a house would soon develop all the electrical power needed to operate all the equipment in the house.

Hamilton Air Force Base

After breakfast buses were loaded for the nearby Hamilton Air Force Base. It was a delightful drive on a beautiful day and over the famous Golden Gate bridge. On arrival the delegates were addressed by Major General William E. Hall, assistant chief of staff for Reserve Forces. As would be expected he spoke of the reserve force, their purposes, plans and problems. The problem of maintaining a base near a large city was a difficult one to solve. The reservist living in the city had to have a field nearby, but the civic officials in general, wanted the field some place else and were saying so in terms that could not be ignored. He said, "This is a grave and disturbing situation. If we are to have an acceptable degree of combat capability in our Reserve Forces, for which a mobilization requirement has been firmly established, we must somehow achieve wider public understanding and acceptance of the Reserve Forces' requirements."

A tour of the station followed. This is a large establishment that looks much like a well settled city, with its permanent buildings looking like apartment houses and its streets lined with palm trees, and green grass everywhere.

An unusually interesting feature of the tour was a visit to the control center and an explanation and demonstration of how it works. In the center (see illustration) is a transparent board divided cross sectionally to cover the surrounding area. The operators or markers work behind the board using color paints and writing backwards so the record can be read from the front. The markers can be seen back of the board in the illustration as ghost-like figures or smudges. They work on platforms at three levels. The board is about 20 ft. by 30 ft.

Every plane that was sighted on the many radar screens in the rooms also appeared on the board and its position was recorded all the time it was in the operational area covered by the plotting board. The data for the board was transmitted constantly to some "higher-ups" for decision as to action. This is a 24-hour-a-day activity.

The static display was very elaborate including almost every type of plane in service and some rockets as well. A good show was presented in removing a jet engine from a plane, putting in a replacement and flight testing. It all took 13 minutes.

Another demonstration was a "scramble". Two crews were called out to man two jet fighters, and in a hurry! In a matter of seconds they were in the air. Such crews stand ready 24 hours every day for emergency calls up and down the coast.

A delightful luncheon was served at the officers club, after which bathing in the pool was offered or an immediate bus ride back to San Francisco.

That concluded the program of the eighteenth annual convention of the Aviation Writers Association. Sunday morning at 7 a.m. the buses left the Mark Hopkins Hotel for the airport and once again MAPS "air lifted" the group back to New York.

It was a really great week. The services and industry certainly extended themselves to show their wares — and they had a lot to show. No one could fail to be impressed with what these great United States have accomplished and have under way for the future.

Funds for the Needy

Recently a senior member of the Institute died and left $25,000.00 to the Institute with the stipulation that the interest hereon be used to assist needy engineers.

This is by far the most substantial contribution the Institute has ever received, and it is indeed appreciated.

Under existing conditions there are not many needy engineers, but under different conditions which may develop in the future this fund will become a most useful and valuable one. It is nice to have a reserve set aside for such a contingency.

Elections and Transfers

A the meeting of Council held at Headquarters, on Friday, July 20, 1956, a number of applications were presented for consideration and on the recommendation of the Admissions Committee the following elections and transfers were effected:

Members

W. P. Armstrong, Toronto
J. W. Barker, New York
C. Boot, Toronto
L. M. Boyd, Montreal
B. D. Elderkin, Goose Bay
R. N. Harrison, North Bay
E. E. Heaton, Montreal
G. D. Hendry, Toronto
A. W. Henschel, Toronto
G. T. J. Hughes, Trail
A. T. Klassen, Toronto
A. F. Mundy, Montreal
Z. F. Oszter, Toronto
R. J. Penman, Montreal
S. M. Peterkin, Toronto
L. S. Piper, Trail
O. Reich, Montreal
H. E. Rentsch, Toronto
M. T. Seguin, Montreal
G. C. Smith, Hamilton
P. W. Trafford, Ottawa
R. J. White, Whitehorse

Juniors

I. A. Andressen, Brownsburg
J. G. Bulleid, Toronto
M. Erdstein, Montreal
J. A. Rotgans, Montreal
A. E. Spence, Dartmouth

Transferred from the class of Junior to that of Member

R. G. Armstrong, Whitehorse
R. E. Chant, Winnipeg
E. R. J. Dupuis, Mackenzie, B.C.
T. Fell, Port Arthur
E. J. Gilbert, Montreal
A. Kofman, Montreal
S. S. Lazier, Kingston
J. C. Querido, Montreal
R. C. Short

Transferred from the class of Student to that of Junior

J. Allan, Dartmouth
J. M. Wigham, Regina

The following Students were admitted:

R. M. Bright, B.Sc.Mech. Queen's 1956
T. A. F. Brookes, Univ. of Toronto
C. D. Burton, B.Sc. Civil Alberta 1956
P. G. Cockburn, Univ. of Toronto
C. T. Courtney, B.Eng. Elect. N.S.T.C. 1955
H. M. Dokken, Diploma, R.M.C. 1956
S. K. Henry, B.Eng. Chem. N.S.T.C. 1956
B. B. Kubow, B.Eng.Elect McGill 1956
U. Luksep, Univ. of Toronto
J. P. Maley, B.Sc.Mech. Queen's 1956
H. R. McGinn, B.A.Sc. Elect. Toronto 1956
J. J. O'Connell, Nova Scotia Tech. College
F. W. D. Shannon, Univ. of Toronto

Applications through Associations

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections and transfers have become effective:

ALBERTA

Members

D. E. Aitken
Z. D'Amico
J. M. den Hartog
W. H. Denier
R. C. B. Jarvis
N. Koslovsky

Junior

P. H. Walker

Junior to Member

I. W. Campbell
B. M. Dafoe
R. W. Jones

SASKATCHEWAN

Students

C. Christianson
W. G. Snetsinger

Junior to Member

F. W. Catterall
A. L. Court
L. E. Davies
R. M. Harry
D. Hoogeveen
D. W. van Es

Student to Junior

E. E. Pelens

MANITOBA

Member

L. E. Poyser

Junior to Member

G. Flavell

NOVA SCOTIA

Junior to Member

D. J. Clements
J. A. McElmon
R. P. Proctor
I. C. Smith
F. A. Villela

QUEBEC

Members

W. T. Pound
W. Sokolowski

Junior

D. St. C. Melanson

Professional Development in Canada

W. A. H. Filer, Jr.E.I.C.

Past Director, Hamilton Branch

Professional Development Program

Canada is a land of boundless opportunity, a young country for young people. We hear this on every hand, and we are told that the greatest potential lies in the field of engineering. How fortunate are we young engineers! Nevertheless, we must realize that with increased opportunity there is increased responsibility, both to ourselves and to our fellow men. The passage of time clearly indicates how little we know, and that a formal university education is simply the foundation on which to build.

Problems Studied

Professional societies in the United States and Canada have been studying the problems of the young graduate in an attempt to ascertain what might be done to help them attain full professional stature. The two-fold result will be the advancement of both the individual and the profession. They have determined that the most difficult, and probably the most critical stage in the engineer's career is the transition between college and industry. During this period he is endeavouring to set professional goals, gain confidence in his own ability, as yet unproven, and to find his place in industry. Possibly he is assuming the responsibility of a family on a modest salary. Any one of these is a major undertaking, and generally all are being established during the first five years after graduation. How successful he is in adjusting himself will determine his future welfare and his usefulness to his employer.

Professional development programs have grown from the realization that these first five years after graduation are the most difficult. The two spheres of influence which must assist the engineer are industry and engineering societies. Whether or not there is a formal training program in industry, technical advance is taking place. In order that the graduate will not become merely a technician, as opposed to a professional man, progress is necessary in broader interests: interests which because of a concentrated university course he has not been able to pursue. This is where engineering societies take their place beside industry.

Engineers' Council for Professional Development

The Engineers' Council for professional development is an amalgamation of the work of eight large and influential engineering bodies in the United States and Canada. Probably no other profession has so many well-established societies. Of these, the American Society of Civil Engineers was founded in 1852, and the Engineering Institute of Canada in 1887. They have contributed in large measure to the industrial advance of our country. Recently these groups have banded together to form the Engineers' Council for Professional Development, specifically for the purpose of counselling would-be engineers in high school, the examination and accrediting of various engineering schools' curricula, and development of the young graduate.

The Monteith Report

For a number of years little progress was made in the search for what the profession might do for the young engineer. In 1949 Dr. A. C. Monteith, of Westinghouse Electric Corporation, was chosen to make a survey and submit a report from which a program could be designed and implemented. The importance of this report can be understood since, if a program could not be implemented from its findings, the Engineers' Council for Professional Development would consider that such an undertaking was beyond its powers. Dr. Monteith gathered a group of engineers together who were interested in assisting the rising generation of engineers to "attain full professional stature". During the ensuing year this committee systematically surveyed the training given by fifty-four companies in the United States, from those who employ five engineers each year to those who employ hundreds. The Monteith Report, presented at the annual meeting of the Engineers' Council for Professional Development in October 1950, confined its remarks in general, to the first five years of professional development under the following headings:

a) Orientation and Training in Industry
b) Continued Education
c) Integration into the Community
d) Professional Identification
e) Self-Appraisal
f) Selected Reading

Consider very briefly, some of these aspects. We are all well aware of their existence, but possibly we are not fully aware of their importance. Orientation and training are largely the responsibility of industry. An engineer often enters an organization at a relatively high level and has not had an opportunity to become familiar with its problems. Of course, the engineer must do much on his own initiative whether or not there is a formal training program. He should be alert and inquisitive in his own department, and should have the opportunity to visit other departments in order better to appraise the work in which he is engaged.

Education is a continuing process, but there is an anticlimax upon graduation when the external compulsion to learn is removed. The individual must, therefore, exert his own initiative to continue his education. In this fast-moving world of technical advance, if he is not keeping abreast of new ideas he is falling behind. A truly professional man realizes this and builds on the firm foundation he established at university.

Responsibilities and Recognition

Engineers, with their advanced education, have a responsibility to their community growing out of this privilege. A professional man should assume certain obligations in municipal, provincial and federal affairs. Yet how many engineers are vitally interested in their community's activities? We, as engineers, want to be considered as professional men, but we are not ready to assume our full share of the responsibility. Until we are ready, our professional acceptance by society will not be forthcoming to the extent that we desire.

An important phase of the engineer's development is the attainment of professional recognition through his affiliations with professional associations and engineering societies. Initially registration in a professional association could be purchased, whereas today it is a privilege to be earned. Academic standards are constantly being raised, thus enhancing the status of the profession. These professional associations are the governing bodies for practising professional engineers. The Engineering Institute of Canada provides the op-

(Continued on Page 1199)

THIRTY-FIVE YEARS AGO

Comment on the Journal of September, 1921

The *Journal* of thirty-five years ago was not as attractive externally as it might have been. At its birth it had adopted a muddy brown jacket to which it adhered for many years, in fact, even today there are traces of it in our covers. It seems to have become fixed by tradition. But a complete job of cover redesign has brightened up our dress and cover illustrations add a lot to our good looks, until now we compare favourably with other similar periodicals. We have nothing of which to be ashamed, though we still think there is room for some improvement.

Saskatoon Meeting

This *Journal* was wholly given up to papers and reports from the Saskatoon professional meeting of August 10-12, 1921. Some of the papers were mentioned here last month. The meeting seems to have been a successful one; 102 members registered and there was a lot of discussion on subjects of most interest to the western provinces.

M. A. Lyons, A.M.E.I.C., had some positive ideas as to road policy for the prairie provinces "(A) committee (may) draft the policy, but there is little more to it than writing out a nice reading (one) . . . After the policy is drafted it is of no use unless it is put into effect and the money found for carrying it out."

The matter of the disintegration of concrete in alkali soils was very much to the fore at this meeting, as well it should have been. It was without doubt the most important and troublesome question then facing prairie construction engineers and contractors. In spite of much investigation and experimental work, not much was really known as yet as to its causes and how to offset them.

Groups from Calgary, Saskatoon and Winnipeg had their say in this discussion. They agreed in general, but there were some arguments over minor details of their findings and the language in which these should be expressed. Methods of making concrete with the best possible alkali resistance were recommended—in essence, "Make the best concrete you can of the best available aggregates with the least possible water."

But even such concrete was not proof against deterioration, so it was suggested that coatings and admixtures should be thoroughly investigated; a little work of this kind had already been done.

The water supply of southern Saskatchewan, both for domestic purposes and for irrigation, was discussed at length "under the direction of the Alberta branches", perhaps because some of their members had had much irrigation experience. The conclusion was that which had been arrived at before; the salvation of this part of the province lay in the South Saskatchewan river, a conclusion which still holds good. As early as 1912 two members of the Institute had told the cities of Regina and Moose Jaw that if they wanted water supplies adequate for their future growth, they would have to go to this river. It took the cities forty years to make up their minds to implement this advice; only recently have they inaugurated a joint supply from that source.

Institute Affairs

One session of the Saskatoon meeting was given over to a discussion of Institute affairs. The general secretary was present, of course, and this gave all the grousers, both individual and collective, an opportunity to take pot shots at him, as representing the entrenched powers. He had a busy time.

The session opened on a note of harmony and self - congratulation. With the help of the Institute seven provinces had enacted some kind of engineers' registration law. Those still outside the pale were Prince Edward Island and Saskatchewan itself, whose 1920 act was declared "unsatisfactory". Some local members were constrained to apologize for this condition, which seems to have been largely due to provincial politics. At least, it couldn't be blamed on socialism; it was still to be many years before the C.C.F. was to take over the provincial government.

Then the members present turned their attention to their own status and incomes and found both poor. They wanted immediate adoption of a schedule of positions and salaries; "live publicity . . . of the true nature, character and extent of engineering services"; and, finally, "that a permanent committee be appointed . . . to keep in touch with all matters respecting this branch of the work."

In none of the discussions on status or salaries, at Saskatoon or elsewhere, does there ever seem to have been any hint that perhaps the individual member could accomplish at least a little by climbing a few steps under his own steam, instead of waiting for somebody else to kick him up the whole flight. The lack of personal pride in the profession and of much feeling of personal responsibility may be among the reasons why engineers do not rank as professionals in the public eye with doctors and lawyers, for example, who possess such qualities in marked degree, instilled into them during their college years.

Three members from Vancouver had a number of suggestions for boosting the Institute: "An energetic campaign should be undertaken . . . to increase membership . . . Surely (twelve associates) are not . . . enough . . . We (are) missing a . . . great opportunity of improving our relations with the business . . . interests by failing to have as associates . . . employers, manufacturers, ministers . . . of public works . . . general managers and presidents of railway companies and a score or more of other . . . . classes . . . which are interested in engineering."

"The present would be a most inopportune time to increase . . . dues . . . By a substantial increase in membership a reduction . . . might . . . be affected . . . The best interests of the Institute can be served by granting more power to the branches . . . The work done by the branch secretary warrant(s) . . . remuneration . . . amounting to one dollar for each corporate member in good standing.

"It has been said of the Institute that it was run for the glorification of a few . . . We do not believe any such statement can be fairly made today . . . (but) offices are occupied too long and too frequently by individual members, no doubt . . . frequently because no one else would act . . . It would be a step in the right direction to have a large number of members hold office."

Actually this was a more powerful blast than is suggested by the excerpts above. It was received without action by the meeting, but we shall have to wait to see if it had any effect on the imperious and stubborn men in Montreal who were imagined by some members to run the Institute pretty much as they wished. Of course, there never was any such clique. R. DeL. F.

NEWS OF THE

Associations and Corporation

Information received through co-operation of the provincial organizations.

ONTARIO

Engineers in the News

W. J. Farago, of Canadian Comstock Co. Ltd., has been named manager of the manufacturing division of the company in St. Catharines, Ont.

An engineering graduate of the University of Saskatchewan, Mr. Farago has been plant superintendent of the same division for the past four years.

Noel B. Montagnon has moved from Arnprior, Ont., to Ottawa, where he is employed by Computing Devices of Canada Ltd., as development engineer in the special projects department of the company.

Franklin P. Buchanan has left the field engineering department of the International Nickle Company at Copper Cliff, Ont., and is employed in the department of works, City of Toronto.

Paul A. Berube has left Canadian General Electric Co. Ltd. at Peterborough, Ont., and has moved to Rochester, N.Y. where he is employed as an electro-mechanical engineer in the telephone division of the Stromberg-Carlson Company.

K. S. Boorman has recently joined Isotrope Products Ltd., Oakville, Ont., in the position of sales engineer.

Mr. Boorman was formerly engaged in sales engineering with the engineering electronics division of Canadian General Electric Co. Ltd. in Toronto.

Ian L. Jennings has been appointed vice-president, supply division, with Standard Paving and Materials Ltd., and also manager of its subsidiary company, Consolidated Sand and Gravel Ltd., Toronto.

Mr. Jennings was formerly the general superintendent of Consolidated Sand and Gravel Ltd. at Paris, Ont.

A. C. Northover, formerly waterworks engineer of Etobicoke Township, has joined J. S. L. King, consulting engineer, 1216 Yonge St., Toronto, as chief engineer.

Mr. Northover has specialized for ten years in municipal engineering, including township projects, in Newfoundland, the West Indies and the Pine Tree line. He graduated in civil engineering from the University of Toronto in 1937 and in 1947 gained the professional degree of C.E. from the same university.

J. R. O. Walli has moved to Saskatchewan from Keno Hill, Yukon Territory, and is chief engineer of Gunnar Mines Ltd., at Uranium City, Saskatchewan.

Arthur E. Smith of Electro Metallurgical Company, a division of the Union Carbide and Carbon Corporation, Niagara Falls, N.Y., has been appointed chief project engineer in charge of the supervision and direction of the engineering department.

A graduate of 1934 in mechanical engineering from Queen's University, Kingston, Ont., Mr. Smith joined the Electro Metallurgical Company in 1936 at Welland, Ont., and successively held the positions of maintenance engineer, process engineer and works engineer. In 1952 he was trasferred to the general engineering department, where he has acted as project design engineer and project engineer. In the latter position he was responsible for the engineering of Electromet's new titanium sponge plant, recently constructed at Ashtabula, Ohio.

The election of **Stephen R. Knott,** to the board of directors of W. Fearnehough (Canada) Ltd., Toronto, has been announced by the parent company, W. Fearnehough Co. Ltd., of Sheffield, England.

Mr. Knott graduated in engineering from the University of Toronto in 1940 and served with the R.C.A.F. during World War II. He was named general manager of W. Fearnehough (Canada) Ld. in 1955.

Stanley M. Roberts is now located in Hamilton, Ont., and is manager of power rectifiers, of the Canadian Westinghouse Co. Ltd. in that city.

Prior to this change in employment, Mr. Roberts was assistant electrical superintendent of Price Bros. & Co. Ltd., Kenogami, Que.

Ross L. Clarke has been named works commissioner for the municipality of Metropolitan Toronto, thus permitting Leslie B. Allan to devote his whole attention to Metropolitan Toronto roads. Prior to this change Mr. Allan directed both the works and roads activities.

Mr. Clark is a native of Toronto and obtained his degree in civil engineering from the University of Toronto in 1937. During the period 1937 to 1942 he was with the engineering department of the Consumers Gas Company of Toronto. In 1942 he joined the R.C.A.F., and served throughout the war. In 1946 he joined the department of works, City of Toronto. He was appointed Metro's deputy works commissioner in 1953.

David H. Johnston has been appointed manager of the engineering department of the Electrohome products division of Dominion Electrohome Industries Ltd., Kingston, Ont. He wil be in charge of all engineering aspects of TV, Hi Fi and radio.

An engineering graduate of Queen's University, Kingston, Ont., Mr. Johnston moves to Electrohome from a large appliance manufacturing company where he held a number of senior management positions.

Zigmas Kuprenas has moved from Toronto to Providence, R.I., where he is employed by the Bulova Watch Company Incorporated. Previous to this move to the United States, Mr. Kuprenas was with Dominion Watch Case Limited in Toronto.

F. V. C. Hewett, of Toronto, has been elected to the board of directors of The Imperial Life Assurance Company of Canada.

President and managing director of McIntyre Porcupine Mines Ltd. and chairman of the boards of Castle-Trethewey Mines Ltd. and Belleterre Quebec Mines Ltd., Mr. Hewett is also a member of the directorate of several other companies.

H. Rozovsky, who was formerly senior ventilation engineer with Canadian Johns-Manville Company at Asbestos, P.Q., has resigned that position to enter the field of private consulting practice in Toronto. As a consultant Mr. Rozovsky will specialize in the fields of air handling, dust control and industrial health engineering for both mining and industrial plants.

He is a graduate of Queen's University, Kingston, and has been with Canadian Johns-Manville Company for over 8 years and engaged in planning and operational problems in mining, milling and industrial health. Prior to joining Johns-Manville he was chief mining engineer for the Buffalo Ankerite Mines near Timmins, Ont., where he was located for over ten years.

Mr. Rozovsky's address in Toronto is 84 Burnaby Blvd.

George B. Anderson has retired as engineer with the Department of Public Works of Canada, Fort William district, after 42 years in the service of the government.

Born in Morrisburg, Ont., Mr. Anderson attended Queen's University, Kingston and joined the Federal Department of Public Works in 1914. During the First World War he served overseas with the Royal Naval Air Service and the Royal Flying Corps. Rejoining Public Works on his discharge from war service he was located at Sault Ste. Marie until 1941, acting as district engineer for a time. Moving to Ottawa he was senior assistant engineer for several years before being appointed district engineer for the Winnipeg district. In 1950 he was appointed district engineer at Fort William. Mr. Anderson has been a member of the Association of Professional Engineers, Province of Ontario, for over thirty years.

Frank C. Richardson has been appointed plant engineer of Avro Aircraft Ltd., Malton, Ont. Mr. Richardson graduated in engineering from the University of Toronto in 1935, joined Avro in 1954 as office and technical general supervisor in the plant engineering department. Prior to that he had engaged in engineering positions and on construction projects for General Electric Company, Dominion Tar and Chemical Company and the Aluminum Company of Canada.

Professional Recognition For Management

During the postwar years, the attempts of Canadian industry to keep pace with the country's rapid and persistent development have focussed much attention upon the engineering profession. Unfortunately, the spotlight has been on the profession in general rather than on individual engineers; and in many instances this has given rise to a latent feeling of dissatisfaction among professional engineer employees, particularly in the larger industrial and manufacturing companies. This dissatisfaction has often led to a feeling of frustration, which results in the engineer's turning to new and what appear to be greener fields.

Heavy turnovers in engineering personnel can jeopardize efficient operation. It has been established that job-switching by engineers is frequently the result of frustration which in turn is usually motivated by lack of professional recognition on the part of the employer. Management, in many cases where job-changing is evident, has not provided a climate in which engineers can work happily and effectively while still retaining their professional attitudes. The provision of an amosphere to encourage professional growth would go a long way towards dispelling frustration. An engineer with the "feel" of responsibility and pride in his profession is a greater asset to his employer than is a frustrated man.

A climate that will encourage and nurture professional growth among engineering employees will include:

—recognition of professional engineering as creative work.

—breakdown of a job to ensure that an individual is given the feeling of responsibility for a specific part.

—acknowledgement of achievement by the use of the professional seal, or by the signature of the individual on a specific part for which he is responsible.

Proper use of engineering personnel is a two-way street. It can be improved by good communications both ways, between management and engineers. Top management knows that professional engineer employees do better work when kept advised of long-term planning and company policy.

Communications should ensure that the ideas of top management reach the individual engineers and that the engineers' ideas reach a top level. Communications, like filing systems, require constant checking.

To The Professional Engineer

An engineer shows his professionalism by a ready acceptance of responsibility and a professional attitude. To begin with he is ambitious for himself; but the drive in him for his own welfare becomes channelled into a deep interest in the progress of his company and his profession. This broadened interest in its turn, resolves itself into a broader point of view than that of mere personal self-interest. The logical and ultimate result is a fusion of ambition with professional pride, in his association with the management team.

It is probable that much of the "engineer frustration" so widely commented on lately is caused by the engineer's hesitation to accept an adequate amount of responsibility while seeking the recogniion he believes he deserves. No one in any profession is entitled to recognition unless he is willing to assume responsibility proportionate to his job.

The fact that so many engineers advance into management positions can be attributed to their over-all type of thinking. They are the engineers who have successfully proved ability to accept many and diversified responsibilities.

An engineer, as an individual, is responsible for the success of his own career. The key to his success is the manner in which he sells himself to management. Paraphrasing the adage: "See yourself as others see you," an engineer might ask himself: "How does my employer rate me as an engineer?"

The rate of an engineer's professional development is directly linked with his professional recognition in the eyes of management. Without development in himself he cannot obtain recognition by others. And to attain both, the engineer must first ask himself: "Am I aware of my responsibility to myself and my employer?" And then he must implement his awareness in action.

Abstracted from a bulletin of the Association of Professional Engineers of Ontario, June 1956.

BRITISH COLUMBIA

Engineers in the News

W. B. Moffat has accepted a position as staff consultant to Western Plywood Co. Ltd. Mr. Moffat had been chief engineer of Sidney Roofing and Paper Company at Victoria, B.C.

H. P. Pfeifer will be an advisor on the United Nations Technical Assistance Mission to Ceylon, commencing Aug., 1956. Mr. Pfeifer was chief electrical field engineer for International Engineering at Kemano, B.C. a few years ago and until recently had a consulting practice in Oslo, Norway.

L. E. Johnson, until recently with the B.C. Engineering Co. is with the General Construction Company working on a project in the Dawson Creek area.

R. B. Fahrig of the Texas Petroleum Company is in Caracas, Venezuela.

Murray Munsell has left Alberni, B.C. to accept a position on the engineering staff of the Powell River Company, Powell River, B.C.

H. T. Miard is now assistant deputy minister, Department of Highways, Victoria, B.C.

D. D. Pringle, formerly mine superintendent at Copper Mountain, now becomes general superintendent in charge of operations at Copper Mountain, Allenby and Princeton, B.C.

L. E. Gower has left the Engineering Services Division of the B.C. Forest Service to accept the position of chief engineer of American Fabricators Limited. This will necessitate a move from Victoria to Burnaby, B.C.

D. A. MacLean has accepted a position in the power development branch of the B.C. Power Commission. Mr. MacLean had been senior hydraulic engineer, hydraulic investigations division, water rights branch of the organization.

H. L. Hinchcliffe, of the Shell Oil Company in Toronto has been promoted from manager distribution, head office, to manager of head office marketing operations.

C. R. de Lannoy has accepted a position as project engineer with the B.C. Power Commission on their upper Campbell Lake development. He had been with the Saguenay-Kitimat Company.

Eugen Ruus has left for Sweden. He intends to spend the next twelve months in that country before returning to the B.C. Engineering Company, Vancouver, where he has been employed for the past several years.

J. B. Twaddle has left the employment of Consolidated Mining & Smelting Co. at Trail and is now employed by Dutton-Williams Bros. of Calgary.

E. A. Peura has accepted a position with the Willock Manufacturing Company. He was previously employed by the Vancouver Rolling Mills.

William Ruck has left the employ of the Consolidated Mining and Smelting Company Limited as development engineer, acid & absorption plants, (chemical-fertilizer division) to join the new firm, North West Nitro-Chemicals Limited, as development engineer. He will move residence from Rossland to Medicine Hat.

W. J. Swanson, resident engineer with the Foundation Company of Canada, has been transferred from his job on the D.E.W. Line to construction of a pulp mill at Thurso, Que.

J. O. Hemmingsen has been appointed manager of logging, western district, for MacMillan & Bloedel, (Alberni) Limited.

Walter Johnson, western division engineer of Rilco Laminated Products, Incorporated has sent word that he has been transferred from the Tacoma office to the sales office in Los Angeles. He will be engaged in promotion, sales and service of engineered timber construction in the Southern California area.

J. C. Oliver, City Engineer, Vancouver, has accepted an appointment as Comissioner of Works on the new board of administration, City of Vancouver.

Randolph Martin, Deputy City Engineer, Vancouver, has taken over the duties of city engineer relinquished by Mr. Oliver. The change was effective July 1.

Professional Development in Canada

(Continued from Page 1195)

portunity for an interchange of ideas amongst the various branches of engineering. It presents an unparalleled opportunity for young engineers to become acquainted with other engineers. Such associations contribute to professional development.

How have these various avenues for professional development been utilized? As a result of the Monteith Report, a director was chosen to inaugurate a course at the University of Cincinnati in 1953. It follows closely work on a post-graduate level in engineering. To date it has been the only such course in the United States.

Professional development programs in Canada are based on continued education of a liberal, non-technical nature. The programs are planned to provide courses which cannot be duplicated at universities in the formal curricula. The organization and operation of Canadian groups varies with the locality, governed largely by the number of interested engineers in the area, and the availability of competent speakers and moderators. Some areas have sufficient engineers to run a course every second or third year. Others have the membership but find it desirable to ask a university to operate a lecture series for them. Of necessity these courses are more formal than those conducted by the membership. In each case however, the basic aim of continuing the young engineer's education is present.

Canadian professional development programs owe their existence to Col. L. F. Grant, field secretary of the E.I.C., whose untiring efforts have produced gratifying results and assisted many engineers through the post-college slump. His foresight in adapting the principles of the Monteith Report to Canadian requirements is apparent.

Organization of Hamilton Branch

The Hamilton Branch of the E.I.C. first sponsored a one-year program in 1951. From the outset it has been well organized. The directorate consists of the director, secretary, treasurer, past director and group chairmen. All matters of general program policy are conducted by the directorate, while individual group business is the responsibility of the group committee through its chairman. This provides the opportunity for the addition of new groups without affecting the whole organization. Since 1951 the Hamilton program has expanded to a four-year course. Membership has increased from thirty in the first year to one hundred and forty in 1956. The content of each group course is being continually assessed to determine how it may be improved. Suggestions from the membership for changes during the year are given careful consideration and may be adopted if beneficial to the group.

Diversity of subjects covered in the groups has made the program attractive and interesting. Group I covers a wide range of topics, such as culture, vocal expression and civil defence. Group II specialized on five major topics, human relations, government, horizons, public speaking, and business management. Each topic is subdivided into three or more subjects. Group III considers business management intensively under five principal headings, such as financial controls, production, and marketing. Group IV studies administrative practices under human relations and business policy. The case study method with a moderator is used to great advantage almost exclusively in this course.

During the year there are two joint meetings of all the groups. In the Fall the first meeting, known as Registration Night, introduces the program to the newcomers and enables members to register in the various groups. The second occasion is known as Employer's Night. The business superior of each member, and the leaders of local industry are invited to hear an outstanding Canadian engineer on a subject of general interest. The aims and operation of the program are explained. This meeting has been one of the highlights of the program.

The directorate is very much indebted to local industry for its genuine interest and support by encouraging its young engineers to participate, and by providing many of the fine speakers and moderators whom we have enjoyed.

Written Constitution a Guide

The Hamilton program reached a significant stage in its development this year with the adoption of a written constitution. Prepared entirely by the members, it is the first of its kind. As such it is anticipated that it will serve as a guide to other groups across the country.

It is not possible to over-emphasize the fact that technical competence is the necessary but not the sufficient condition for becoming a professional engineer. In Canada's expanding economy which is so dependent on industrial growth, the engineering profession will be expected and indeed required, to assume more power and influence. The young engineers of today will be the industrial leaders of tomorrow, making it imperative that they be prepared now for advancement.

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OBITUARIES

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Henry Waldron McLeod, M.E.I.C., who retired from the Canadian Pacific Railway in 1950 as principal assistant engineer for the prairie and pacific regions, died in Vancouver in 1955. He had been living there since the beginning of his retirement.

An eastern Canadian, from St. John, N.B., born on January 17, 1884, he received his education at St. John high schools and the University of New Brunswick. There he obtained a civil engineering degree. With the Intercolonial Railway, Moncton, and the Pennsylvania Railway, Columbus, Ohio for a total of three years' experience, he joined the Canadian Pacific Railway in 1906, beginning a career that was to last for forty-four years. During this time Mr. McLeod carried out his work in Calgary, Medicine Hat, Alta., Vancouver and Winnipeg. In 1929 he was principal railway assistant engineer at Winnipeg.

He was a life member of the American Railway Engineering Association and was one of the charter members of the Association of Professional Engineers of Manitoba. Active in the affairs of the Institute, he served as chairman of the Winnipeg Branch in 1948.

Mr. McLeod joined the Institute in 1913 as an Associate Member. He was transferred to Member in 1940, and granted Life Membership in 1949.

Angus McGugan, M.E.I.C., member of the three-man Canadian Maritime Commission died suddenly, in Ottawa, on July 7, 1956.

Mr. McGugan came to this country from his native Glasgow, where he was born on January 28, 1900. He attended secondary schools in that city and studied engineering at the Royal Technical College, Glasgow, from which he graduated in mechanical engineering in 1921.

Serving a five-year apprenticeship while also attending the Royal Technical College classes, he gained experience in mechanical engineering with two of his country's shipbuilding concerns, Fairfield Shipbuilding and Engineering Company Limited and the firm of Parsons and Brown-Curtis, and remained with the latter a year after earning his qualifications in 1921.

Transferring his services to Canada he was from 1923 to 1926 marine engineer officer with Canadian Pacific Steamships Limited. In 1926 he became associated with the firm of Williams and Wilson Limited, engineers and manufacturers, Montreal, where, from 1926 until the beginning of World War II he was engaged in design and sales engineering.

With the Department of Munitions and Supply at the beginning of the war, in 1940, he served as chief technical officer with the Inspection Board of the United Kingdom and Canada and in 1941 he became director of the naval shipbuilding branch of the Department. In April 1944, on the formation of the Canadian Shipbuilding and Ship Repairing Association, Ottawa, he became its first manager.

His appopintment as member of the three-man Canadian Maritime Commission was made in 1948.

Mr. McGugan joined the Institute as an Associate Member in 1938, and was transferred to Member in 1940.

W. R. Manock, M.E.I.C., who retired from the presidency of Horton Steel Works Limited in 1951, died in Chicago, Ill. on May 3, 1956.

From Farmer City, Illinois, he was born on August 25, 1886, educated at the University of Illinois and graduated with a B.Sc. in civil engineering in 1910. Two years later he became associated with Chicago Bridge and Iron Company in Chicago, transferring to the Canadian subsidiary, Horton Steel Works, in 1924 as manager of operations. In 1926 he was made secretary-treasurer of the company and in 1936 became vice-president and managing director. He was appointed president of Horton Steel Works Limited in June 1945.

A past vice-president of the Institute for the province of Ontario, in 1946, he also served as councillor for the Niagara Peninsula Branch from 1938 until 1942.

Mr. Manock joined the Institute as an Associate Member in 1927, and transferred to Member in 1940.

W. Arthur Wood, M.E.I.C., chief engineer and works manager with the Harrington Tool and Die Company Limited, Lachine, Que., died suddenly in Victoria, B.C., on July 22, 1956.

Born there on September 18, 1910, he had his schooling at the Victoria High School and studied for a B.A.Sc. degree at the University of British Columbia. Graduating in 1932 he found work shortly after with the Department of National Defence at Esquimalt, B.C., as a civilian draughtsman. In 1937 he joined the Vancouver firm of Pumps and Power Limited as draughtsman. Three years later he transferred his services to Defence Industries Limited as mechanical draughtsman in the layout of processing equipment for a short period, and in 1941 began his association with the Harrington Tool and Die Company Limited, Lachine, Que. Named engineer in charge of the design and draughting office, that year, he was in 1946 named works manager.

Mr. Wood joined the Institute in 1941.

Guy Joseph Desbiens, S.E.I.C., of Three Rivers, Que., died in an accident on May 27, 1955.

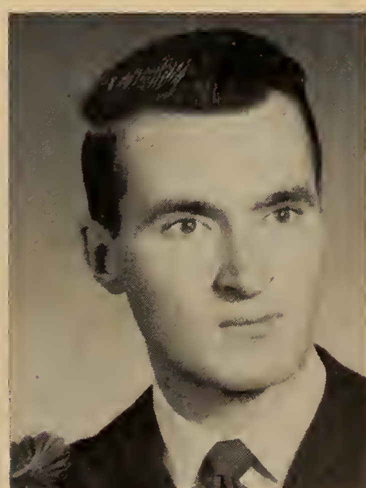
Born and educated in Three Rivers, he attended the Academy de La Salle and was among the graduates of the Ecole Polytechnique, class of 1955, in mining geology.

Mr. Desbiens had been employed with the Malartic Gold Field Mine, and was at Lac Matchi-Manitou at the time of the accident.

He joined the Institute as a student in 1950.

H. W. McLeod, M.E.I.C.

W. R. Manock, M.E.I.C.



G. J. Desbiens, S.E.I.C.

Personals

News of the Personal Activities of Members of the Institute.

Professor G. Ross Lord, M.E.I.C., has been appointed head of the department of mechanical engineering at the University of Toronto.

Professor Lord was born in Peterborough, Ont., and was educated at the University of Toronto, where he obtained his B.A.Sc. degree in 1929, and at the Massachusetts Institute of Technology. He studied in Berlin as Freeman Fellow of the American Society of Mechanical Engineers, and also at Munich and Karlsruhe. He obtained his Ph.D. from the University of Toronto in 1939.

A Member of the Association of Professional Engineers of Ontario since 1937, Dr. Lord was its president in 1946. He is also a member of the American Society of Mechanical Engineers, and was chairman of the Ontario Section last year. His other affiliations include the American Waterworks Association and he has been on the North York Planning Board since 1952.

Dr. Lord is a member of the Senate of the University of Toronto. He has served as consultant to the Ontario Department of Planning and Development on Flood Control since 1945, and to the Ontario Hydro Commission since 1937.

N. R. Crump, M.E.I.C., president of the Canadian Pacific Railway Company, Montreal, has been named "International Management Man of the Year", by the National Management Association.

Mr. Crump had his preliminary education in British Columbia and spent his very early years as a machinist apprentice with the C.P.R. in that province. Later, he worked at Winnipeg's Weston railway shops, began night university courses and from there went on to Purdue University, Indiana. In 1929 he returned to the C.P.R. in Winnipeg with B.Sc. and M.E. degrees.

During the next nine years he held various positions in Saskatchewan and Alberta, and in 1939 was moved to Winnipeg to become chief mechanical draughtsman for western lines. The following year brought him the appointment of assistant superintendent of motive power for western Canada.

Named assistant to the vice-president in Montreal in 1942, he was transferred to Toronto to carry out the responsibility of general manager for Ontario in 1943. Within a few months he took office as manager of the eastern lines.

Elected vice-president five years later, he held this position until 1955 when he became C.P.R. head.

Commodore (E) A.C.M. Davy, R.C.N., M.E.I.C. has retired from an active naval career after thirty-nine years' service. He will undertake an appointment with Columbia Engineering Company of Vancouver.

Originally from Montreal, Commodore Davy attended naval college at Halifax and then went on to England for training at the Royal Navy Engineering College at Devonport, England, in 1923.

Holding numerous appointments at naval stations across the dominion, at Halifax, Esquimalt, Vancouver and Kingston, through the years he has also served as director of naval engineering with the Department of National Defence, Ottawa, in the early thirties, and, during World War II, held the responsibilities of wartime director of shipbuilding for the R.C.N.

In 1946, then a captain, he was among those honoured with the award of the O.B.E.

Commodore Davy was appointed deputy chief of naval technical services and engineer in chief at naval headquarters, Ottawa, in 1949.

Lieutenant Colonel H. H. Minshall, M.E.I.C., for many years associated with Dominion Bridge Company and latterly erection manager in Vancouver, has formed the company of H. H. Minshall and Associates Limited, in that city. As president, he will offer services in the construction field, based on over thirty years of construction and engineering experience.

Lieut. Col. Minshall joined the staff of Dominion Bridge Company's Pacific Division in 1929 and with the exception of leave of absence for the duration of World War II, he has had twenty-seven years' service with the organization. Starting in the production and erection department, he has been instrumental in the erection of all major bridge projects carried out in British Columbia by his company since he joined it. On the Pattullo and Lion's Gate bridge, he was re-

N. R. Crump, M.E.I.C.

Commodore (E) A.C.M. Davy, R.C.N., M.E.I.C.

Lieut. Col. H. H. Minshall, M.E.I.C.

sident engineer throughout the entire construction period. Vancouver's most recent Granville Street Bridge was built during his office as manager of the erection department.

Embarking on his construction career after his graduating from the University of Toronto, he was associated with the Northern Construction Company and J. W. Stewart Limited, Vancouver, in 1924, and with the Sydney Junkins Company of Vancouver and Winnipeg.

Dr. Thomas H. Hogg, M.E.I.C., internationally known consulting engineer and past president of the Institute, has been elected a director of the Brazilian Traction, Light and Power Company Limited.

Dr. Hogg was chairman of the Ontario Hydro-Electric Power Commission from 1937 to 1947 and is a director of a number of Canadian companies, including Sheritt Gordon Mines Limited, Canadian General Investments Limited, Chartered Trust Company, British Newfoundland Corporation Limited and Phillips Electric Company Limited.

Dr. Hogg was president of the Institute in 1940.

Lewis J. B. Forbes, M.E.I.C., president of Pilkington Bros. (Can.) Limited, of Toronto, has been elected to the Board of Directors of Canadian Vickers Limited.

Mr. Forbes is president of several Canadian firms and of the Association of British Manufacturers and Agencies. He was also elected a vice-president of Canadian Vickers Limited.

Professor Raymond Boucher, M.E.I.C. A major appointment at the Ecole Polytechnique, engineering school affiliated with the University of Montreal is that of Professor Raymond Boucher, head of the hydraulics section of the department of civil engineering who has been named chairman of the department of civil engineering.

Professor Boucher holds a master's degree in civil engineering from the Massachusetts Institute of Technology as well as an initial degree obtained at the Ecole Polytechnique and has been full professor of hydraulics and head of the section at Ecole Polytechnique since 1944. In 1949 Professor Boucher entered private practice in partnership under the name Boucher, Cartier, and Leclerc, consulting hydraulic engineers.

Professor R. Boucher, M.E.I.C.

E. R. Jacobsen, M.E.I.C., was recently appointed president of Cia. Meridional de Mineracao, the U.S. Steel Corporation mining subsidiary in Brazil. He will continue to act as president of Brazaço S/A., the commercial subsidiary of the U.S. Steel Export Company. This year Mr. Jacobson is also president of the American Chamber of Commerce in Sao Paulo.

I. R. Tait, M.E.I.C. consulting engineer, Canadian Industries Limited, was honoured this summer at the graduation ceremonies of Sir George Williams College, Montreal. He was presented with an honorary membership in the first graduating class of Sir George Williams, in honour of the active role he has played in the progress of the college. A governor, he is also chairman of the building committee and has been involved in the construction of the new college building in Montreal.

V. E. Vaughan, M.E.I.C. The award of the 1956 Franki Fellowship for graduate research in soil mechanics by the Franki Compressed Pile Company of Canada Limited has been made to V. E. Vaughan of the instructional staff of the Department of Civil Engineering, Nova Scotia Technical College, Halifax.

A native of Halifax and graduate of the above named college, Mr. Vaughan has been a member of the staff since 1946. He has completed graduate studies in soil mechanics at the University of Maryland and is working for a master's degree. The subject of his research under the Franki Fellowship, which is designed to stimulate and encourage the development of soil research by engineering graduates, will be the "Study of the Relationship Betwcen Energy per Blow and Compaction of Sands."

V. E. Vaughan, M.E.I.C.

T. C. Macnabb, M.E.I.C. Chairman of the Nipissing and Upper Ottawa Branch of the Institute this year is T. C. Macnabb of North Bay, Ont., assistant district engineer with the Canadian Pacific Railway.

A native of Manitoba, Mr. Macnabb had his schooling in Winnipeg schools, Earl Gray's School and United College, and then went on to engineering studies at the University of Manitoba. He graduated with a bachelor of Science degree in civil engineering, class of 1940. Many years with the railway following high school and in his undergraduate years, Mr. Macnabb saw service across the four western provinces. On graduation he was permanently employed in Toronto, but spent brief periods in Montreal and London, Ont. In 1944 he received the appointment of assistant special engineer in Montreal, and two years later was named special engineer in Toronto. He received his present appointment in 1952.

T. C. Macnabb, M.E.I.C.

Mr. Macnabb served on the executive of the Nipissing and Upper Ottawa Branch in 1954 and 1955.

He is a member of the Corporation of Professional Engineers of Quebec.

Arthur C. Abbott, M.E.I.C., was recently elected president of the Canadian Electrical Association for the 1956-57 session.

Vice-president in charge of distribution with the Shawinigan Water and Power Company in Montreal, Mr. Abbott has been for many years associated with the organization. He graduated from McGill University in mechanical and electrical engineering in 1925 and 1926 and was then placed on Shawinigan's staff as a student apprentice. In 1928 he was named assistant superintendent of the Beauharnois Electric Company, Ltd., Valleyfield, Que. The following year he was superintendent of the company.

Appointed distribution engineer for Shawinigan Water and Power Company's

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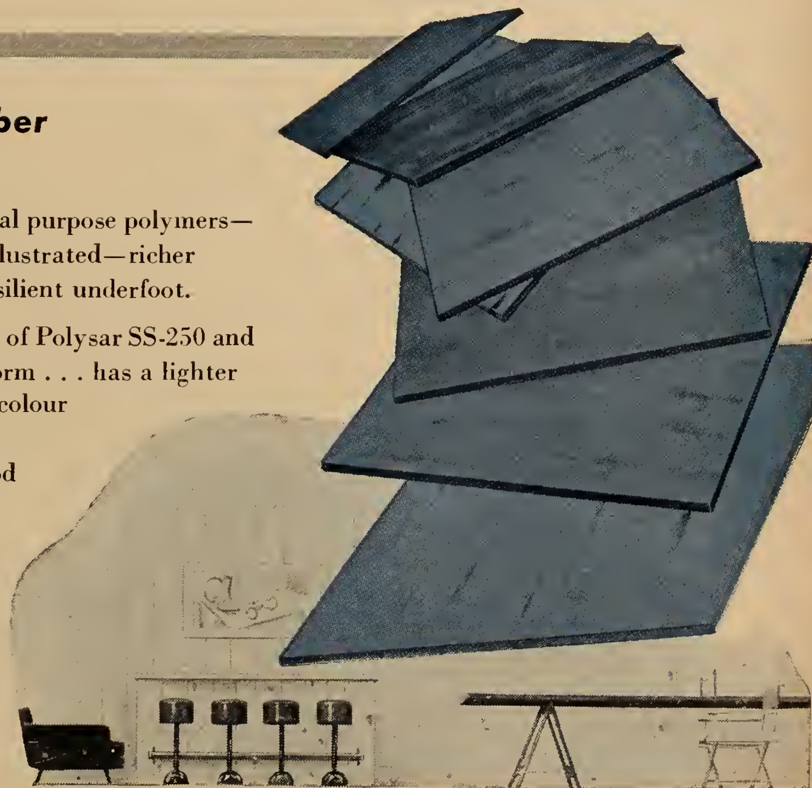

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newly formed commercial and distribution department in 1930, he has since that time held various appointments including those of electrical engineer, commercial and distribution department, and during the war acted as priorities officer for the company in its dealings with the department of munitions and supply. In 1945, returning to the commercial and distribution department he was responsible for general supervision over operation and engineering. He was named assistant manager of the department in 1947. He became manager three years later, and in 1952 received by his present appointment.

Mr. Abbott also holds membership in the Corporation of Professional Engineers of Quebec and the American Institute of Electrical Engineers.

Lillian Gilbreth, HON., M.E.I.C., was among seventeen women recently presented with a "Women of Achievement" award by the American Federation of Soroptimist Clubs.

Dr. Gilbreth was one of six eminent engineers on whom honorary membership in the Institute was conferred in December 1949. Two years ago she was presented with the George Washington Award for her "oustanding contribution to engineering and management, and for unselfish devotion to problems of the handicapped". A top engineering honour, presented for the first time to a woman, the award was made by the Western Society of Engineers and the American Societies of Electrical Mining, Civil and Mechanical Engineers.

Among her many accomplishments, as author, lecturer and engineer, Dr. Gilbreth has been president of the consulting engineering firm of Gilbreth Inc., Montclair, N.J. With her husband she pioneered the field of efficiency engineering and management and the principles and techniques of motion study.

Steve Dembicki, M.E.I.C.

Steve Dembicki, M.E.I.C., has been appointed director of engineering for the management consulting firm of Alliance Management Associates Limited with head offices in Montreal.

Mr. Dembicki is a graduate of the University of Alberta and holds a Master of Engineering degree from McGill University.

With the Verdun plant of Defence Industries Limited on various engineering projects during the war years, he was later associated with Dominion Electrohome Industries, Kitchener, Ont., as an industrial engineer. In 1951 he was associated with the head office industrial engineering group of Canadian Industries Limited and in the latter position he travelled between C.I.L's various plants on industrial engineering assignments. For the past two years Mr. Dembicki has been employed with the Drummondville plant of Canadian Celanese Limited where he organized, trained and managed an industrial engineering department.

Mr. Dembicki served on the executive committee of the Kitchener Branch of the E.I.C. in 1950 and has been

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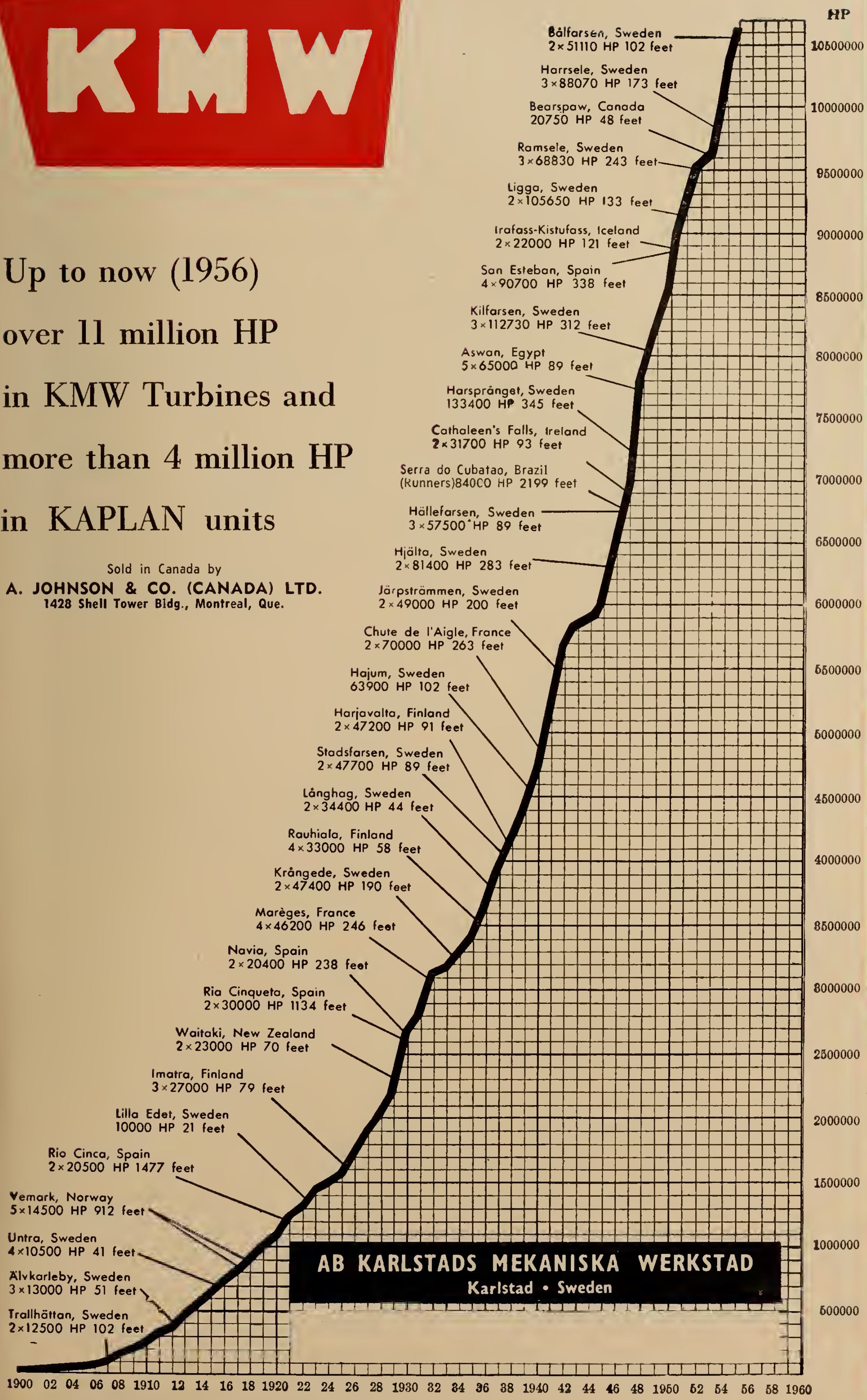

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• PERSONALS

active on the membership committee of the Corporation of Professional Engineers of Quebec.

Colonel R. J. Carson, M.E.I.C., formerly command engineer at Western Command headquarters in Edmonton, with the rank of Lt. Col., has been promoted to the rank of Colonel, with the R.C.S.M.E., Camp Chilliwack, B.C.

Col. Carson has previously served as command engineer officer with Eastern Command in Halifax, and as G.S.O.1 to the chief engineer of the Canadian Army.

W. D. Pippy, M.E.I.C., 1955 secretary-treasurer of the Halifax Branch of the Institute has accepted a position with the Shawinigan Water and Power Company at Trois Rivières, Que. His duties commenced August 1.

With the Nova Scotia Light and Power Company Limited at Halifax recently, Mr. Pippy has also held the position of superintendent of the Edison Electric Light and Power Company Limited, at Springhill, N.S. in 1953. Much earlier in his career, in 1943, he was on the staff of the Nova Scotia Light and Power Company Limited. He graduated from the Nova Scotia Technical College with a B.Eng. in electrical engineering, class of 1937.

Dr. Bernard Ulrich, M.E.I.C., formerly general manager of the St. Lawrence Cement Company, both at Quebec and Villeneuve, Que., has been named executive vice-president of the company at Clarkson, Ont.

Dr. Ulrich followed his engineering studies at the Swiss Federal Institute of Technology, in Zurich, Switzerland. He is a 1942 graduate.

B. R. Lewis, M.E.I.C., formerly assistant superintendent of production engineering with Ford Motor Company of Canada Limited in Windsor, Ont., has accepted a position with Canadian Westinghouse Company Limited, Hamilton, Ont. His duties will be those of director of manufacturing and equipment engineering, with the headquarters manufacturing staff.

Mr. Lewis is a 1947 graduate of the University of Saskatchewan. He studied engineering physics.

J. H. McIntosh, M.E.I.C., known at one time in engineering circles in Canada as a student of the University of Toronto, and in British Columbia as an engineer with the British Columbia Cement Company Limited during the early thirties, now holds an executive status with two African cement companies. He is managing director of the Salisbury Portland Cement Company Limited, Salisbury, Southern Rhodesia, and director and consultant of Whites Southern African Portland Cement Company Limited, Johannesburg.

Serving with the 5th (B.C.) Coast Regiment R.C.A., during the war, as a major, he became associated with Portland Cement Manufacturers Limited in England on demobilization, in 1945.

Two years later he was works director in Johannesburg, S.A., with Whites (S.A.) Portland Cement Company Limited.

In 1951 he held the position of director with the organization.

John C. Hamilton, M.E.I.C., works manager for Canadian Resins and Chemicals Limited, at Shawinigan Falls and Ste. Therese, Que., since 1955, has been named vice-president-manufacturing.

Mr. Hamilton joined the company in 1943 shortly after graduating from Queen's University. He served as production supervisor and general superintendent of plants before undertaking his more recent appointments.

A. Sandilands, M.E.I.C., western regional manager of Phillips Electrical Company Limited in Winnipeg for the past three years has recently been named sales manager with the firm's head office in Brockville, Ont.

A graduate of the University of Manitoba, Mr. Sandilands was for a number of years associated with Automatic Electric (Can.) Limited as branch manager in Edmonton and Winnipeg. Earlier in his career he was on the staff of Canadian Telephones and Supplies Limited and the Power and Mines Supply Company, Regina and Edmonton. In 1940 he was assistant secretary of the Industrial Development Board of Manitoba.

R. W. Johnson, M.E.I.C., is in Jamaica, where he is with Sprostons (Canada) Limited as construction manager.

Earlier in his career associated with the Aluminum Company of Canada, he was known at Arvida, Que., and also at MacKenzie, British Guiana, S.A., as manager of the Demerara Bauxite Company Limited.

F. A. Davis, M.E.I.C., has accepted an apppointment as manager for the Toronto


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• PERSONALS

office of Catalytic Construction of Canada Limited. The firm has its offices at Sarnia, Toronto, and Montreal.

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

Experienced in the petroleum field, Mr. Davis was with the British American Oil Company for a number of years at Montreal and Toronto and in 1946 rose to the position of chief process engineer, Toronto. He worked in that capacity for some time.

A Queen's University graduate of 1940, Mr. Davis joined the firm that year.

John C. V. Bishop, M.E.I.C., formerly of the North Shore and Labrador Railway Company, Que., where he filled the position of assistant chief engineer, has joined the firm of Racey, MacCallum and Associates Limited, in Montreal.

Mr. Bishop is a graduate of the Royal Military College, Kingston class of 1939.

Dennis P. Herring, M.E.I.C., is the recent choice of the City of Belleville for the newly created post of city manager.

With the Polymer Corporation at Sarnia, Ont. for a number of years, he held the position of senior project engineer. Then, in 1954, he went into private con-

D. P. Herring, M.E.I.C.

sulting engineering practice, Hamilton, Ont.

Mr. Herring was formerly chairman of the Sarnia Hydro-Electric Commission and president of District 8, Ontario Municipal Electric Association.

He is a graduate of the University of Saskatchewan, class of 1942.

J. G. Dickinson, M.E.I.C. A recent appointment on the staff of the Northern

J. G. Dickinson, M.E.I.C.

Electric Company Limited is that of J. G. Dickinson who has been named assisant marketing manager with the general department of the company's sales division.

With the Northern Electric Company Limited all his graduate career, he joined the firm in Montreal in 1946 on graduation from the University of Manitoba. At first working as wire and cable sales specialist, later in 1950 he went to the mid-western district as wire and cable overhead and underground and power apparatus sales specialist. In 1951 he became power apparatus sales manager in that district and was in 1952 granted leave of absence to attend the Harvard Graduate School of Business Administration. He obtained an M.B.A. degree in 1954. In the same year he was named manager of marketing research.

D. F. Rhodes, Affiliate E.I.C., after five years in Montreal as chief research chemist with the lubricating oil and grease plant of Canadian Oil Companies, Limited, has moved to Sarnia, Ont., where he is assistant to the company's manager of manufacturing.

Mr. Rhodes has been associated with Canadian Oil Companies, Limited for twenty years, since leaving McMaster University, a graduate in mathematics and physics.

Lester W. Ziegler, M.E.I.C., has taken a position as staff specialist in the plant engineering department, Chrysler Corporation of Canada, at Windsor, Ont.

Mr. Ziegler was formerly with the Ebersol Farm Equipment Company, Mil-

verton, Ont., as general manager and in charge of engineering.

He obtained a B.Sc. degree in mechanical engineering from the Tri-State College, in 1941.

A. I. Wotherspoon, M.E.I.C., a Glasgow University graduate, class of 1949, is structural engineer with Durnford, Bolton, Chadwick and Ellwood, consultant architects, in Montreal.

Mr. Wotherspoon has been known in Canada in connection with his work with Dominion Bridge Company Limited in Montreal, and the Sault Structural Steel Company Limited, Sault Ste. Marie, Ont.

J. A. Hansford, M.E.I.C., who was formerly with the Hydro Electric Power Commission of Ontario has received an appointment with the Bell Telephone Company in the Mid-Canada Defence Line at Fort McMurray, Alberta. His work is that of supervisory engineer.

Leslie Keith, M.E.I.C., is with Blakeburn Constructon Limited, at Terrace, B.C.

Mr. Keith was at one time associated with the Civil Aviation branch of the Department of Transport in Vancouver. He also served the Department in Edmonton and Whitehorse.

R. C. Bezanson, M.E.I.C., has accepted a position with Montreal Engineering Company Limited.

A graduate of Dalhousie University and the Nova Scotia Technical College, class of 1951, Mr. Bezanson was at an earlier date associated with the Dominion Steel and Coal Corporation in Sydney, N.S., in connection with The Seabord Power Plant.

A. F. Gregory, M.E.I.C., a 1950 graduate from the University of Toronto in geological and chemical engineering has taken up work with the Sherritt Gordon Mines Limited, at Lynn Lake, Man.

Last year Mr. Gregory worked as a geologist in the exploration division of the Eldorado Mining and Refining Limited, at Eldorado, Sask.

G. R. Pritchard, M.E.I.C., has been appointed manager of the refrigeration and air conditioning division of John Inglis Company Lmited.

Mr. Pritchard joined the John Inglis Company Limited in 1947 and was until recently manager of the boiler and pressure vessel department. He had previously been associated with Canadian Allis-Chalmers and Canadian General Electric Company.

He graduated from the University of Manitoba in 1937 and is a member of the Associations of Professional Engineers of Ontario and Alberta.

L. E. Willis, M.E.I.C., has received an appointment as maintenance engineer for the City of Calgary.

With the Department of Public Works of British Columbia for a number of years, he was district engineer in Kelowna, B.C., in 1948 and in 1953 served as a divisional engineer with the provincial government.

Mr. Willis is a University of Alberta graduate in civil engineering.

John Macfarlane Bedington, M.E.I.C., a University of Edinburgh graduate has accepted employment with Perini Quebec Inc., at Labrieville, Que.

Mr. Bedington was last year associated with the construction division of the Hydro Electric Power Commission of Ontario, at Toronto, where he was an estimating engineer.

D. A. Fraser, M.E.I.C., who has held the position of roadmaster at Swift Current, Sask., with the Canadian Pacific Railway, has receved a transfer to Winnipeg. He has been assigned to duties of special engineer.

A graduate of the University of British Columbia in 1945, Mr. Fraser has spent a number of years with the company across Western Canada.

H. J. Barton, M.E.I.C., has moved from Dalhousie, N.B., where he was a member of the staff of the New Brunswick International Paper Company, to Gatineau, Que. He is now associated with the Canadian International Paper Company.

Mr. Barton is a Queen's University graduate, class of 1943.

René Dupuy, M.E.I.C., is now associated with the Montreal firm, Quemont Construction Inc.

Formerly with the Mitis Construction Company Limited, at Rimouski Que., in 1951 Mr. Dupuy became director and vice-president of that concern.

E. S. Babinszki, M.E.I.C., has accepted a position with Sandwell and Company, consulting engineers in Vancouver.

Mr. Babinszki has been employed by the Riverside Iron and Engineering Works Limited in Calgary since 1954. He received a diploma in mechanical engineering from the Stuttgart Institute of Technology in 1947.

Gordon F. Bayne, M.E.I.C., has joined the staff of Atlantic Sugar Refineries Limited in St. John, N.B. He was associated with Defence Construction (1951) Limited as project engineer in charge of the company's Chatham, N.B. office for some time previously.

Mr. Bayne received a degree in mechanical engineering at Queen's University in 1948.

H. G. E. Rhodes, M.E.I.C., has joined the staff of the George A. Fuller Company in New York City.

Briefly with the special contracts division of the Bell Telephone Company of Canada at the Pas, Man., this year, and the firm of Morrison, Hershfield, Millman and Huggins, in Toronto, he has also carried on private consulting work and has been associated with the City of Regina's engineering department.

L. W. Swain, M.E.I.C., formerly chief design engineer with W. C. Wood Company Limited in Guelph, Ont., has ac-

cepted an appointment in Galt with the firm of Babcock-Wilcox, and Goldie-McCulloch, steam power plant equipment and accessories manufacturers.

B. W. Anderson, M.E.I.C., employed with the St. Regis Paper Company, Montreal, is now associated with the firm at Cap de la Madeleine, Que.

Mr. Anderson is a McGill University graduate, class of 1944.

Leon Baskin, M.E.I.C., is with Universal Geotechnique Limited, in Toronto.

He was employed as an engineering geologist with H. G. Acres and Company Limited, construction engineers in Niagara Falls, Ont., in 1955.

Mr. Baskin is a Fellow of the Geological Society of London, Eng., and earned a diploma at the Imperial College of Science and Technology, in 1943.

W. F. Hull, M.E.I.C., a University of Toronto graduate in civil engineering, class of 1949, engaged in engineering in Bulawayo, Southern Rhodesia, holds the position of general manager, Laing and Roberts (Rhod.) Limited.

Mr. Hull has been associated with the firm for several years, in various parts of the country.

H. E. Dishaw, M.E.I.C., has joined the firm of J. D. Mollard and Associates

H. E. Dishaw, M.E.I.C.

Limited, Regina, Sask. In this capacity, Mr. Dishaw will assume charge of aerial photographic studies and ground investigations relating to the location of constructon materials and the selection and engineering analysis of construction routes.

Mr. Dishaw graduated from the University of Saskatchewan in 1951. As special projects engineer with the materials and research branch of the Saskatchewan Department of Highways, he carried out studies in soil exploration and soil testing, foundation design, and the mapping of sand and gravel sources from aerial photographs.

T. M. MacIntyre, M.E.I.C., is resident engineer for Kilborn Engineering (1954) Limited, at Bancroft, Ont., engaged in work concerning mill construction for Dyno Mines Limited.

Within the last few years Mr. MacIntyre has been associated with H. G. Acres and Company in Niagara Falls, Ont., and Victoria, B.C., where, in the latter instance he was field engineer on hydro electric projects for the British Columbia Power Commission.

He was with Gulf Construction Company at Clark City, Que., in 1953, and the following year worked with Cartier Construction Company at Labrieville, Que.

A. N. Campbell, M.E.I.C., construction supervising engineer in Montreal with the Dupont Company of Canada Limited since 1954 has been named assistant manager of the organization's Kingston nylon works.

With the company since 1946, Mr. Campbell is a mechanical engineering graduate of the University of Toronto.

M. F. Painter, M.E.I.C., a forestry engineering graduate of the University of British Columbia, class of 1950, formerly with the B.C. Forest Service at Kamloops, B.C., is at work in Vancouver as a consultant forester and engineer. He is associated with the firm of C. D. Schultz and Company Limited.

J. A. Ferrier, M.E.I.C., has been appointed plant engineer with the Terrace Bay, Ont., firm of Longlac Pulp and Paper

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Company, Limited.

Although at work in Neenah, Wisc. in 1955, he formerly held the positions of plant engineer and maintenance engineer with the Spruce Falls Pulp and Paper Company Limited, Kapuskasing, Ont.

He is a graduate of Queen's University, class of 1937.

W. R. Sadler, M.E.I.C., formerly practicing engineering in Lethbridge, Alta., with Superior Masonry Products Limited, has moved to Edmonton where he holds the position of supervising engineer with the Department of Highways, main branch, for the Province of Alberta.

Earlier in his career in 1947, Mr. Sadler was resident highway engineer with the Department of Public Works in Edmonton.

Peter M. Baxter, M.E.I.C. Moved to Abbotsford, B.C., is P. M. Baxter, formerly with the Alberta Government Telephones, Calgary. He has accepted employment with the British Columbia Electric Company Limited as a distribution designer.

He came to this country from Edinburgh where he followed his engineering studies.

F. R. Thompson, M.E.I.C., for the past four years a mill engineer with Canadian Johns-Manville at Asbestos, Que., has accepted a position as design engineer with Consolidated Mining and Smelting Company at Trail, B.C.

Mr. Thompson studied engineering at the University of Saskatchewan. He was awarded a degree in mechanical engineering in 1946.

D. C. Rotherham, M.E.I.C., who has been associated with geological engineering since graduation from the University of Saskatchewan in 1951 is now at work with the Mogul Mining Corporation at Lake Cowichan, B.C.

Mr. Rotherham was geologist with Dee Explorations Limited at Saskatoon, Sask., in 1954, and last year at Trail, B.C., was employed by S.W. Explorations, Canadian Mining and Smelting Company.

E. H. Martin, M.E.I.C., has accepted a position with the British Columbia Power Commission at Victoria, B.C., as assistan construction engineer, following a number of years' service with the City of Winnipeg Hydro Electric System in the construction and design field.

He is a graduate of the University of Manitoba.

L. J. MacKay, M.E.I.C., a graduate of the Royal Technical College, Salford, England, class of 1948, and recently of the firm of Messrs. John Holt and Company, Accra, Gold Coast, Africa, is with Construction Management Corporation, New York, N.Y.

Mr. MacKay was known in Canadian engineering circles several years ago when he was associated with the firms of Dar-

• PERSONALS

ling Brothers, Montreal, and Fraser-Brace Terminal Construction, at St. John, N.B. in 1953.

F/O J. R. Rundle, JR.E.I.C., has joined the staff of the Royal Military College, Kingston, Ont. He will lecture in the Department of Civil Engineering.

F/O Rundle is a Queen's University graduate of 1954.

R. LeR. White, JR.E.I.C., has accepted employment as sales engineer with Mac-Craft Industries in Sarnia, Ont.

On graduating from Queen's University in mechanical engineering, in 1951 Mr. White joined the Allis Chalmers Manufacturing Company in Milwaukee, Wis., as a graduate trainee. Later in 1954 he transferred to the Montreal office of Canadian Allis Chalmers Limited.

G. H. Soberling, JR.E.I.C., is assistant production engineer with Canadian Pratt and Whitney Aircraft Company Limited at Longueil, Que.

Mr. Sobering has gained several years experience with Ford Motor Company of Canada, since receiving a mechanical engineering degree from McGill University in 1949.

Raymond E. Jonasson, JR.E.I.C., previously a sales engineer with the Canadian General Electric Company Limited in Winnipeg, has been named sales representative for the organization's mid-west district which includes Saskatchewan, Manitoba and the Lakehead area in Ontario. His headquarters are in Winnipeg.

Mr. Jonasson gained his engineering training at the University of Saskatchewan, graduating in the class of 1949.

R. K. Nicholson, JR.E.I.C., has been named sales manager, eastern district, Canadian General Electric Company Limited, with headquarters in Montreal. His territory will include the province of Quebec and the Ottawa district of the province of Ontario.

With the firm since shortly after graduating from McGill University in 1949, he was at first sales engineer wth the company in Toronto.

H. F. Pragnell, JR.E.I.C., is with the Eddy Match Company at Pembroke, Ont., after a period of employment with the Foundation Company of Canada Limited at Chalk River, Ont.

Mr. Pragnell joined the latter organization in 1949 on graduation from McGill University.

D. I. Ourom, JR.E.I.C., a Saskatchewan graduate in civil engineering, now employed as a metallurgist in the Ontario city of Kingston, holds the office of secretary-treasurer, Kingston Branch.

With the Aluminum Company of Canada for the last three years, Mr. Ourom has also spent some time as engineer with the Demerara Bauxite Company Limited, Mackenzie, British Guiana.

Prior to that he was a member of the legal surveys branch, Department of Mines and Technical Surveys, Ottawa,

and the Canadian Westinghouse Company Limited, Hamilton, Ont., plant engineering department.

Born and brought up in Saskatchewan, he was a 1949 graduate of the University, following a short career with the Canadian Army.

F. A. **Tayelor**, JR.E.I.C., has taken on the duties of resident engineer, with the Alaska Pine and Cellulose Limited's research division in Vancouver.

After a 1950 graduation in mechanical engineering from the University of British Columbia he became associated with Letson and Burpee Limited.

V. G. Barnden, JR.E.I.C., known in Montreal as a construction engineer with Atlas Construction Company Limited, has accepted the appointment in Australia of construction engineer and wood preservation division manager for Laxton Timber and Trading Limited, Victoria, Australia.

Mr. Barnden is a civil engineering graduate, class of 1949, from the University of Western Australia.

S. B. Carroll, JR.E.I.C., a 1953 graduate of the University of Manitoba, in civil engineering has recently moved from Regina, Sask., to Kitimat, B.C., where he is construction engineer with the Corporation of Kitimat.

Mr. Carroll joined the staff of the City of Regina shortly after receiving his degree.

R. M. Harry, JR.E.I.C., has accepted a position as sales engineer with the Husky Oil and Refining Limited in Regina, Sask.

Mr. Harry, who is a graduate of the University of Saskatchewan, class of 1949, has been associated with Canadian Allis-Chalmers Limited in Montreal and Milwaukee, Wis., where he attended a company training course.

S/L G. W. Flewelling, JR.E.I.C., one of McGill University's 1950 graduates in mechanical engineering who was last year officer commanding trade training for air frame and aero engine mechanics at the R.C.A.F. station at Camp Borden, Ont., has been posted to Aylmer, Ont.

He is known at Dorval, Que., and at Goose Bay, Labrador, where he was, in turn, officer in charge of servicing and aeronautical engineering officer.

Lawrence C. White, JR.E.I.C., formerly instrumentman and project engineer with the Department of Highways, in Toronto, has accepted employment with the firm of Angus Robertson Limited in that city.

S. C. Pike, JR.E.I.C., is with the Bell Telephone Company Limited in Beaconsfield, Que.

Formerly at work as a design engineer with the Matthew Conveyor Company Limited in Port Hope, Ont.

Mr. Pike earned his B.Eng. degree at McGill University in 1950.

C. E. Williamson, JR.E.I.C., who since graduation from the University of Toronto in 1950, has spent several years with the Plymouth Cordage Company at Welland, Ont., is now with the Canadian Kodak Company Limited in Etobicoke, Ont.

Howard R. Lumsden, JR.E.I.C., has left Imperial Oil Limited in Sarnia, Ont. He is with the Bell Telephone Company of Canada at Cranberry Portage where he is at work on the Mid Canada Defence Line.

Mr. Lumsden graduated from McGill University in 1949 with a B.Eng. in civil engineering.

M. F. Luft, JR.E.I.C., a B.Sc. graduate in electrical engineering from the University of Alberta, class of 1951, has been named sales representative in the Alberta district of the motor and control department of Canadian General Electric Company Limited. His office is in Edmonton.

E. D. Mackie, JR.E.I.C., lately of the sales division of Electrical Contracting and Machinery Company Limited in Calgary has accepted a position in Vancouver. He is now employed with the B.C.

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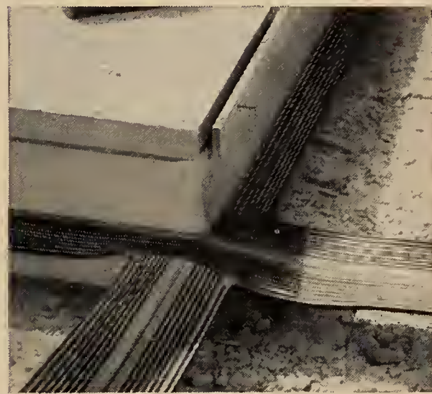

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  DESIGN ENGINEERS: H. G. Acres and Co. Ltd. of Niagara Falls, Ontario
  PURCHASED BY: Canadian Commercial Corporation of Ottawa
  CONTRACTOR: Angus Robertson Ltd. of Montreal
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  DESIGN ENGINEERS: H. G. Acres and Co. Ltd. of Niagara Falls, Ontario
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Mr. Mackie received his engineering degree at the University of Saskatchewan in 1950.

J. H. Wright, JR.E.I.C., is with the Union Carbide International Corporation at Texas City, Texas.

Mr. Wright went to the United States as a scholarship winner shortly after his graduation from McGill University in 1949 and then gained employment with the Shell Chemical Corporation in New York, N.Y., and at Houston, Texas.

J. Urbain Moreau, JR.E.I.C., The choice of the St. Maurice Valley Branch of the Institute for chairman, 1956, is J. Urbain Moreau, consulting engineer of Trois Rivières, Que.

Commencing his education at the Academie de Quebec, Quebec City, with an Arts and Science degree obtained in 1941, Mr. Moreau studied various courses before embarking on his engineering training. With the Canadian National Telegraphs Company Limited in Montreal he studied a radio attendant course shortly afterwards. Joining the Canadian Army Active in 1943, he served until the end of the war. During this time he also studied at the University of Montreal. In 1946, again with the Canadian National Telegraphs he undertook a wire chief's course in Toronto. Two years later he was a graduate from McGill University with a B.Eng. degree in mechanical engineering.

His first graduate position was that of plant engineer with the St. Regis Paper Company Canada Limited, Cap de la Madeleine, Que. After two years with

J. U. Moreau, JR.E.I.C.

the firm he transferred his services to L. Massicotte Limited as construction engineer in the same locality.

It was in 1951 that Mr. Moreau went into private practice as a consulting engineer. He is engaged in mechanical and electrical design with related structural work.

He is a member of the Corporation of Professional Engineers of Quebec. Also active in Branch affairs of the Institute for some time he served as chairman of the Trois-Rivières Junior section, 1950-1951, was regional representative for the St. Maurice Valley from 1953 to 1955 and a Branch committee member from 1954 to 1956. In 1955 he served on the executive.

Donald I. Nelson, JR.E.I.C., has recently been named manager of the Sudbury branch office and warehouse, now under

D. I. Nelson, JR.E.I.C.

construction, for Canadian Ingersoll-Rand Company Limited, Toronto.

Following early warehouse and clerical experience with Ingersoll-Rand in Vancouver, Mr. Nelson joined the R.C.A.F., working for four years on radar equipment maintenance and operation. On demobilization he entered the University of British Columbia and in 1950 obtained a B.A.Sc. degree in mechanical engineering. Rejoining Canadian Ingersoll-Rand after graduation he was posted to Kirkland Lake, covering rock drills, detachable bits, compressors and general products. Prior to his new appointment he was on the staff of the Toronto branch handling sales engineering on general products.

He is a member of the Association of Professional Engineers of Ontario and the Canadian Institute of Mining and Metallurgy.

H. R. Stephens, JR.E.I.C., has moved from McMasterville, Que., to Nobel, Ont., where he is with Canadian Industries Limited.

He is a chemical engineering graduate of Queen's University, class of 1947. He was at that time employed as a chemist in the explosive division of C.I.L.'s plant at McMasterville.

A. A. Hills, JR.E.I.C., has left the staff of Ferranti Electric Limited, research division, and has joined the aeronautical division of Minneapolis Honeywell Limited, Leaside, Ont.

Mr. Hills graduated from Queen's University, with the class of 1949, then spent some time in the metrology department of National Research Council, Ottawa, as a junior research officer.

A. M. Garlicki, JR.E.I.C., a mechanical engineer with the firm of Timberland Machines Limited at Woodstock, Ont. until recently, is now associated with Eastern Steel Products Limited at Preston, Ont., in the design department.

He was employed with Babcock-Wilcox and Goldie-McCulloch Limited for several years since coming to this country.

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Mr. Garlicki is a 1951 graduate in mechanical engineering from the Polish University College of London, Eng.

Ronald C. Getty, JR.E.I.C., has joined the Can-Met Exploration Ltd., at Spragge, Ont.

Formerly with Margison, Babcock and Associates in Toronto, he is a civil engineering graduate from the University of Toronto, class of 1950.

E. R. Bruce, JR.E.I.C., is with the Aluminum Company of Canada at Kitimat, B.C., after several years with the company in Montreal and Isle Maligne, Que.

Mr. Bruce joined the organization in 1951 after a Queen's University graduation.

Raymond Earle Chant, JR.E.I.C., has been named chairman and professor of mechanical engineering with the department of mechanical engineering, University of Manitoba, Fort Garry, Man.

In 1953 Mr. Chant received the appointment of associate professor of mechanical engineering with the University.

B. C. Cameron, JR.E.I.C., a University of Toronto graduate, class of 1952 in mechanical engineering is now in England with the firm of Babcock and Wilcox. He is located at the Castle Donington Power Station, Nr. Derby, England.

Formerly Mr. Cameron was with Canadian Industries Limited at Maitland, Ont., as a power house assistant.

Douglas R. Grimes, JR.E.I.C., is working as a structural engineer in the development branch, Department of Public Works, Ottawa.

A McGill University graduate, class of 1954 he gained an M.Sc. degree in civil engineering this spring at Queen's University. While attending the latter university he also lectured at the Royal Military College, Kingston.

J. R. McGovern, JR.E.I.C., is with Sola Electric (Canada) Limited in Toronto.

A McGill University graduate in electrical engineering, class of 1951, he was formerly associated with the Herbert Morris Crane and Hoist Company Limited in Toronto.

G. D. Langereis, JR.E.I.C., a Delft University graduate of 1954 is with the Montreal Engineering Company as design engineer.

A short time ago he was associated with Mannix Limited in Calgary, on estimating and field work.

J. H. A. Lavallee, JR.E.I.C., of the Bell Telephone Company of Canada at Trois Rivières, Que., has been nominated secretary of the St. Maurice Branch of the Institute.

J. H. A. Lavallee, JR.E.I.C.

A Montrealer, he was born there and received his secondary education at Chomedy de Maisonneuve high school. Before embarking on his engineering studies Mr. Lavallee spent a considerable length of time in the armed forces, as a pilot with the R.C.A.F. in England and the Middle East. In 1945 he enrolled at the Ecole Polytechnique in Montreal and began his professional studies in civil engineering. Concluded in 1951, he be-

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gan his graduate career with Bell Telephone Company of Canada, outside plant section, engineering department, in Montreal. Following a company transfer in 1954 he has since been resident at Trois Rivières.

Mr. Lavallee is a member of the Corporation of Professional Engineers of Quebec.

T. C. Arnold, JR.E.I.C., has been transferred by the Aluminum Company of Canada Limited, from the Arvida works, Arvida, Que., to the head office, general purchasing department at Montreal.

At the Arvida works since 1953 he has held the positions of industrial engineer and mechanical maintenance engineer.

Mr. Arnold is a University of Toronto graduate in mechanical engineering, class of 1950. He also holds a master of Business Administration degree from the University of Western Ontario.

Prior to joining the staff of the Aluminum Company he was employed on the Canadian General Electric test course and was also associated with the Square D Company as a sales engineer.

Mr. Arnold has also been appointed a part-time lecturer with the Department of Commerce at McGill University.

R. C. Legge, JR.E.I.C., has been transferred from Lloydminster, Sask., to Calgary with the Husky Oil and Refining Limited. With the firm for a number of years he was a 1949 graduate of the University of Saskatchewan.

Frank S. Miller, JR.E.I.C., has joined the firm of Scarfe and Company Limited, Aurora, Ont., as a sales engineer specializing in industrial finishes.

Mr. Miller has been associated with several organizations since graduation in 1949. They include the Rubberset Company of Canada, Gravenhurst, Ont., and the Aluminum Company of Canada Limited.

Claude J. Blais, JR.E.I.C., has left the staff of the Canadian General Electric Company Limited at Montreal and has joined the Consolidated Paper Corporation Limited at Port-Alfred, Que.

Mr. Blais was an electrical engineering graduate of McGill University in 1952.

L. E. Parker, S.E.I.C., a 1955 graduate in mechanical engineering, from the University of Saskatchewan, is now living in Edmonton. An employee of the British American Oil Company, he was recently transferred to the west from the Clarkson Refinery, Toronto, Ont.

Adelbert J. Comeau, S.E.I.C., a 1956 graduate from the Nova Scotia Technical College has been placed on the staff of Avro Aircraft Limited, Scarborough, Ont. as junior engineer.

Mr. Comeau was awarded a B. Eng. degree in electrical engineering.

Severino Dozzi, S.E.I.C., a Queen's University graduate, class of 1956, in civil engineering, is on the staff of Dominion Bridge Company Limited, Lachine, Que.

Ian P. Campbell, S.E.I.C., is employed with Atomic Energy of Canada Limited, Deep River, Ont., following his recent graduation in mechanical engineering from the Nova Scotia Technical College which took place this spring.

P. Mantyla, S.E.I.C., a 1956 graduate of Queen's University in mechanical engineering has begun his professional career in Aruba, Netherlands Antiles, with the Lago Oil and Transport Company Limited.

T. P. Gilchrist, S.E.I.C., a University of Saskatchewan graduate, class of 1956, with a B.Sc. degree in agriculture has been taken on the staff of the Saskatchewan Department of Agriculture, conservation and development branch, where his work is that of project engineer.

D. G. Dueck, S.E.I.C., a 1956 graduate from the University of Manitoba in mechanical engineering has accepted a position with Brown Boveri (Canada) Limited in Montreal.

NEWS OF THE BRANCHES

Activities of the Forty-Seven Branches of the Institute and abstracts of the papers presented at their meetings

VANCOUVER

A. D. CRONK, JR.E.I.C.
Secretary

Visit to Wire Rope Plant

One hundred and fifty Vancouver Branch members were recently welcomed by the British Ropes Canadian Factory Limited, Vancouver, when the wire rope manufacturing company held "open house" at its Grandview highway plant.

The engineers were taken on tour of the factory, and visited the plant of Grandview Industries Ltd., a subsidiary of British Ropes, engaged in the manufacture of plastic pipe.

Feature event of the afternoon was a demonstration of the new wire rope pre-stressing plant, which was recently completed on a site immediately north of the factory premises.

R. E. C. Cadman, British Ropes president, and other members of the company staff, were on hand to explain the operation of the pre-stressing machinery, and to discuss the applications of pre-stressed wire rope.

It was pointed out that pre-stressing removes the initial "give" from new rope, and allows engineers to determine the degree of elasticity.

Positions of cable bands and installations can be marked on the cables in the stretched condition they will assume under the design load.

Pre-stressed cables are used on suspension bridges, aerial tramways, and pipe line crossings. The British Ropes plant which was designed by Robert McLellan, has already pre-stressed the ropes for the Capilano Canyon suspension bridge, and the four giant 10,300 ft. cables for the B.C. Electric Jervis Inlet transmission crossing.

The two-inch diameter cable which was pre-stressed during Wednesday's demonstration will be used on the Shelley Crossing of West Coast Transmission's gas pipeline.

Prior to the building of the local plant, which is the only one west of the Mississippi, all pre-stressed wire cables used in British Columbia had to be obtained from eastern Canada, the U.S. or overseas.

HAMILTON

W. A. H. FILER, JR.E.I.C.,
Branch News Editor

1956 Engineers' Ball

An ambitious committee has noticed everyone getting healthy under the summer sun and concluded that all the accumulated excess energy must be given an outlet. The Engineers' Ball for 1956 will provide all that is to be desired.

Already plans are under way to eliminate any obstacle that could possibly stand in the way of its success. No effort is spared, no detail is overlooked.

Tell your wife now so she can enter the date on your social calendar and

At left: Harold Epps, plant engineer gives visiting members of the Institute facts concerning the powerful grips at the live-end terminal of the company's new wire rope pre-stressing plant. At right: R. E. C. Cadman, president, explains details of pre-stressing to Stuart Lefeaux, chairman of the Vancouver Branch. Others in the photo are, E. E. Lathrop, vice-president of the firm, H. P. Archibald, consulting engineer, Harold Epps, plant engineer. Kneeling: Alex Ross, sales manager and Professor W. O. Richmond, head of the University of British Columbia mechanical engineering department.


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DISTRICT OFFICES: QUEBEC, MONTREAL, TORONTO, FORT WILLIAM, WINNIPEG, REGINA, CALGARY, EDMONTON, VANCOUVER

• BRANCH NEWS

get your party together for Friday evening, October 5, 1956. Let's fill the combined Century and Burgundy rooms at the Fischer's Hotel in Hamilton.

Excellent music for dancing by Ted Hader and his orchestra from 9.00 to 1.30 a.m. Time out to draw prizes and a fine buffet lunch at midnight.

Tickets $6.00 per couple. Information as to how and where to get them will reach you through the mail soon. Act quickly and avoid disappointment.

TORONTO

Joint Committee, E.I.C., I.C.E., A.S.C.E.,
H. Fealdman, m.e.i.c.,
Chairman,
B. Hardcastle, m.e.i.c.,
Secretary

The Annual Report adopted at the Executive Committee Meeting at Toronto on June 4, 1956.

The Executive, Toronto Branch, Engineering Institute of Canada,
The Council, Institution of Civil Engineers,
The Council, American Sociey of Civil Engineers.
Gentlemen,

We, the chairman and officers of the Joint Area Committee, beg to submit a report on the operation of the first season, as follows—

Meetings

Four meetings were held during the 1955-56 season. These consisted of:

November 24, 1955 — "One Cycle Moment Distribution", by C. Hershfield. Mr. Hershfield discussed the simplified method which he has developed.

February 9, 1956 — "Waterworks and Fluid Mechanics", by D. G. Huber, who discussed what effect the introduction of fluid mechanics based on mathematical theory has had, or should have had, on the practical treamtent of waterworks design.

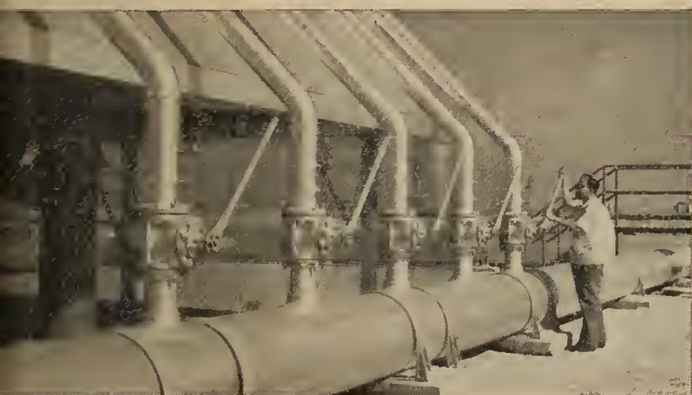
March 8, 1956 — "Foundation Problems and Small Structures", by D. J. Bazett. Mr. Bazett discussed foundation problems, investigation variations in the soil and the effects of trees and other vegetation were also discussed.

April 12, 1956 — "Loading Test on a Prestressed Concrete Beam at Cobourg, Ontario", by L. J. Marcon and W. R. Schriever. This paper described a field loading test on a hundred ft. continuous two span prestressed concrete beam designed as the main roof supporting member for some large Army warehouses at Cobourg, Ont.

Prior to each of the aforementioned meetings, the executive met for dinner in the faculty dining room at Hart House (University of Toronto), and entertained the guest speaker.

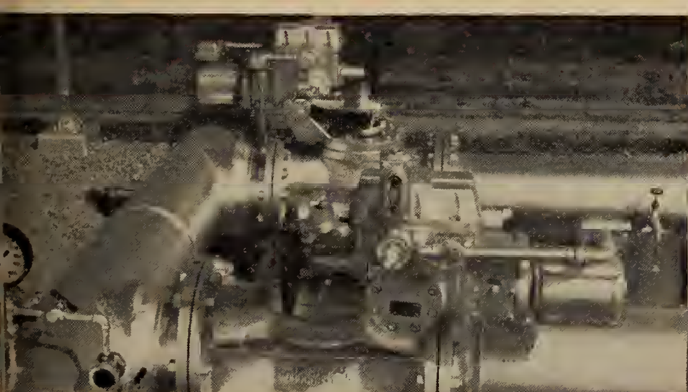
Bottlenecks

ROCKWELL-Nordstrom VALVES Keep Every Line On Stream



AT A GLANCE, you can tell whether a Rockwell-Nordstrom valve is open or closed. Costly, often dangerous guesswork and old-fashioned "feeling" a valve are eliminated.

BIG . . . BUT FAST. Every Rockwell-Nordstrom valve is fully opened or fully closed in one quarter-turn. On gear operated valves, this means operation is two to five times faster.



FOR POWER OPERATION, Rockwell-Nordstrom valves assure dependability and economy because simpler and less costly actuators are required for quarter-turn operation, and lubricant keeps them "ready to go."

For forty years, process engineers have insured better quality control and mechanical performance, greater safety, and lowest maintenance costs with Rockwell-Nordstrom chemical valves. They have been *proven* on every service from the earliest refineries to today's exacting demands of precise flow control in automatic chemical and processing plants. The facts speak for themselves . . . everywhere you use Rockwell-Nordstrom valves they will assure you greater "on stream" dependability at lower cost than any other valve you have ever used.

Look at these installation photographs for just a few of the reasons why Rockwell-Nordstrom valves can help you break production bottlenecks. *Canadian valve licensee:* Peacock Brothers Limited, Box 1040, Montreal, Que. Also, Sydney, Toronto, Sudbury, Winnipeg, Edmonton, Calgary and Vancouver.

ROCKWELL-NORDSTROM VALVES

Made in Canada by

PEACOCK BROTHERS LIMITED

40th YEAR *of lubricated plug valve leadership*

• BRANCH NEWS

Attendance

While actual attendance figures for each of the meetings are not available, an average approximation would be one hundred members, which represents approximately 12½ per cent of the potential. This is considered extremely good for technical meetings in the Toronto area, and augers well for the future operation of the committee, and certainly justifies the co-operation and assistance so generously given by each of the parent bodies.

Membership

The current mailing list of the committee is composed of the following numbers, which include members, associate members, graduates and students:

Engineering Institute of Canada (Toronto Branch)	685
Institution of Civil Engineers	136
American Society of Civil Engineers	48
total listed	869
total served	812

Note: the totals differ slightly owing to dual memberships in the parent bodies.

Following the preparation of this comprehensive mailing list and the circularising of members prior to each meeting, many requests for inclusion on the list have been received by the members of the executive, and very gratifying comments have been made by individual members.

It is felt that this membership will grow in the future years, following the publication of pertinent details in the various journals of the parent bodies.

Third Annual
PROFESSIONAL ENGINEERS' BALL
of the
Niagara Group of the A.P.E.O.
and the Niagara Peninsula Branch of the E.I.C
FRIDAY, SEPTEMBER 28, 1956
at
Prudhomme's Garden Centre Hotel
Queen Elizabeth Way at Vineland

BAR OPENS 6:30 p.m. — DINNER 7:30 p.m. SHARP
Dress Optional — Music by "The Solidaires"

For information:

St. Catharines — Gavin Brown — Ontario Paper Company
R. N. Millman — Ontario Paper Company
Niagara Falls — H. J. Saaltink — H. G. Acres & Company Limited
Fort Erie — A. Zanatta — Horton Steel Works
Port Colborne — A. Zahavich — International Nickel
Welland — Eric Bergenstein — Reliance Electric

Make up your party now and reserve your tickets.

Finances

From the period of inception of the committee up to and including December 31, 1955, all of the expenses of the Committee were borne by the Toronto Branch of the Engineering Institute of Canada. This included the initial costs of setting up stencils for the bulk of the mailing list, and the cost of printing and mailing notices for the first meeting held on November 24, 1955. It will therefore be seen from the statement of expenses that the average cost per meeting for each of the three meetings held in 1956 was $64.88.

Two further meetings are planned for the current year and it will be seen therefore that an estimated deficit based on the above cost per meeting can be expected for the first year of operation. It also appears that, on the basis of five meetings per year, the annual approximate costs for a year of operation will be in the neighborhood of $360, allowing for miscellaneous minor contingencies.

It should be noted that the costs of members' dinners have been borne by the individuals concerned, and only the cost of entertaining the guest speaker has been included.

Organization

As presently constituted, the executive committee consists of the following—
Institution of Civil Engineers — two members.
American Society of Civil Engineers — two members.
Engineering Institute of Canada (Toronto Branch) — three members.

The committee has also added to its numbers by inviting a secretary and a

ATTENTION PLEASE!
E.I.C. BRANCH EXECUTIVES

Several months ago you were written to by headquarters' staff on the subject of new developments in your area of Canada, and the desirability—almost the necessity—of getting Journal papers to describe them. There is so much going on now, in so many places, that ordinary methods of keeping abreast of the engineering news may fail us. We hope not, but you can help us to be sure. Please organize your branch this year so as to cover these two things:—

1. When you hear about a new development in your vicinity, in engineering or technology, get a few facts together, plus the names of some of the principals, and send this information to the editor. We will take it up from there, if you wish.
2. When you have a paper delivered before your branch, if it is a reasonably worthwhile effort TRY to get a manuscript of it and send it to the editor. Some of our finest technical presentations are lost forever because of this lack, and no record exists beyond the memories of the comparative few who heard the speaker.

HELP THE EDITORS TO KEEP IMPROVING OUR JOURNAL treasurer from the E.I.C. (Toronto Branch). The chairman and the immediate past chairman of the E.I.C. (Toronto Branch) are also ex-officio members of the Committee, as also are Mr. E. A. Cross and Mr. R. F. Legget (Institution of Civil Engineers).

Mr. H. Fealdman was elected chairman by the members of the committee.

Executive Members

Engineering Institute of Canada (Toronto Branch) — D. G. Watt, C. Hershfield, M. Walkinshaw.

Institution of Civil Engineers — A. F. Staig, H. Fealdman.

American Society of Civil Engineers — M. S. Yolles, R. G. Watson; secretary, B. Hardcastle; treasurer, L. F. Bresoln; ex-officio, K. F. Tupper, M. W. Huggins, E. A. Cross, and R. F. Legget.

Future Plans

The committee is planning five meetings for the 1956-57 season, one of which will be an open night, for which endeavours are being made to promote a paper from a local member of the group. In this way, the committee hopes to stimulate interest in the presentation of local papers.

E.I.C. and Professional Development

Report of P.D. Courses in Canada

For over five years the Institute has been promoting courses in professional development within the branches. Believing that not many members had any concept of the scope of the Institute's interest and activity in this field, the following general report has been prepared for the attention of all members.

Although it is well known to those who have been associated with the acitivity, there are many who do not know that the field secretary Colonel L. F. Grant has been the "spark plug" throughout these many years. It is a pleasure to have this opportunity to acknowledge publicly the great efforts he has made on behalf of the young engineers, and the success that has attended them.

Summary Report on Professional Development

In 1950, the Engineers' Council for Professional Development published the report of a committee headed by Dr. Monteith (of Westinghouse) entitled, "The First Five Years of Professional Development". The theme of this was the "Continued

Education of Graduate Engineers".

In the United States, because they planned along very ambitious lines, they did not get a course started until 1954/55, in Cincinnati. They are now organizing a second course in Detroit.

However, Colonel L. F. Grant decided to get courses going in Canada right away, which would be self-supporting from a small fee, and more or less run by the young engineers themselves. The first courses began in the 1951/52 season, so that P.D. in Canada has completed its fifth year.

It is difficult to estimate the number of young engineers who have benefited but it is probably about 2,000. There were 15 courses operating in 11 branches in the past season with approximately 450 enrolled (and this does not include the Montreal Junior Section).

Colonel Grant felt that if a group of young engineers met weekly during the winter, and invited well known authorities to speak on non-engineering subjects, they would acquire not only valuable general knowledge but would get training in public speaking by acting as chairmen, introducers, thankers, and asking questions at the meetings. This has proved to be the case. Those who have taken the courses show a most decided improvement in manner and self confidence.

During the first years many of the branches set up courses which ran for two and three seasons; then in smaller centres because they used up the number of speakers available, and there was some repetition when the same members returned each year, they have either turned to something operated by a nearby university, or in some cases discontinued the courses. The Field Office has taken on the work of circulating literature and offering assistance, and in Toronto actually runs the two courses which have been in continuous operation.

Branch P.D. Programs

Last year eleven branches had courses, as follows:

Quebec: This is an engineering course directed through L'Universite Laval, and covers advanced design of structures and soil mechanics. The course lasts three years and includes three hours per week of lectures plus

• BRANCH NEWS

assigned work. Those who complete it and produce an acceptable thesis may be granted a master's degree by the university. This grew out of their original P.D. course and is considered as one of the Quebec Branch activities. One of the Provincial Government educational organizations gives the Quebec Branch $1,000 a year for this project.

Hamilton: The P.D. course in Hamilton is considered the model for all P.D. courses. They operate four groups with a total enrolment of 150.

Group one stresses general knowledge. Group two gives specialized study on five topics: business management, public speaking, government, human relations and philosophy. Group three takes up business administration. Group four studies administrative practices by the Harvard Case Method.

Hamilton seems to have achieved a continuity of enthusiastic committee officers which has assured the success of the course.

Kootenay: This branch has had P.D. for three years. Fifteen graduates of their P.D. I of 1954/55 formed a P.D. II in 1955/56, and arranged five talks on business administration and five general topics. They feel they will now have to discontinue for one year for lack of speakers.

Halifax: P.D. is in its fourth year in Halifax. The first year they had a general course; the second year they concentrated on public speaking only; the next year on investment; and during the past year had 12 lectures available through St. Mary's University extension.

Winnipeg: Here the second year of P.D. has been completed. They now have two courses, more along the lines of Hamilton and Toronto, which is the type of course Colonel Grant prefers, i.e., the first year general subjects (last year specializing in government and law), and the second year on the arts.

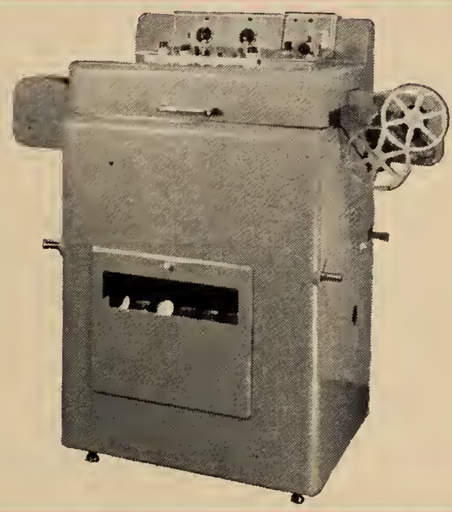
Ottawa: The general program at Ottawa last year included ten plant visits as well as general meetings. There was also an evening with refreshments, for university students.

Belleville: This branch has just completed a two-year course in business administration under the auspices of

(*Continued on page 1322*)

INSTRUMENTATION CAMERA
AND AUTOMATIC
TRI-FILM PROCESSOR

PRECISION'S PERFECT PAIR



SPECIFICATIONS

INSTRUMENTATION CAMERA TYPE T232 Mk7

Size:	7½" x 5⅞" x 6½"
Weight:	13 lbs.
Power:	28 volts DC; constant demand .4 omperes; intermittent up to 1.8 amperes. The Type T232 DC power supply, which operates from 110v 60 cps, is available to power the camera
Lens:	28mm Augenieux F3.5, or to customer specification
Magazine:	100 ft. 35mm standard sprocketed film, No. 10 daylight loading spool. 400 ft. magazine available on special order
Picture Formats:	18x25, 25x25 or 25x36 mm.
Exposure:	1/100 second, or longer with intervol-ometer control
Interval Time:	3 cycles per second maximum

AUTOMATIC TRI-FILM PROCESSOR TYPE T246 Mk3

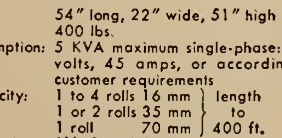
Size:	54" long, 22" wide, 51" high
Weight:	400 lbs.
Power Consumption:	5 KVA maximum single-phase: 110 volts, 45 amps, or according to customer requirements
Process Capacity:	1 to 4 rolls 16 mm / 1 or 2 rolls 35 mm / 1 roll 70 mm } length to 400 ft.
Rate of Processing:	1½, 3 or 6 ft. per min.

Temperature-controlled solutions and dryer
Daylight operation except loading of film into magozine
Processes perforated or plain film

Here is the perfect answer to the problems of film recording and the obtaining of quick results without loss of quality. The Mark 7 Instrumentation Camera is completely flexible through the entire field of instrumentation and aerial survey positioning photography. The shutter is a focal plane type, the basic exposure speed of which is 1/100 second. The camera may be cycled from 3 frames per second to any desired longer interval. Interchangeable apertures permit photographs of 18x25, 25x25 or 25x36 mm. A high degree of accuracy is achieved in respect to lens alignment, focusing and format positioning. Main components designed on the "module" system make conversion from one camera type to another relatively simple should customer requirements change.

A fitting companion is the transportable Mark 3 Automatic Tri-Film Processor that develops and dries 16, 35 or 70 mm film at 1½, 3 or 6 feet a minute. Four 400-ft. 16 mm films can be handled simultaneously—or two 400-ft. 35 mm films—or one 400-ft. 70 mm length. The various film sizes are accommodated by simple adjustments of film separators. Separate temperature control of the processing solutions is possible on each tank from 60 to 110 degrees F, within ± 1 degree. The latest high temperature chemical resistant plastics and Type 316 stainless steel are used in all chemical areas.

Write for literature and quotations.



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News of Other Societies

Important Meeting in Montreal

The Engineering Institute of Canada was happy to co-operate with The American Society of Mechanical Engineers through the ASME-E.I.C. International Council in arranging meetings at the Windsor Hotel, Montreal, on June 19 to 22 last, inclusive, of two important organizations from south of the border.

Once each year the ASME Boiler and Pressure Vessel Committee meets jointly with The National Board of Boiler and Pressure Vessel Inspectors in a location outside of New York City. This year an invitation to meet in Montreal was accepted and the occasion was rendered especially notable for two reasons. It was the 25th general meeting of the National Board and was also the first occasion on which the annual joint meeting of the two bodies has been held in Canada.

Work of the Committees

The ASME Boiler and Pressure Vessel Committee was set up originally by The American Society of Mechanical Engineers in 1911 for the purpose of formulating standard rules for the construction of steam boilers and other pressure vessels. The National Board of Boiler and Pressure Vessel Inspectors was organized in 1919 and is now composed of the chief inspectors of states and municipalities in the United States and of the provinces in the Dominion of Canada that make use of the Boiler and Pressure Vessel Code.

Registration for the meeting opened at 10 A.M. on Tuesday, June 19 and later in the morning an executive session of the National Board took place. After luncheon attended by the members and their guests, including the ladies, the meetings were formally opened with addresses of welcome by the following officials or their representatives: Hon. Antonio Barrette, Minister of Labour for the Province of Quebec, His Worship Jean Drapeau, Mayor of Montreal, Robert L. Dunsmore, M.E.I.C., vice-president, The Engineering Institute of Canada, Montreal, Gerald N. Martin, M.E.I.C., chairman, ASME-E.I.C. International Council, Montreal, Harry E. Boardman, Mem.ASME, chairman of the ASME Boiler and Pressure Vessel Committee, William A. Calvin, president, International Brotherhood of Boilermakers, Blacksmiths, Forgers and Helpers, Frank X. Gilg, Mem.ASME, representing William P. Heuser, president, American Boiler Manufacturers Association and Affiliated Industries.

At the conclusion of the welcoming ceremonies a most interesting technical paper was presented by I. N. MacKay,

National Board—ASME Boiler Code Committee meeting. Head table guests for the dinner which took place on June 21, were, left to right, H. G. Thompson of the E.I.C.; F. W. Smith of Salem, Oregon, president of the National Board; A. LaBissoniere, chief boiler inspector, Province of Quebec; C. O. Myers of Columbus, Ohio, secretary-treasurer of the National Board; G. N. Martin, chairman of the ASME-E.I.C. International Council; Wm. Ferguson, manager, Union Boiler Law Society, Hartford, Conn.; H. E. Aldrich, Vice-chairman, ASME Boiler Code Main Committee, New York; L. Austin Wright (behind the camera), general secretary, Engineering Institute of Canada.

Below. A session of the ASME Boiler and Pressure Vessel Committee and the National Board of Boiler and Pressure Vessel Inspectors meeting in Montreal.

• NEWS OF OTHER SOCIETIES

M.E.I.C., manager, engineering, Civilian Atomic Power Dept., Canadian General Electric Co. Ltd., Peterborough, Ont., dealing with "Atomic Power Developments in Canada".

Later the same afternoon the National Board entertained all members and guests together with their ladies at a reception and cocktail party in the York Room of the Windsor Hotel.

On Wednesday, June 20, the morning was devoted to a panel discussion on Sections I, II and IV of the ASME Boiler Code with Alfred LaBissonniere, Mem.ASME., examiner and chief inspector, Province of Quebec, as moderator. In the afternoon the same panel continued with discussions of Sections VIII and IX of the Code. The following morning, Thursday, June 21, simultaneous open meetings were held of the following ASME subcommittees: Unfired Pressure Vessels, Heating Boilers, Welding, Fire Tube Boilers, Power Boilers.

Thursday afternoon there was a panel discussion dealing with National Board "Recommended Rules for Repairs to Power Boilers and Unfired Pressure Vessels by Welding" with J. N. Briggs, director, Department of Labour, Province of Ontario, Toronto, as moderator.

Reception and Dinner

The main social event of the meetings consisted of a dinner and dance held in the Windsor Hall on Thursday evening. This was preceded by a reception and cocktail party in the Rose Room of the Windsor Hotel, arranged by the local committee. Through the very kind generosity of those Canadian companies whose interests bring them into contact with the work of the ASME Committee and the National Board.

The meetings concluded with open sessions of the ASME Boilers and Pressure Vessel Committee which carried on all day Friday and which were attended by all those present. The Canadian representation at all meetings was most gratifying and in addition to the provincial inspectors there were several members of the Canadian Standards Association B-51 Committee as well as many representatives of the steam power plant equipment, oil refining and paper industries present.

Ladies who accompanied their husbands to these meetings were made especially welcome and the local Ladies Committee, thanks again to the generosity of the contributing Canadian industrial and other organizations, were able to provide a bus tour of the Laurentians on Wednesday, including lunch at the Laurentide Inn, Ste. Agathe as well as a tour of Montreal with lunch at the Restaurant Hélène de Champlain on St. Helen's Island on the Thursday.

The participating organizations were most profuse in their expressions of appreciation for the excellent manner in which all of the local arrangements were carried out. Since these were due in very large measure to the local committees working under the auspices of the ASME-E.I.C. International Council, the members are named hereunder in sincere thanks for their efforts.

General Committee on Arrangements

Chairman, H. M. Esdaile, M.E.I.C.
Vice-chairman, I. P. Fitzgerald
Entertainment, J. D. Hood
Registration, T. L. Noel
Reception, G. N. Martin, M.E.I.C.
Transportation, M. D. Phillips, J. L. Bajada, H. E. G. Dupuy, M.E.I.C., E. H. Brooke, M.E.I.C., P. W. Gooch, M.E.I.C.
National Board Executive, Alfred LaBissonniere, Mem. ASME.
Secretary, H. G. Thompson, M.E.I.C.

Ladies' Committee

Chairman, A. M. Bain, M.E.I.C., Mrs. A. LaBissonniere, Mrs. E. H. Brooke, Mrs. A. M. Bain.

Calendar

The Canadian Good Roads Association will hold the annual convention at the Chateau Frontenac Hotel, Quebec City, October 2 to 5.

Features of the program will be a review of developments at the site of the $12-million road durability test in Illinois, by Dr. Gordon Campbell, CGRA's engineer-observer on the Highway Research Board project; and the "Roads Round-up" in which senior government authorities will report developments.

CGRA offices are at 270 Maclaren Street, Ottawa.

The Association has also announced the award of two scholarships, valued at $2,000 each for post-graduate study in highway engineering in the United States.

The first, the Armco Drainage Good Roads Fellowship, has been awarded to Henri Perron of Quebec City. Mr. Perron has been employed by the Quebec Department of Roads since 1947.

The second, the Canadian Salt Good Roads Scholarship, goes to Robert B. Campbell, of Toronto, who has been employed by the Ontario Department of Highways since 1949.

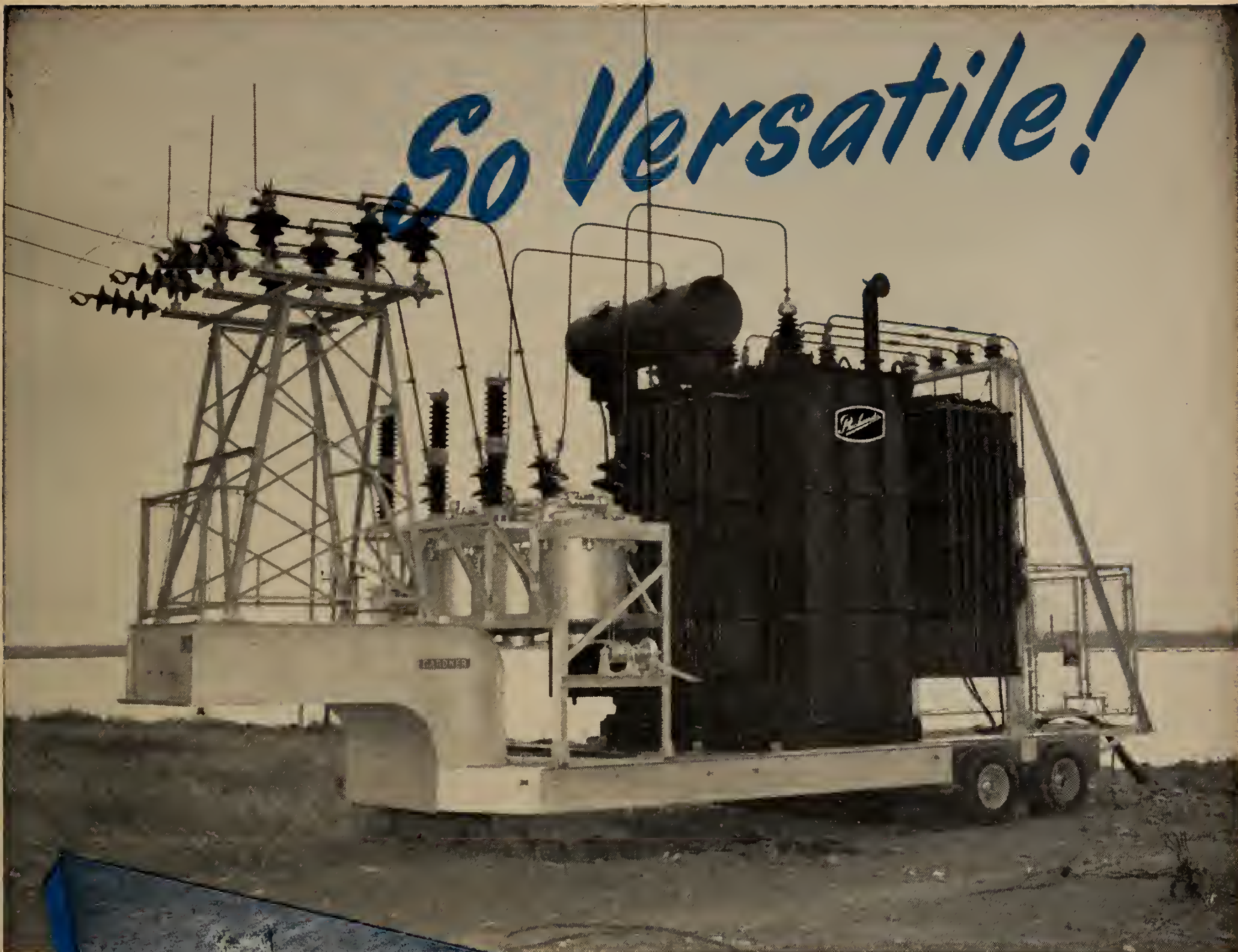
The Engineers' Council for Professional Development (29 West 39th Street, New York) will hold the twenty-fourth annual meeting on October 25 and 26, 1956 in Detroit, Mich.

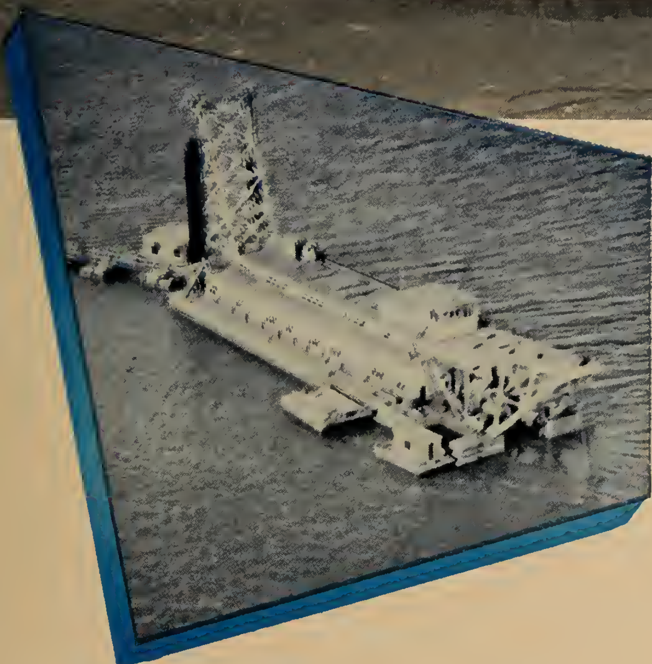
The meetings and luncheons, through the courtesy of the Engineering Society of Detroit, will be held at their Headquarters, at 100 Farnsworth Avenue.

Hotel headquarters will be the Statler Hotel, where the annual dinner and buffet supper will take place.

The printed invitations, reservation cards, and programs will be mailed a month or six weeks before the meeting. However, hotel reservations may be made now.

A splendid program is planned by the Training Committee, with emphasis on





Mounted on a 50 ton trailer, this mobile substation supplies current by submarine cable to the largest pipeline dredge in the world, the "Hydro-Quebec". The dredge is being used to deepen and widen the Beauharnois Canal to provide additional electric horsepower for the Quebec Hydro Electric Power Commission.

The 10000 KVA fan-cooled transformer, designed and built by PACKARD, is fed at 44000 volts and delivers power to the dredge at 13200 volts, 3 phase, 60 cycles.

The transformer windings are designed to give secondary voltages of 2300/2540/6900/7620 delta connected, and 4000/4400/12000/13200 wye connected, making the whole unit exceptionally versatile.

Packards — A BUYWORD FOR QUALITY IN ELECTRICAL APPARATUS SINCE 1894

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• NEWS OF OTHER SOCIETIES

the project in Detroit these past two years. An interesting program is being arranged for the ladies.

The Ontario Section of the American Society of Mechanical Engineers, with the co-operation of the B-51 Committee of the Canadian Standards Association will hold a one-day seminar on the ASME Boiler Code and the ASA Code for Pressure Piping on September 21, 1956.

Readers are invited to submit questions which they would like to hear answered. It is expected that most questions will concern power boilers, unfired pressure vessels, code for pressure piping. In addition there will probably be questions arising from welding requirements and others arising from nuclear applications.

Information may be obtained from G. C. Smith, chairman, or D. Quan, secretary, Ontario Section, ASME, Box 511, Hamilton, Ont.

For the first time in its fifty-year history, the American Concrete Institute (182 West McNichols Road, Detroit 19, Michigan) will hold its regional meeting in Montreal this year.

Many of the 8,000 members of this association intend to be at the meeting which will be held at the Sheraton-Mount Royal Hotel in Montreal on October 24-25. In addition to the business sessions, the program calls for two full days of tours of plants and of the St. Lawrence Seaway Power and Canal developments.

The Montreal meeting will mark the second time that this annual conference is held outside the United States.

The American Concrete Institute has contributed in a large way to the development of concrete technology on this continent.

The Canadian Chamber of Commerce (Board of Trade Building, Montreal 1) will hold the 26th annual meeting at Quebec City, October 15 to 18, 1956. Meetings will be at the Chateau Frontenac.

D. E. Kertland, of Toronto, has been elected president of the Royal Architectural Institute of Canada for 1956-57, the Institute announced recently.

A. F. Duffus of Halifax is first vice-president; K. C. Stanley of Edmonton is second vice-president. The honorary treasurer is Maurice Payette of Montreal and the honorary secretary is Harland Steele of Toronto.

The British Nuclear Energy Conference will be held November 22-23, 1956 at the Institution of Civil Engineers (1-7 Great George Street, London SW1).

Sponsors are the Institutions of Civil, Mechanical, Electrical and Chemical Engineers and the Institute of Physics.

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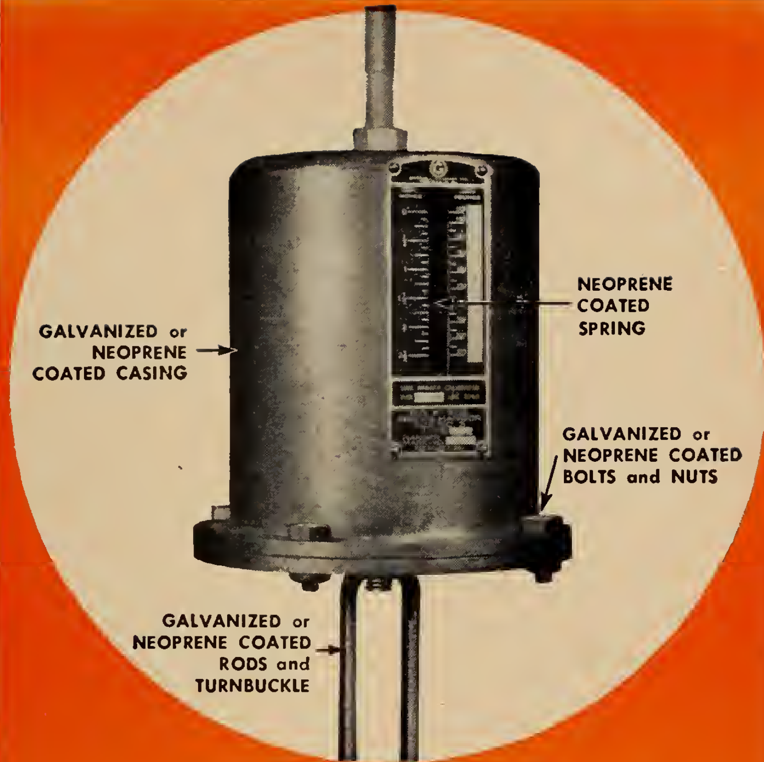
Another Grinnell First!

Grinnell pre-engineered spring hangers are now offered in two new lines to meet the need for spring hangers in installations subject to highly corrosive industrial conditions and to severe weather exposure.

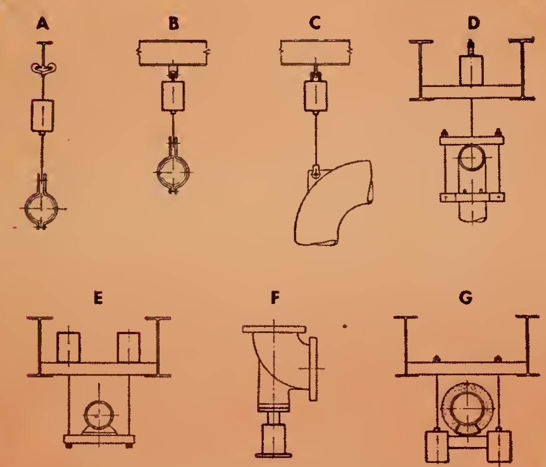
These hangers are the result of extensive experimentation with various coatings for Grinnell's standard pre-engineered spring hangers. In addition to providing flexibility in pipe suspension, they provide versatility of application through their corrosion-resistant characteristics. They are . . .

1. Neoprene coated — for highly corrosive conditions such as those found in chemical plants and refineries. *All* parts of the hanger are neoprene coated to protect the base metal from a wide range of corrosives. The flex life of the spring is unaffected by the neoprene . . . the coating resists cracking or flaking over a wide temperature range.

2. Galvanized — for outdoor installations where weather conditions are severe. All parts of the hanger are galvanized except the spring, which is neoprene coated to avoid alteration of temper, hydrogen embrittlement and decreased flex-life of the spring — usual hazards to springs from the galvanizing process.



AVAILABLE IN 7 TYPES FOR THESE TYPICAL APPLICATIONS



(A) Rod threaded to top cap (B) Furnished with single lug (C) Two lug style (D) Top adjusting (E) Adjustable top and bottom (F) For floor support (G) Trapeze assembly.

Along with the obvious advantages of such corrosion and weather-resistant characteristics, consider these features...

- Maximum variation in supporting force per ½" of deflection is 10½% of rated capacity — in all sizes.
- Precompression* assures operation of spring within its proper working range, as well as saving valuable erection time. Reduced over-all height saves space.
- 18 sizes available from stock for load ranges from 53 lbs. to 12,000 lbs.
- Available in 3 spring lengths for travel ranges of 1¼, 2½, and 5 inches.
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*Precompression is a patented feature.

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Library Notes

Additions to the Institute library
Reviews, Book Notes
Standards

BOOK REVIEW

A guide for development;
Uranium City and district.

K. Izumi and G. R. Arnott. Regina, Department of municipal affairs, Community planning branch, 1956. 74p., mimeog.

This guide for the "fastest growing community" in Saskatchewan has a threefold purpose; to record existing conditions, to review initial premises and assumptions, and to outline requirements for future developments as a guide for local officials.

The committee preparing the report had very little information with which to work. For example, there was no detailed topographical information for other than the immediate townsite. At the time of he 1951 census Uranium City did not exist. Consequently, all estimates of future population, number, types ages, etc., have had to be based on techniques currently employed in planning new towns. This report supplements that issued in 1955 on the Beaverlodge Area in general.

Commencing with a brief history of the community from the arrival of the first inhabitants in 1952 up to September 1955 when there were some 1500 people living in the town, the report next considers location and climate.

The next few chapters consist of a population forecast, an estimate of the land required for both commercial and residential use, and a consideration of the sections of land in the area which will be usable for development. A forecast is made of the numbers of various types of accommodation which will be required, and suggestions are made as to minimum housing standards to be reached, methods of financing purchase, etc.

Suggested street plans are given for both residential and commercial districts, and recommendations are also made as to the numbers and types of commercial buildings which will be required eventually.

Other topics on which suggestions are made are education, recreation, transport, highways and traffic, utilities and services, and administration, including taxation, municipal officials and staff.

Although referring to one particular town, with its own set of problems, the report should be of interest to anyone concerned with establishing either a completely new town, or with planning new developments in an existing community. This is the second such publication we have received from the Saskatchewan Community planning branch within the past few weeks, and we think they are to be congratulated on the thorough way in which the plans are drawn up.

S. C.

Members may borrow the books mentioned in these Notes on application to the librarian. Two books may be borrowed for two weeks.

LIBRARY HOURS

Monday to Friday
9 a.m. — 5 p.m.

BOOK NOTES

Prepared by the Library The Engineering Institute of Canada

* Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

Asbestos: its origin, production and utilization.

W. E. Sinclair. London, Mining publications, 1955. 365p., illus., 50/—.

Seeing that Canada supplies seventy-three percent of the world's asbestos, it is interesting to see this book which, although general in nature, tends to concentrate on conditions in South Africa and Souhern Rhodesia, also large producers of asbestos.

After a short history of the mineral, there is a detailed discussion of the various types of asbestos and the form and nature of their disposition, and world distribution. Production methods are discussed, mining, milling, classification, grading and marketing. The commercial applications of the fibre are considered and brief mention is made of synthetic asbestos.

There are many statistics on resources, production, consumption and cost, although unfortunately few of these are for later than 1952. A good bibliography and geograhical index complete this very interesting and useful book.

Atoms and energy.

H. S. W. Massey. New York, Philosophical library, 1956. 174p., illus., $4.75 (U.S.)

Written by the vice-president of the Atom scientists association who has already written three monographs on atomic physics, this book gives a non-technical account of the developments in atomic physics leading to the large scale release of atomic energy.

The first two chapters discuss the relations between electrons, protons, neutrons and atoms and the chemical energy in atoms. Also discussed are the large scale release of atomic energy, and the uses of atomic energy, both peaceful and otherwise. A final chapter details some of the present day research in atomic physics.

***Calculation of change gear ratios.**

E. H. Wang. Available from the author, 601 Monroe Drive, Xenia, Ohio, 1954. 116p., spiral binding, $3.50 (U.S.)

The problem of finding two, four, six, and more gear ratios that will approach desired ratio in the form of a decimal is an old one. The author here provides a systematic development of simple principles. Factor tables and sample work charts follow a step-by-step explanation of the methods. The most suitable practical ratio within a given permissible error may be found or, if wanted, the ratio with the smallest error.

***Design manual for roller and silent chain drives.**

Prepared by Jackson and Moreland. Indianapolis, Association of roller and silent chain manufacturers, 1955. 95p., illus., $3.50 (U.S.)

A practical manual covering the design of roller chains and sprockets, procedures for selecting roller chain drives for given requirements, and roller chain installation, lubrication, and maintenance. A chapter on the design of silent chain drives, a brief history of chain drive, and a discussion of the relative merits of chains, gears, and belts are also included.

The disposal of sewage, 3rd ed.

T.H.P. Veal. Toronto, British Book Service, 1956. 208 p., illus., $5.10.

A textbook on the subject, now in its third edition, the book covers the main principles and methods of sewage treatment and disposal. Descriptions of older

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WHEN IT COMES to equipment, you can't fool maintenance men. They know what stands the gaff—and what doesn't. They also know a lot of their work is due to faulty selection of equipment—mistakes in judgment of quality, mainly.

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methods of historical interest have been retained, but the rest of the material has been brought up to date, and a chapter has been added on the disposal of liquid industrial waste. Some of the topics covered are quantity of sewage, settlement processes, bacteria beds, bio-aeration tanks and disposal of sludge. There is also a suggested scheme for a city with a population of 50,000.

Electrical interference.
A. P. Hale. New York, Philosophical library, 1956. 122p., illus., $4.75 (U.S.)

The amount of knowledge available on electrical interference with radio and television reception is now quite large. It is, however, largely scattered throughout technical journals. In this book the author has attempted to cover the subject in a thorough and practical manner.

He discusses both the causes and effects of interference, the latter being illustrated by actual photographs of the different types of television picture distortion caused by different electric motors. Also covered are measurement, location and avoidance and interference, filters and Faraday cages. There is also a listing of British standards on radio interference and suppression.

Electronic computers and management control.
George Kozmetsky and Paul Kircher. Toronto, McGraw, 1956. 296p., $6.00.

Written by a business executive and a college professor, this book is intended for the business executive, and is written in non-technical language. Its purpose is to show how electronic computers can help to solve business problems, and how they can influence management planning and control.

Introductory chapters describe just what an electronic computer is, and surveys electronic methods of data processing. Actual applications of the use of computers are cited, and the extensive bibliography lists source material for those wishing to pursue the subject further. Included in the appendices are a description of the "language" used in a computer, programming for a computer, and details of the various types of electronic data-processing equipment.

Electrons, waves and messages.
J. R. Pierce. Toronto, Doubleday, 1956. 318p., $5.95.

An explanation, for specialists in other fields and for the general reader, of the principles of modern electronics and their applications, chiefly in long distance communication and radar. The author reviews some of the basic laws of physics concerning motion, electric and magnetic fields, and waves; shows these at work in such devices as transmission lines, resonators, antennas, and vacuum tubes; and explains how these components are combined in mocrowave systems. Other subjects discussed include television, communication theory, relatively, and quantum mechanics.

°Elementary nuclear theory, 2nd ed.
H. A. Bethe and Philip Morrison. New York, Wiley, 1956. 274p., $6.25.

This is an introduction to the subject for students and scientists who are not specialists in nuclear physics. As in the first edition, the central theme is the problem of nuclear forces treated from the empirical point of view. In this revision, more space has been devoted to the structure and reactions of heavier nuclei. In addition, the book has been expanded to twice the number of pages in order to take into account theoretical and experimental advances, particularly in the energy range of hundreds of Mev. The appended table of nuclear species and their masses has also been revised.

Engineering fluid mechanics.
Charles Jaeger. Glasgow, Blackie, 1956. 529p., illus., 60/-.

This English translation of a well-

• LIBRARY NOTES

known book is in effect a third edition, as it incorporates changes made in the French translation which appeared in 1954, and contains further additions and revisions.

Beginning with a section on fundamental hydraulic principles, this text has three subsequent major sections on steady flow, unsteady flow, and flow in underground strata. Particular attention is paid to basic hydrodynamic equations, open - channel flow, surge tanks, and water hammer. An appendix discusses experimental values for hydraulic calculations dealing with the effect of bends and other physical conditions. The value of the book is increased by the large number of bibliographical footnotes.

Handbook of radioisotope applications. (1)

Manual of nuclear instrumentation. (2)

New York, Nucleonics, 1956. (1) 144p., $1.00 (U.S.) (2) 96 p., 50 cents (U.S.)

Both books are compilations of articles which have appeared in the periodical Nucleonics.

The Handbook is concerned with the applications of radioisitopes, and after an introductory section on the sources of radiation, the other five sections cover applications in the industrial field; in food sterilization; chemical uses; and applications in the fields of biology, medicine, agriculture, geology and metallurgy.

The Manual of nuclear instrumentation is composed of twenty-four articles covering the latest instrumentation methods and devices. These include radiaion detectors, calibrators, beta gauges, counting methods, scintillation counters, monitoring of liquids for radioactivity, etc.

The hazards to man of nuclear and allied radiations.

Ottawa, United Kingdom information service, 1956. 128p., $1.04.

Prepared by the British medical research council, this report presents the medical aspects of the dangers of nuclear radiation.

After an introductory chapter on the nature of radiation and its action on living cells, the report considers the effect of radiation on health, and the genetic effects. Also discussed are the existing and foreseeable levels of exposure to radiation, and one chapter is devoted to the different ways in which people are exposed, ranging from workers in hospitals handling radioactive isotopes to the use of X-rays in fitting shoes.

This is a very clear presentation of a subject which is becoming of increasing importance.

Heat transfer and fluid mechanics institute, 1956.

Stanford, University Press, 1956. 278p., $5.75 (U.S.) (Preprints)

This Institute was the ninth in the series started to make available to engineers in the west a program of research in heat transfer and fluid mechanics. The papers are presented in this preprint form so that participants may have a chance of reading them before the meetings, and so stimulate discussion.

The seventeen papers presented covered a wide variety of topics, the emphasis being on those which cover more than one specific field. There were, in addition, two special sessions or irreversible thermodynamics.

Those already acquainted with this series do not need to be reminded of its value, which is further enhanced by the bibliographies given at the end of most of the papers.

Manganese steel.

Hadfields Limited. Toronto, Clarke, Irwin, 1956. 128p., illus., $3.75.

Manganese steel was first produced by Sir Robert Hadfield in 1882. This book gives the history of that invention, and discusses the manufacture and properties of this extremely tough steel, under such headings as heat treatment; work-

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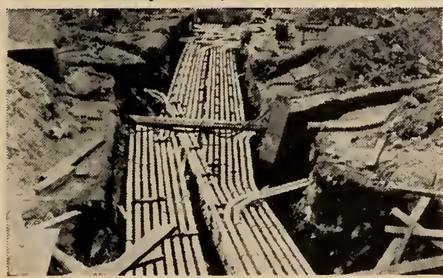

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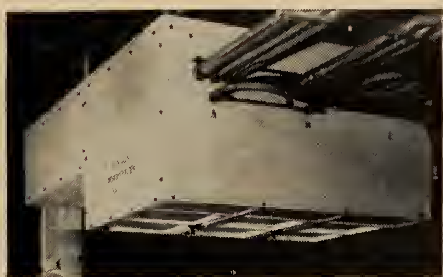

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hardening, abrasion and wear resistance; machining; welding; industrial applications.

Written by members of a firm most closely associated with its manufacture, this book may be regarded as a reference work on manganese steel.

Micro-indentation hardness testing.
B. W. Mott. Toronto, Butterworth, 1956. 272p., illus., $8.40.

Primarily for those in the metallurgical field, this book was written in order to provide as comprehensive a review as possible of the work which has been done on micro-indentation hardness testing. This is a relatively modern development, having taken place in the last twenty years, and the majority of the references in the five hundred item bibliography are taken from this period.

After an introductory chapter on the various concepts of hardness, and the relation of indentation hardness to other physical properties, various types of apparatus for low-load testing are considered. Following chapters cover the classificiation of factors involved in determining hardness, correct application of the load and accurate measurement of the impressions produced, variations on low-loads and the extensive range of low-load testing to a study of metals and non-metallic materials.

Future applications and problems for investigation are covered in the last chapter, while tables of hardness numbers for both metallic and non-metallic materials are given in the appendices.

Modern techniques of excavation.
H. L. Nichols, Jr. Greenwich, North castle books, 1956. Various pagings, illus., $9.00 (U.S.)

Land clearing, ditching, dewatering, landscaping, grading, tunneling, underground mining, and other operations are described in detail, with special attention given to planning, supervision, and techniques for solving problems that may arise. With the exception of a section on defects in equipment, the contents follow closely the chapters titled "The work" in the author's "Moving the earth", published in 1955.

Petroleum and its combustion in diesel engines.
John Lamb. London, Griffin, 1955. 264p., 26/–.

The author has based this work on his forty years' experience with diesel engines of all types.

He deals with the burning of diesel fuel, the special machines which purify residual fuels, and the production of petroleum. The book is full of advice on the trouble-free and economical running of engines, and contains much information on the easy diagnosis of irregularities in combustion. The book will be of particular value to ships' engineers and motorship owners.

Plastic design of steel structures.
J. W. Dolphin, A.M. Nelson and D. T. Wright. Kingston, R.M.C. and Queen's university, 1956. irreg. paging, mimeog., diagrs.

In recent years there have been rapid developments of the ultimate or plastic strength design methods for steel structures. A short course was given on the subject at Lehigh University in September of 1955, and in May of this year a short course for practising structural engineers was given jointly by the Royal military college and Queen's university under the sponsorship of the Canadian institute of steel construction.

This book presents notes of the ten lectures given at this course, and covers such topics as the simple plastic theory of flexure; collapse of indeterminate beams; collapse mechanisms; plastic moment distribution; and building design.

All those interested in this type of design will find this a most valuable and interesting book, supplementing as it does the scattered periodical literature on the subject. The value of the notes is increased by the bibliographies found at the end of each lecture.

Principles of color television.
Knox Mcllwain and C. E. Dean, eds. New York, Wiley, 1956. 595p., diagrs., $13.00.

Compiled from a series of reports prepared by the Hazeltine corporation, this book presents the features of transmitting, receiving and measuring equipment needed for colour television.

Some of the topics covered include colour perception, colorimetry, production of a composite colour signal, synchronization, equipment for producing the transmitted signal, and decoders. Also included are the television standards of the FCC, and a glossary of color television terms.

The value of the book is enhanced by the long bibliographies at the end of each chapter.

Principles of electric and magnetic fields, 2nd ed.
W. B. Boast. New York, Harper, 1956. 418p., diagrs., $6.00 (U.S.)

A textbook for undergraduate students taking a first course in electrical engineering, this book covers both electric and magnetic fields comprehensively.

Although not a complete revision, the text in this second edition has been brought up to date, and a new chapter has been added providing an introduction to Maxwell's field equations. No mathematics higher than elementary calculus are required, and the MKS system of units is used throughout.

Principles and techniques of applied mathematics.
Bernard Friedman. New York, Wiley, 1956. 315p., $8.00.

The author's aim in writing this book was to show that the abstract methods developed in pure mathematics can be used to systematize the techniques for solving problems in applied mathematics.

Throughout the book, stress is laid on ideas, and not the details of proof. These latter, together with many examples, have been placed in the appendices and problems occurring at the end of each chapter.

The first part of the book is concerned with a study of abstract linear spaces, and of operators defined on such

spaces. Chapters are also devoted to ordinary and partial differential equations.

Radiocarbon dating, 2nd ed.
W. F. Libby. Toronto, University press, 1955. 175p., $4.50.

The principles and techniques of estimating the ages of organic materials, especially artifacts of archeological interest, by measuring their radioactive carbon content is discussed in this book.

In this second edition, the latest advances in measurement and sampling techniques are included, and the list of dates determined by the author's laboratory research has been greatly enlarged. A chapter by Frederick Johnson discusses the importance of radiocarbon dating. The bibliographical references have also been brought up-to-date.

Techniques of plant maintenance and engineering, 1956.
New York, Clapp and Poliak, 1956. 248p., $10.00 (U.S.)

The importance of plant maintenance has been increasing for many years, and the advent of automation further enhances its importance. The series of books on the techniques of plant maintenance, of which this is the seventh, has proved itself of value to all plant maintenance engineers.

This book reports the proceedings of the conference held in conjunction with the seventh plant maintenance and engineering show and contains the texts of 16 papers, summaries of 15 round-table discussions and answers to approximately 1,100 specific questions.

Subjects include preventive maintenance, getting maintenance people to work as a team, measuring the effectiveness of maintenance, sanitation, equipment replacement policies, independent contractors, 24-hour operation, painting, design and operation of maintenance shops, cost control, inspection procedures, building and yard structure maintenance, use of punched cards, electrical equipment, lubrication, machine tools, report writing, relationship between maintenance and purchasing departments, utilities, forms and reports, and tool room control.

Five industries were considered in particular at these sessions; air transport shops; chemical plants; petroleum refineries, paper mills and paper products plants; and textile mills.

The ultimate-load theory applied to the design of reinforced and prestressed concrete frames.
A. L. L. Baker. London, Concrete publications, 1956. 91p., $4.00.

The design of reinforced and prestressed concrete structures by the ultimate load method has been in use in some Continental countries for several years. A feature of this method of design is that it is based on the load causing failure of the whole structure instead of the elastic theory now generally used. This book discusses the probability of failure and its effects, and describes how a suitable factor of safety can be

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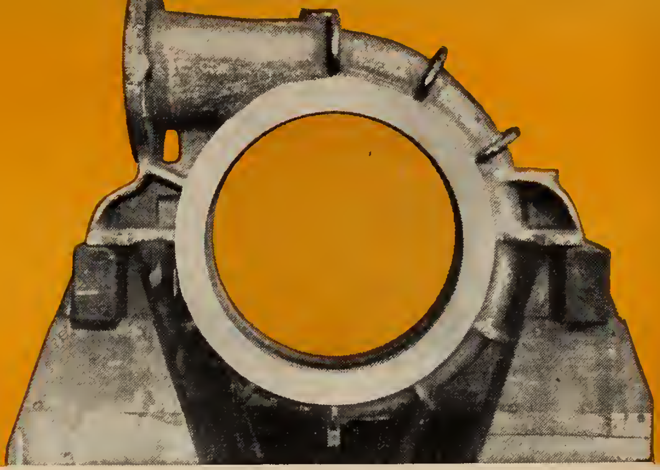

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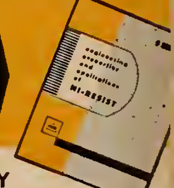

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• LIBRARY NOTES

decided upon. The conception of plastic hinges enables full use to be made of the economies that are possible by the ultimate-load method of design. Some of the information is given in tabular form, and there is a valuable list of references on the subject.

BOOKS RECEIVED

Amplitude modulation
A. Schure. New York, Rider, 1956. 56 p., diagrs., $1.25 (U.S.)

Asymptotic expansions
A. Erdelyi. New York, Dover, 1956. 108 p., $1.35 (U.S.)

Blocking oscillators
A. Schure. New York, Rider, 1956. 64 p., diagrs., $1.25 (U.S.)

Experiment and theory in physics
M. Born. New York, Dover, 1956. 44 p., $.60 (U.S.)

Hydro-dynamics
H. L. Dryden and others. New York, Dover, 1956. 634 p., $2.50 (U.S.)

The evolution of the igneous rock
N. L. Bowen. New York, Dover, 1956. 332 p., diagrs., $1.85 (U.S.)

Infinite sequences and series
K. Knopp. New York, Dover, 1956. 186 p., $1.75 (U.S.)

Investigations of the theory of the Brownian movement
A. Einstein. New York, Dover, 1956. 119 p., $1.25 (U.S.)

Shopping centers
E. J. Kelley. Saugatuck, Eno, 1956. 192 p.

The principles of mechanics presented in a new form
H. Hertz. New York, Dover, 1956. 269 p., $1.75 (U.S.)

Society for experimental stress analysis. Proceedings, V. XIII, No. 2.
Cambridge, The Society, 1956. 197 p., illus.

TV repair questions and answers on sound & L-V circuits.
S. Platt. New York, Rider, 1956. 111 p., diagrs., $2.10 (U.S.)

The following reports have also been received.

American institute of steel construction. National engineering conference, 1956. Proceedings.

Canada. National harbours board. Annual report for 1955.

Engineers joint council. Proceedings second general assembly, 1956. ($1.00)

Great Britain. Dept. of scientific and industrial research. Report for 1954-55. (U.K.I.S. $1.43)

Industrial hygiene foundation of America. History.

Verein deutscher Ingenieure. 100 Jahre, 1856-1956.

STANDARDS REVIEWED

A.S.T.M. Standards, American Society for testing materials, 1916 Race St., Philadelphia 3.

Light metal and alloys.

This third edition includes specifications on light metal alloy die castings, aluminum wire and cable for electrical purposes, and aluminum and aluminum alloy arc-welding electrodes and for brazing filler metal.

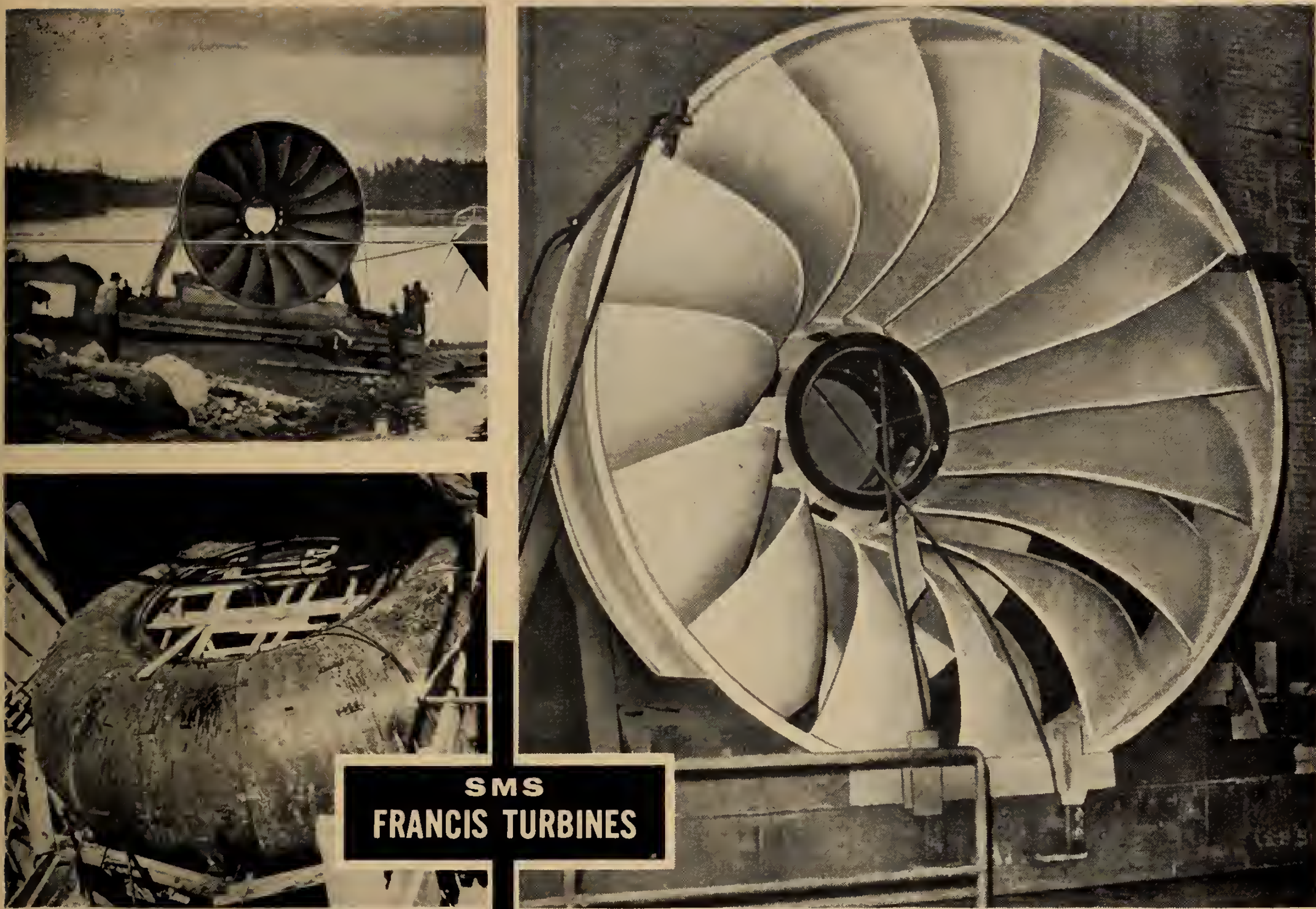
The standards include ingots, castings, bars, rods, wire, forgings, pipe and tube, sheet and plate, wrought products for electrical purposes, filler metal, electroplating, and general methods of test. There is also included the ASTM codificcation system for light metals and alloys. 276p., $3.50 (U.S.

British standards, British standards institution, 2 Park St., London, W.1. Also available from the Canadian standards association.

B.S. 1952:1956 — Copper alloy gate valves for general purposes

B.S. 1953:1956 — Copper alloy check valves for general purposes.

These new British standards, the sec-



Some of the SMS-Francis Turbine units, rated at a total of 56,000 HP under a 124-foot net head at a speed of 112.5 RPM, are shown during shipment and installation for the Manicouagan Power Company, Ltd., Quebec.

GIVE YOU HIGHER EFFICIENCY

Where head and flow do not vary widely, SMS-Francis Turbines can be expected to give you higher maximum efficiencies than other types. For heads between 100 and 1,000 feet, their outstanding performance characteristics, rugged design and dependable operation mean top performance.

In Canada, and throughout the world, SMS-Francis Turbines representing more than 8,300,000 HP are installed or on order. They are the product of over 75 years' experience in the design and manufacture of hydraulic turbines and accessories. This broad engineering background is your assurance of equipment that will meet the highest standards. For full information, write to S. Morgan Smith, Canada, Limited, 300 Bay Street, Toronto 1, Ontario.

S. MORGAN SMITH
CANADA

AFFILIATE OF S. MORGAN SMITH CO., YORK, PENNSYLVANIA

HYDRAULIC TURBINES
PUMPS
GATES & HOISTS
TRASH RAKES
LIQUID HEATERS

HYDRODYNAMICS

ROTOVALES
BALL VALVES
BUTTERFLY VALVES
FREE-DISCHARGE VALVES
CONTROLLABLE-PITCH SHIP PROPELLERS

ond and third in a series for copper alloy valves for general purposes specify requirements for rating, design and manufacture, materials, dimensions and tests and markings. 6/— and 5/—.

B.S. 2718:1956 — Gas cylinder trolleys for use in hospitals

This British standard has been added to the series published during the past few years on tubular-framed equipment for hospitals.

It specifies the materials, dimensions and constructional requirements for gas cylinder trolleys primarily intended for use in hospitals. Two patterns are specified in sizes related to oxygen cylinders of 24, 48, 120 and 180 cu. ft. capacity, but the trolleys are suitable also for the carriage of cylinders of compressed air and other gases.

As a precaution against risks arising from the discharge of static electricity, all rubber on the trolleys is required to be of anti-static composition and the base plates supporting the cylinders are required to be finished with a conductive metallic coating, 3/6.

B.S. 2746:1956 — PVC insulation and sheath of electric cells

This standard has been prepared to bring together in a single publication the methods of test and test requirements for various types of polyvinyl chloride insulation and sheath taken from electric cables. A colour chart giving thirteen standard colours is included. 7/6.

B.S. 2G112:1956—Air-driven directional gyroscopes for aircraft. 3/—.

B.S. S500:1956—Inspection and testing procedure for steel sheets and strips. 7/6.

B.S. S510:1956—28 ton carbon steel sheets and strips (suitable for welding) 2/—.

B.S. S523:1956 — 23/18 chromium-nickel steel sheets and strips (heat-resisting) 2/—.

Canadian standards, Canadian standards association, National research building, Ottawa.

B35-1956 — Binding head machine screws, 3rd ed.

This standard shows the series of sizes and pitches, with head dimensions, body diameters, and screw and thread lengths, for binding head screws. These screws are used in the electrical trade for the purpose of securely holding wires or clips, or as a substitute for round head screws where a larger head diameter with reduced head height is required. The range of sizes given is considered sufficient for all practical purposes, and should be adhered to whenever possible. 75 cents.

C22.2 No. 49-1956 — Construction and test of flexible cords and fixture wires, 3rd ed.

This specification applies to various types of flexible cords and fixture wires —except armoured cords — intended for use on power and lighting circuits in accordance with the Rules of Part I of this Code.

It is divided into seven sections, and covers cords with the following types of insulation: rubber, thermoplastic, asbestos, and cotton. It also covers heater cords and tinsel cords, and test methods and apparatus. $3.00.

C84.1-1956 — Enamelled round copper wire, 2nd ed.

This specification covers the dimensional and performance requirements for round copper magnet wire insulated with a coating of baked oleo-resinous enamel. It covers dimensions, electrical resistance and tests. $1.25.

C84.2-1956 — Vinyl acetal insulated magnet wire, 2nd ed.

The specification is based largely on that issued by the National electrical manufacturers association covering this type of wire. It covers the dimensional and performance requirements for round copper magnet wire insulated with a coating of baked vinyl acetal resin.

The Electrical Power Industry

THE AMENITIES OF modern life such as readily available light and heat, radio, television, and other domestic appliances are now too frequently taken for granted. So also, to some extent, is the great industrial expansion that is now under way in Canada as in other industrial countries.

A few moments thought will bring to mind that our domestic amenities, our transportation and the fuels to move it, agricultural equipment and chemicals, that permit the production of enough food — in short, almost any aspect of our existence— are largely dependent on electrical power for their manufacture or functioning.

Electric power is of particular import in Canada, which now has the second highest power consumption *per capita* in the world (the Province of Quebec actually has the highest figure) and stands second only to Norway in the *per capita* production of electricity from water power. Power production must keep pace with the need for expansion of the country's industry as a whole—without power, in the right place and at a reasonable cost, the industry will not be able to expand.

It has been estimated that firm energy requirements in 1955 were rather more than 72,000 million kilowatt-hours (kwh.); by 1959 these requirements will have increased by nearly 40 per cent to over 100,000 million kwh. These figures do not include the indicated reserve, which amounts to an additional 10 to 14 per cent. The capital investment required to keep up with the demand is estimated at $634 million in 1956, compared with $450 million in 1955 and $455 million in 1954. Experienced observers regard the next decade or so as the period of greatest potential expansion within the history of the electric power industry.

The engineer will play a very large part in this expansion.

The production of electric power in Canada has become associated in many minds almost exclusively with the country's great hydro-electric developments, and Canada is certainly among the leaders in this field. Furthermore, it is estimated that only about 27 per cent of the country's available water power has yet been developed, and that there is a potential of some fifty million undeveloped horsepower.

All this is true, and there is now great scope for engineers in the planning, design, and development of new hydro-electric plants and the extension of existing facilities. There is, however, a much wider aspect of the future of the power industry.

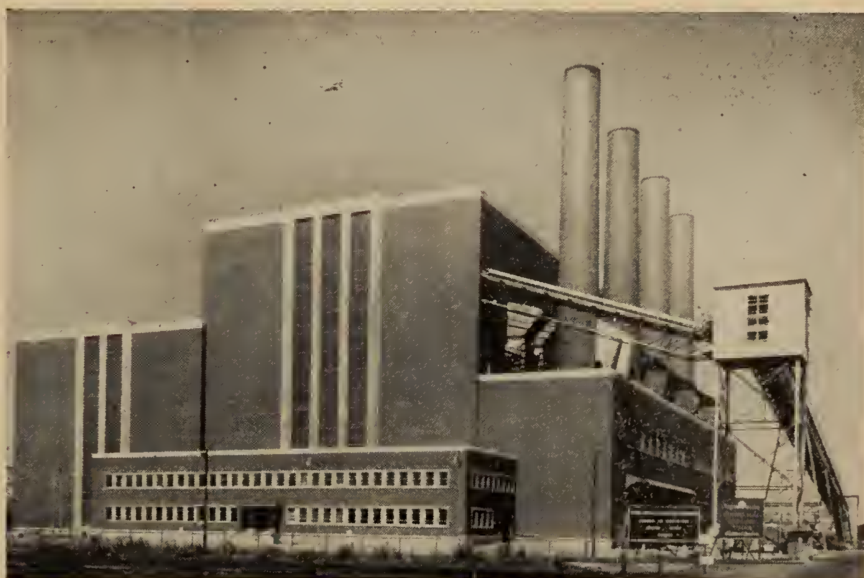
The huge potential of water power, at present rates of development, could well be exhausted within a generation. Moreover, not all this power could be developed economically enough to compete, in a given area, with other methods of power generation, perhaps because of a location too remote from the consumer and excessively high transmission costs. Consequently, future plans of the industry as a whole foresee a very great expansion in thermal generating stations, using coal, oil, and other conventional fuels, according to their availability, with nuclear energy as a long-term addition to the energy resources.

Thermal Power

The distribution of economically developable water power between provinces varies considerably. A notable example of the trend to thermal power generation is found in Ontario, where studies made by Ontario Hydro for their future expansion indicate that by about 1968 thermal generation will almost equal hydraulic generation, and after that time the system resources will become predominantly fuel-electric. (In 1955, the Commission's hydro/fuel generation ratio was approximately 5/1.)

Ontario Hydro further estimates total resources may be 23.6 million kilowatts (approximately 4.5 million kw. at present), of which 5.5 million kw. will be from hydro-electric generating stations, 10.6 million kw. from conventional fuel-electric

Thermal (fuel-electric) plants will play an increasing part in Canadian power production. Shown here is the largest thermal (pulverized coal) plant in Canada, which will have a capacity of 600,000 kw. when additions are completed in 1958.



stations, and almost 7.5 million kw. from nuclear-electric sources.

These figures, of course, refer to one province only, but they are indicative of the general future trend and of the great rate of expansion that is contemplated.

The demand for engineers is also considerably extended into the field of thermal generation. Improvements are constantly being sought and new techniques introduced as the result of engineering studies. In the 1920's coal-burning power plants required about three pounds of fuel per kwh.; today consumption has been reduced to one pound, or less, per kwh.

New problems arise with the introduction of the gas turbine into large-scale power production. A 100,000 h.p. gas-turbine generating station is to be built on Vancouver Island, the decision to use this form of power production having been made as the result of intensive engineering studies.

Probably the most intensive field of study, that is now in the process of developing on a large scale in Canada, is that of nuclear engineering. Nuclear power is not the quick answer to the question of how to meet future shortages; it is undoubtedly a long-term solution to many such problems, but only as the result of much fundamental work and the development of new engineering techniques.

Transmission

The scope of the industry under discussion does not end with the production of electric power. This power must be transmitted from its source to the consumer, quite frequently considerable distances over very difficult country, and the engineer is constantly faced with new problems of ensuring efficient transmission under all conditions and with the greatest efficiency and economy.

The Role of the Engineer

Many branches of engineering are involved in the electric power industry, and many engineers are needed.

This demand exists across the whole country, but as an example of the numbers of engineers involved one may take the Hydro-Electric Power Commission of Ontario, which (in 1955) employed some 1000 professional engineers, of whom about 100 occupied senior supervisory positions. Though not a necessary qualification, many of the senior executive positions of the power industry are filled by professional engineers.

The civil engineer finds work in the fields of reinforced concrete, structures, soil mechanics, hydraulics, plant layout and construction, and so on. The mechanical engineer may deal with such matters as design, construction and operation of coal- and oil-fired steam generators, large high - pressure high - temperature steam turbines, gas turbines, pumps, fans, ventilating and exhaust systems, and metallurgical studies.

The electrical engineer is responsible for the electric design of hydro and thermal generating plants, transmission lines, substations, distribution systems, high-speed switch-gear and relays, and electronic remote control and communication systems. The chemical engineer is also in demand for the study of feed waters and their treatment, insulating oils, and other materials.

Engineers of all categories find their place in such fields as rate and statistical study and analysis, and in general administration and management.

Opportunity for the engineer in the electric power industry is said to be exceptionally good during the present and foreseen period of expansion, which has already been outlined in this article.

Training

Most of the organizations within the electric power industry accept students for summer work, some of them on a considerable scale.

The graduate engineer, on entering the industry, is generally provided with on-the-job or special training for periods that may range up to about two years. In some cases the organization will help to pay for approved post-graduate courses.

Salary Scales and Benefits

Salaries throughout the industry are generally comparable and in accordance with the schedule recommended by the Associations of professional engineers across the country.

Other benefits, such as pension and health schemes, paid vacations, and so on, are customary.

Some Recent Developments

There are many papers and articles on the electrical power industry available for reference in the engineering libraries, but we would mention here some papers that have recently been published in *The Engineering Journal* and which give an insight into some of the problems tackled in recent developments.

(1) Report on investigation into the failure of two 100-Mw. turbo generators. Sir Claude Gibb. 1955, Mar.. p. 213. Discussion, 1956, May, p. 627.

(2) Power transmission by insulated cable. L. G. Brazier. 1955, July, p. 933.

(3) The preliminary design of NPD (demonstration nuclear-electric power plant) H. A. Smith, M.E.I.C. 1955, Dec.

4) Switching of shunt capacitors and reactors. G. W. Clayton. 1956, Feb.

(5) Bersimis-Lac Cassé Hydro-electric power development. F. Rousseau, M.E.I.C. 1956, Apr., p. 373.

(6) Progress report on Canadian atomic power I. N. MacKay, M.E.I.C. 1956, May, p 617.

(7) Cross suspension system, Kemano-Kitimat transmission line. H. B. White, M.E.I.C. 1956, July, p. 901.

(9) Mechanical design features of the St Lawrence power project. O. Holden, M.E.I.C. 1956, Sep., p. 1143 (this issue).

A 9,000 kilovar 60,000-volt capacitor installation at a sub-station in the asbestos mining district of Quebec. Power transmission is of major concern to the engineer.

Business and Industrial Briefs

A DIGEST
OF INFORMATION
RECEIVED BY
THE EDITOR

Appointments and Transfers

Canadian Westinghouse Appointments—Recent appointments within Canadian Westinghouse Company Limited include: J. M. Bester, manager of product engineering, and M. K. Riddell, senior project engineer, engineering department of the defence apparatus division; W. G. Ratz, manager, standard induction motor engineering, and C. C. Sargeant, manager, large rotating machine engineering, in the engineering department of the power products division; G. S. Peabody, district service manager, Montreal district, and G. E. Matthews, district service manager, Moncton, N.B., in the service department of the district apparatus division. R. R. Guenett has joined the electronics division for special market development assignments.

Defence Production – The Right Honourable C. D. Howe has announced the appointments within the Department of Defence Production of David B. Mundy as director of the electronics branch, and of D. Lyn Thompson as acting director of the aircraft branch.

Minnesota Mining and Manufacturing – Kenneth J. Shea has been appointed vice-president and general manager of Minnesota Mining and Manufacturing of Canada Limited. Mr. Shea was previously vice-president and general sales manager with the company's international division.

K. J. Shea

English Electric Appointments – H. G. Nelson has been appointed managing director of the English Electric Company Limited, England, Sir George H. Nelson, Bart., having relinquished this position to devote all his time as executive chairman of the company.

Within the Canadian company, English Electric Company of Canada Limited, T. R. H. Jenkins has been appointed manager, circuit breaker engineering.

Canadian Car and Foundry—E. J. Cosford, president of Canadian Car and Foundry Co. Limited, announces the appointment of Allan C. MacDonald as executive vice-president. Mr. MacDonald has been managing director of Canadian Pacific Steamships Limited since 1952, and now also becomes president of the newly-formed Canadian Steel Foundries (1956) Limited (formerly Can Car's Steel Foundry Division). The new company is a separate corporate member of the A. V. Roe Canada Limited group: Mr. Cosford is chairman of the board and G. L. McMillin is vice-president and general manager.

Allan C. MacDonald

Robert M. Buchanan

Wallaces Barnes Appointment—Carlyle F. Barnes, president of the Associated Spring Corporation, and chairman of the board and acting president of its subsidiary, The Wallace Barnes Company Limited, has appointed Robert M. Buchanan general manager of the Canadian company.

Du Pont of Canada – J. H. Childs, division sales manager of the Du Pont Company of Canada Limited, announces the appointments of T. A. Day as sales technical manager and of W. B. McTavish as technical service supervisor in the films division of the company.

Trans-Canada Pipe Lines – T. H. Atkinson, former vice-president and general manager of The Royal Bank of Canada, has been elected a member of the board of directors of Trans-Canada Pipe Lines Limited, and appointed chairman of the company's finance committee.

Canadian Liquid Air–Paul J. Filiatreault has been appointed supervisor of the recently established retail marketing division of Canadian Liquid Air Company Limited. William C. Firth has been appointed manager of the company's recently established Niagara Falls branch.

Trane Appointments – Trane Company of Canada Limited announces the appointment of R. M. Fisher to their Hali-

It's a phantom bridge which nobody has ever seen, but all know it's there just the same. Traditions are its foundations, and ideals its lofty supports. Each span is a measure of hope in the future . . . each new span another link in the twin destinies of two friendly nations — the United States and Canada.

There have been many such links in the past. Here again, in the St. Lawrence Seaway Project, we've added another span — another instance of united action which will surely reap immense benefits to both peoples.

Yes, that bridge is there all right — invisible, yet never stronger . . . never wider . . . never more real than it is now — reaching over the International Seaway.

CANADA'S FIRST BANK
working with the U.S. and Canada . . .

Almost from the time of its foundation 139 years ago the Bank of Montreal has been contributing to the better understanding of the peoples of Canada and the United States by facilitating the flow of goods and information across the "border without bayonets".

It was in 1818, just one year after its establishment in Canada, that the B of M appointed Prime, Ward and Sands as its representatives in New York. Forty-one years later, the bank opened its own agency in New York, and followed later with offices in Chicago and San Francisco.

Today, with 675 branches across Canada, and with offices in New York and San Francisco and a special representative in Chicago, the Bank of Montreal is well qualified to help develop new and more fruitful relations between the two nations.

"MY BANK"
TO 2 MILLION CANADIANS
B of M

BANK OF MONTREAL

Canada's First Bank . . . WORKING WITH CANADIANS IN EVERY WALK OF LIFE SINCE 1817 fax sales engineering office and of Robert Chapman to the head office heating sales engineering department.

TV-Electronics Firm — Appointment of John M. McLean as vice-president and general manager of General Instrument —F. W. Sickles of Canada Limited is announced by General Instrument Corporation, parent company. An expansion plan now in hand will double the floor space of the company's Waterloo, Ont., plant.

Kenny Consolidated Engineering — W. F. Andrews is appointed sales manager of the separation and processing equipment department of Kenney Consolidated Engineering Industries Limited.

Dominion Rubber Company — Gordon A. Lamond becomes manager of sales of belting, v-belts, packing, cured stocks and tapes, mechanical goods division of the Dominion Rubber Company Limited.

Airco Appointment — P. F. Toner has been appointed assistant district sales manager, Air Reduction Canada Limited.

Josam Canada — J. S. Newman, vice-president and general sales manager of Josam Canada Limited announces the appointment of A. G. Stratton as Ottawa representative.

General Controls — George Crothers is appointed general manager of General Controls Co. (Canadian) Limited.


Ewart Greig


A. A. Cumming


F. Perry Wilson

Union Carbide Canada— At recent meetings of the board of directors of Union Carbide Canada Limited, the following senior appointments were made: Ewart Greig, chairman of the board; A. A. Cumming, president; F. Perry Wilson, vice-president (and continuing as president, Bakelite Company, Division of Union Carbide Canada). Also announced is the appointment of Philip O. Jeffrey as vice-president, Bakelite Company.

Naugatuck Chemicals — C. Ronald Howey is appointed development department manager of Naugatuck Chemicals, division of Dominion Rubber Company Limited.

Chiksan Field Engineer—Frank N. Land is named senior field engineer of Chiksan of Canada, Limited.

Glidden Company — Lionel Labreche becomes manager of the Glidden Company's new Quebec City branch.

Gardner-Denver Appointment — James P. Finnigan becomes general manager of Gardner-Denver Company (Canada) Limited, on the retirement of Charles E. Kaiser.

Canadian Ingersoll-Rand — T. M. Parr, manager, central region, Toronto, of the Canadian Ingersoll-Rand Company Limited, announces the appointments of John


J. K. Irwin


J. Knox

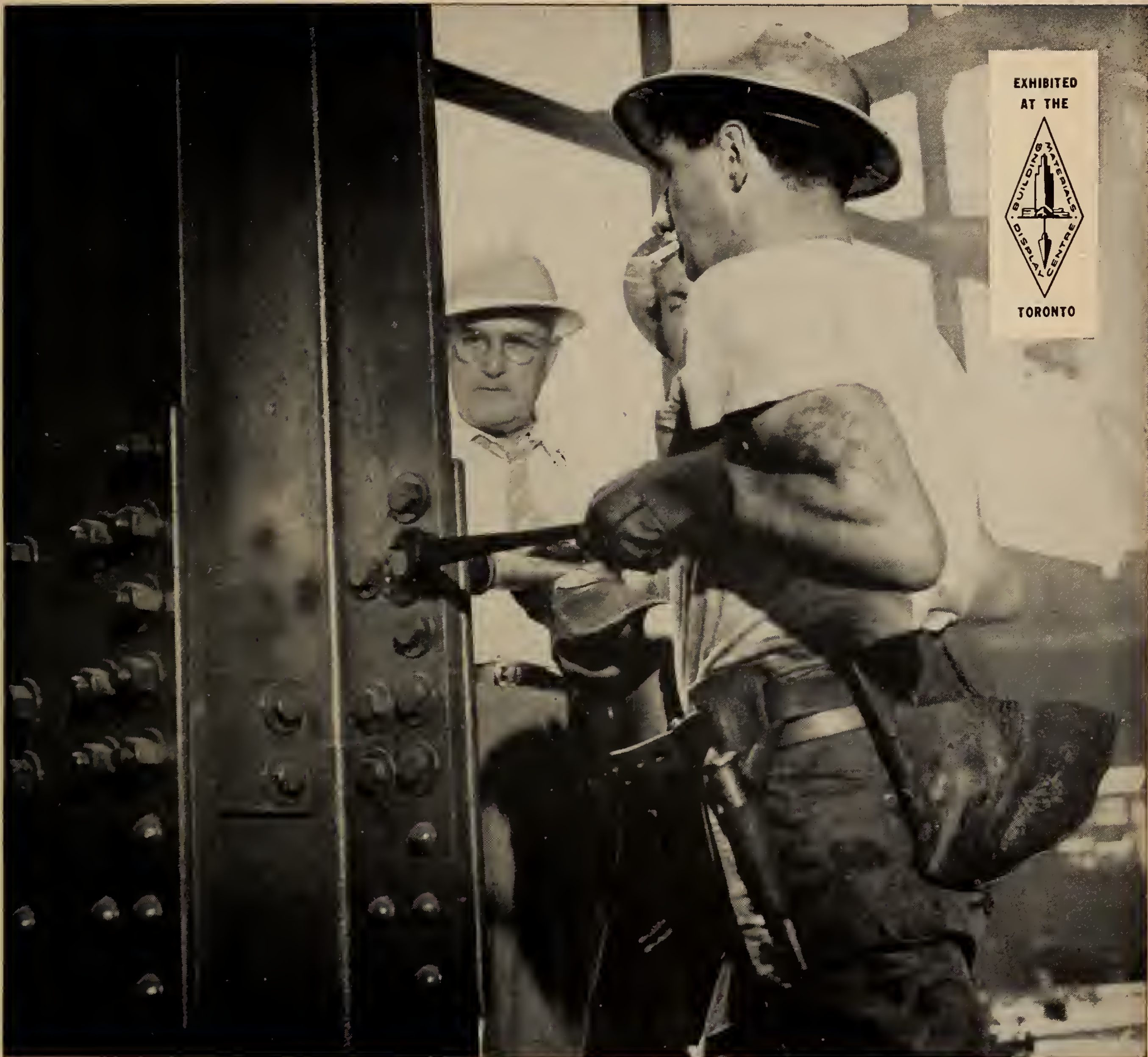
K. Irwin as manager of the company's Toronto branch, and of John Knox as manager of the Kirkland Lake branch.

Shell Oil—James S. Elliott has been appointed purchasing representative, Montreal, for the Shell Oil Company of Canada, Limited. Formerly assistant chief engineer, field, at Shell's Montreal East refinery, Mr. Elliott will now be responsible for the local purchasing for the refinery.

3M Appointment—Roy W. Keeley, former director of sales of Minnesota Mining and Manufacturing of Canada Limited has been appointed vice-president and general sales manager of 3M's International Division, St. Paul, Minnesota. He will be leaving the Canadian company to assume his new position early this fall.

J. H. Lock & Sons—W. J. Elliott has been appointed sales representative of the Steel Division of J. H. Lock & Sons, steel fabricators, Toronto. The announcement was made by W. Dalziel, manager of the Steel Division.

C-I-L Appointment—C. Scott Hannen has been appointed production manager of the explosives division of Canadian Industries Limited. He replaces Victor P. Row who has retired from the company.



Bolting beats riveting 3 to 1

The new Hiram Walker & Sons Ltd. Distillery Building in Windsor, Ontario, uses approximately 30,000 Stelco High-Strength Bolts.

Consulting Engineers:
Smith, Hinchman and Grylls, Detroit
Structural Steel:
The Canadian Bridge Co. Ltd., Walkerville, Ont.
Construction Engineer:
B. L. Bailie, Hiram Walker & Sons Ltd., Windsor, Ont.

High-Strength Bolts are quite commonly being installed at rates averaging 150 per man/day by crews with little or no previous experience . . . whereas 50 per man/day is a creditable rate of riveting, even for an experienced crew.

In addition, high-strength bolting requires less equipment, less training, less supervision, and causes less noise. It has also been proved both experimentally and in the field to produce stronger joints, with greater adaptability for future additions or alterations to the structure.

Finally, High-Strength Bolts in place on the job cost less than rivets. For a free technical booklet on this rapidly growing technique, contact any Stelco Sales Office.

56152.B

STELCO **HIGH-STRENGTH BOLTS**

THE STEEL COMPANY OF CANADA, LIMITED

Executive Offices: Hamilton — Montreal

Sales Offices: Halifax, Saint John, Montreal, Ottawa, Toronto, Hamilton, London, Windsor, Winnipeg, Edmonton, Vancouver. J. C. Pratt & Co. Limited, St. John's, Newfoundland.

New Equipment and Developments

New Desurger — A new desurger only one-sixth the size of older type devices has been announced by the Canadian Westinghouse Company. It can be used wherever a flow of liquid is maintainel. Available in sizes from one to eighteen inches.

Rechargeable Flashlight — Batteries that are recharged rather than replaced are a feature of Multi-Lite, a two-cell flashlight equipped with a 110 volt charger. The nickel cadmium cells deliver a steady bright light for a period equal to the average dry cell and are recharged by plugging the charger into the base of the light. The flashlight can be recharged 200 or more times according to Gould National Batteries of Canada Ltd., Toronto.

Turbo-Generators Ordered.—Orders for 200 Mw. turbo-generators for power stations in England and in Canada have been received by C. A. Parsons & Co. Ltd., Newcastle-upon-Tyne. The machine for Canada will be the first 200 mw. turbo-generator to be installed in that country, and the first 200 Mw. set to be exported from England. The machine has been ordered by The Hydro-Electric Power Commission of Ontario for the Richard L. Hearn Generating Station, Toronto. The new machine is of the cross compound design, the H.P. line running at 3600 r.p.m. and the L.P. line at 1800 r.p.m., each line being coupled to a 100 Mw. generator. The operating steam conditions are 1800 lb. sq. in pressure, 1000 deg. F. temperature, and with reheating of the steam to 1000 deg. F. after partial expansion.

Research and Development Laboratory. — A further addition to its research and development laboratory facilities will be made by Canadian Industries Limited. The new laboratory will be located on the site of C-I-L's "Fabrikoid" works at New Toronto, Ontario, and will service the company's plastics and "Fabrikoid" divisions.

The plastics section will replace the plastics laboratory at the C-I-L York works in Toronto, and will be equipped with modern commercial-sized extrusion, injection moulding, paper coating and wire covering machines. Its chief function will be to provide increased technical service to Canadian plastics converters, most of whom are located in the Toronto area. The new laboratory will work in conjunction with C-I-L's plastics development laboratory at Edmonton and research laboratory at McMasterville, Quebec.

New Plant.—Manning, Maxwell & Moore of Canada, Ltd., will build a new plant in Galt, Ontario, that will cost approximately $250,000, Chester H. Butterfield, vice-president, recently announced. To be built on a ten-acre site, the new plant will be a one-storey design and contain over 30,000 square feet of manufacturing and office space. Ball Brothers, Limited, Kitchener, Ontario, is the contractor and occupancy is to take place about January, 1957.

Arc-Welding Safety Slide Film.—The Air Reduction Canada Limited has available a new 20-minute sound slide film, entitled "Always On The Job", covering the basic principles of safety in electric arc-welding. A companion film to Air Reduction's prize winning oxyacetylene safety slide film, "The Guy Behind Your Back", the new film also features the light, cartoon approach to this serious topic. Record is 33-1/3 r.p.m. speed. This film is available from Air Reduction Canada Limited, 905 Hodge Street, Montreal 9, on a free-loan basis.

Most Powerful Kaplan Turbines.— S. Morgan Smith Company, of York, Pennsylvania, will build three 280-inch Smith Kaplan turbines for a U.S. Army, Corps of Engineers project. Installation will be at Ice Harbor Lock and Dam on the Snake river, 12 miles from Pasco, Washington. The turbines will operate over a head range of 78 feet to 102.5 feet. Their rating is 143,000 h.p. at 90 r.p.m. under an 89-ft. head. These will be the world's most powerful Kaplan turbines surpassing even McNary which has a rated capacity of 111,300 horsepower under 80-ft. head. Shipment of embedded parts starts December 1, 1958, with completion of the third unit, July 1, 1960.

Hydro-Electric Development.—The site of The Shawinigan Water and Power Company's newest hydro-electric development, Rapide Sans Nom or the rapid without a name, has been named Rapide Beaumont by the Quebec Geographical Commission. It is on the St. Maurice River about 10 miles above La Tuque, Que. Announcement of the naming of the rapids after Robert J. Beaumont. chairman of the Board of Directors of the Shawinigan Company, was made recently, and the new hydro-electric plant at the site, construction of which has started, will now be known as the Beaumont development.

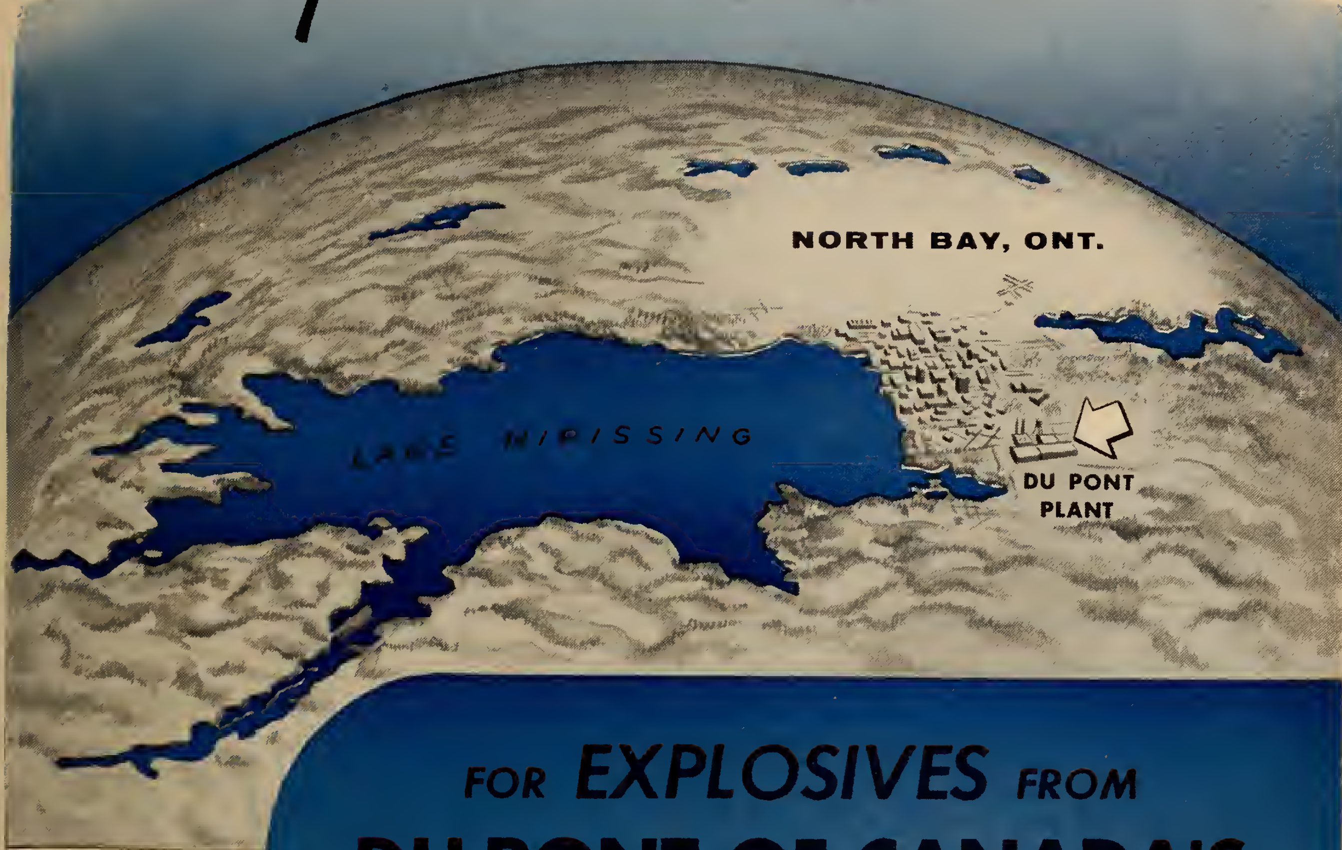
The plant will have an ultimate capacity of 246,200 kw. and first power is scheduled to be produced late in 1958. It is expected to cost about $56,000,000, including an additional transmission line to Trois-Rivieres.

New Sales Office.—Canadian Allis-Chalmers have announced the opening of a new district sales office in the Maritimes. Centre of operations will be in La Societe de L'Assomption Building. 232 St. George Street, Moncton.

Wire and Cable Plant.— Γ. A Lindsay, president of Phillips Electrical Co. Ltd., has announced that they will build a 1¼ million dollar factory in Vancouver. A plant site, approximately 14 acres of ground near Marine Drive, has been secured. A single storey structure is to be built by Dominion Construction Co. Ltd. Building and land will cost close to $650,000, and Phillips will spend over $600,000 on machinery and equipment for the new plant. The factory will occupy 57,600 sq. ft. of floor space with a further 6,950 sq. ft. for offices. Building designs call for a masonry and precast concrete structure, with a 20-ft. ceiling in the plant and a 10-ft. height for the office. The floor will be at railroad car level for easy loading into both trucks and box-cars.

A complete line of plastic covered telecommunications wires and cables as well as a full range of all types of

Next Year LOOK TO DU PONT



FOR EXPLOSIVES FROM DU PONT OF CANADA'S *Modern New Plant*

Strategically located at North Bay, Ontario, the new Du Pont of Canada Explosives Plant will be in a unique position to meet the needs of Canada's rapidly expanding mining, construction and allied industries with the latest and the best in explosive products.

Now under construction, the plant incorporates all the latest advances in design and will be one of the few on the continent employing the continuous nitration process.

Next year look to Du Pont for quality explosives and technical services, backed by the extensive experience of the Du Pont organization.

EXPLOSIVES
DU PONT
CANADA

DU PONT COMPANY OF CANADA LIMITED — MONTREAL
Explosives Department

building wires and cables, also plastic insulated, will be produced in the new plant.

New Sling Splice.—"Wrap Loc" is the name of a new mechanical splice, now available on wire rope slings made by Canada Wire and Cable Company Limited and reported to develop the full catalogue strength of the wire rope itself. Slings with this splice will handle safe loads up to 30% higher, according to the company. The sleeve covering the loop splice is annealed seamless steel, not a casting, hence it adds to the strength of the splice and stands up to the abuse inherent in sling service. While "Wrap Loc" spliced slings can be made with fibre core steel rope, the company recommends wire rope with independent wire rope centres which provides 7½% greater strength and prevents deforming of wire strands, greatly reducing strength loss.

Coloured Protected-Metal.—Red, green, buff and grey are the four new colours of "Colour Galbestos" protected-metal roofing and siding now available from Robertson-Irwin Limited of Hamilton, Ontario. Company spokesmen report this new development now makes it possible to have coloured roofs and sidewalls on industrial and commercial structures at lower cost than before, because the surface is permanent and maintenance-free. Robertson can now supply "Colour Galbestos" with either one, or both sides coloured. Profiles available include: standard corrugated sheet (9/16 in. deep by 33 ins. wide), V-beam sheet (1¾ ins. deep by 29 ins. wide) and mansard sheet (1 in. deep by 33 ins. wide). Flat sheets are also available.

Sales - Engineering Representative. — Chemical & Industrial Sales, Ltd. (CISCAN), Edmonton, Alta., has recently been appointed sales-engineering representative for Conoflow Corporation. CISCAN will handle the provinces of Alberta and Saskatchewan, according to an announcement by John C. Koch, Conoflow's vice president in charge of marketing.

Canadian Distributor.—The Greist Manufacturing Company, New Haven 15, Conn., has appointed Upton Bradeen & James Limited, Toronto, as exclusive distributor in Canada for their Micro-Height gage, according to an announcement by Merritt D. Vanderbilt, president.

Plastics Representation.—Twinpak, Ltd., of Montreal and Toronto, has been appointed Canadian representative for Gomar Manufacturing Company, Newark, N.J., U.S.A., makers of continuous roll and sheet plastics and plastic laminates.

Federal Public Works Contracts.—Public Works Minister Robert Winters has announced that contracts involving expenditures totalling $4,099,095.56 were awarded by the Department during the month of June 1956. The amount for new works is $3,417,027.85; for the repair and maintenance of existing structures $311,587.27; and for dredging $370,480.44.

New Casting Technique—What is stated to be an entirely new system of producing castings, generally to within a few thousandths of an inch, has been perfected by a British firm. This will be of particular interest to industries that use accurate dies, plungers, and moulds for mass production.

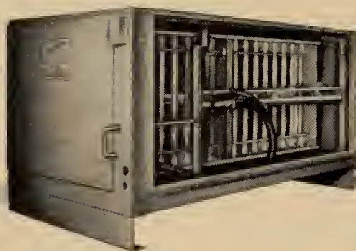
The new system, designated "Tru-process", is an investment technique using a high-grade refractory material, resistant to attacks by steels and other special alloys of high melting point. In fact, it is a logical development of the lost-wax process, but is quicker and cheaper while having the same degree of accuracy.

The castings are produced from patterns made of wood, brass, aluminium, plaster of paris and plastics. The firm Darwins Limited, of Sheffield, England, claims that "Tru-process" castings have a satin surface finish which can, if necessary, be given a mirror finish by polishing. Its special alloy steels have been fully tested in the new process, including stainless steels, special corrosion and acid-resisting steels, heating-resisting and magnet alloys.

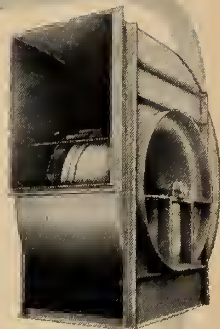
(*Continued on page 1316*)

CERTIFIED PERFORMANCE

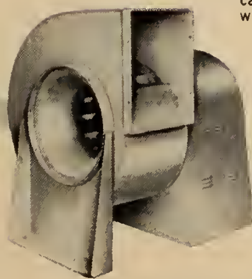
. . . in every application



PRECIPITRON . . . In sizes and capacities to suit every application where clean air is essential.



SILENTVANE (series 3000) Non-overloading horsepower characteristics with stable, quiet operation.



VENT SETS . . . Direct-connected or V-belt driven . . . compact for outdoor or indoor installation.

INDUSTRIAL HEATERS . . . The steam unit heater for industrial plants, warehouses, garages . . . floor, wall or ceiling mounting . . . adjustable nozzle outlets.

DOWNBLAST SPEEDHEATERS . . . For steam or hot water systems, wherever it is necessary to project heated air downward from considerable heights.

AIR HANDLING UNITS . . . Contain all components necessary for "package" heating, ventilating and air conditioning.

For complete application and engineering service, call your Consulting Engineer, your nearest Sturtevant Sales Engineer or Agent . . . or write B. F. Sturtevant Company of Canada Limited, Galt, Ontario.

B. F. Sturtevant Company of Canada Limited

A subsidiary of Canadian Westinghouse Company Limited

HEATING - VENTILATING - AIR CONDITIONING - DRYING - AIR CLEANING - MECHANICAL DRAFT

Sturtevant *Puts Air to Work*

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HALIFAX — E. S. Stephenson & Co. Ltd.
QUEBEC CITY — J. L. Beaudet
ST. JOHN'S (Nfld.) — Heap & Partners Limited

HEAD OFFICE — GALT, Ontario

SALES OFFICES —
Toronto, Montreal, Hamilton, London

• BRIEFS

New Westinghouse Department—The formation of a new department, to deal specifically with power rectifiers, has been announced by the Canadian Westinghouse Company. The department is responsible for coordination of development and application engineering, design and manufacturing, negotiation service, order service, scheduling, testing and installation. S. M. Roberts has been named manager of the new organization.

Change of Address—After more than 30 years in the Drummond Building in Montreal, the entire staff and facilities of Stadler, Hurter and Company are being transferred to 1501 St. Catherine Street West, where, the various deparments of the firm will be on one floor. The new address becomes valid as of Sepember 15th.

New C-I-L Plant—The purchase of a tract of land in the Seven Islands area of the erection of a plant has been announced by Canadian Industries Limited. With the cooperation of the Quebec government a total of 3,400 acres of crown land has been acquired between the town of Seven Islands and Moisie River, on which a plant for the manufacture of blasting agents will be erected to supply consumers in the Quebec-Labrador area. M. J. Watson, general manager of the explosives division of C-I-L, said present plans are to have the first unit in production early in 1957.

Wire and Cable Expansion—Canadian Wire and Cable Company Limited is completing the doubling of its Vancouver plant this year as part of a long-range, $13 million expansion and decentralization program. In addition, two other major steps are intended: expansion of its B.C. operations by increasing present capacity and adding facilities for further lines including underground cable manufacture; and transfer of high voltage and submarine power cable facilities from Leaside, Ont., to a deep-water site in eastern Canada.

C.G.E. Plant Expansion—An expansion project which will more than double the floor area of the Canadian General Electric Company Limited small appliance plant in Barrie has been announced. The company said it plans to increase floor space at the plant by 120,000 square feet, bringing total floor space to 230,000 square feet, bringing total floor space to 230,000 square feet.

B. F. Goodrich Expansion—A $400,000 addition to the B. F. Goodrich plant at Kitchener, Ont., has been announced by M. G. Morgan, vice-president, manufacturing. The new structure will house the company's expanded roll covering and tank lining departments and will add 10,000 square feet of floor space to the present departments. The 40-foot high structure will be 180 feet long and 60 feet wide. Work on the new addition is expected to be completed early in 1957.

A $1,255,000 headquarters building for B. F. Goodrich Canada Limited will also be constructed in Kitchener, it was announced recently by Ira G. Needles, president. The combination head office and warehouse will be built on a 12-acre landscaped area and will be completed late in 1957.

New Pressure Pipe Plant—Pressure Pipe Company of Canada Limited, one of the Canada Iron group of companies, is proceeding with the construction of a $2,000,000 plant in the Meropolitan Toronto area to manufacture Hyprescon pressure pipe. The 100,000 square foot plant will produce Hyprescon steel cylinder reinforced concrete pressure pipe in sizes from 12 in. internal diameter up to 54 in. internal diameter in 16 ft. lengths. Production will average 1,000 feet of pipe per day. Plans call for production to start by the spring of 1957.

Pipeline Construction—Trans-Canada Pipe Lines Limited has opened a division office in Regina, from which construction of the Trans-Canada 34-inch natural gas pipe line from Burstall, Sask., to Winnipeg, will be directed. Division proj-

Here is the Goodyear H.D. Glass Cord Steam Hose coupled to the head of the high-speed steam hammer.

DRIVING TO BEDROCK

with Glass Harness!

Shown above is a general view of the bridge building activity. Work is progressing on schedule.

Goodyear H.D. Glass Cord Steam Hose carries the steam to sink heavy steel pilings.

At Toronto, Ontario, McNamara Construction Co., Ltd. are building a new Humber Bridge to link an expressway of the near future.

On the job is Goodyear H.D. Glass Cord Steam Hose carrying steam pressure of 125 pounds at 353°F. to the operating head of the pile driver to sink heavy steel piling thru' clay to solid bedrock at a relentless clip.

Goodyear H.D. Glass Cord Steam Hose is economical in ultimate cost - - - lasts longer, can't be cooked to bursting point by heat. It is safe - - - cuts accident rates and saves valuable working time. It is the lightest, most supple, easiest handled hose ever built to carry 200 pounds of saturated steam of 388°F.

There are more than 800 different types of hose especially designed by Goodyear. Every inch of Goodyear Hose is backed by 50 years of experience in producing industrial rubber products.

GOODYEAR

INDUSTRIAL RUBBER PRODUCTS ENGINEERED FOR THE JOB

For complete information write or call your nearest Goodyear office at—Moncton, St. John, Quebec City, Montreal, Toronto, London, Windsor, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Vancouver or Head Office, New Toronto.

ect engineer in charge is K. E. Britain and division right-of-way supervisor is D. C. Calder. District offices, which will co-ordinate the construction work in the field with the Regina division office, are being established at Swift Current, Sask., and Brandon, Man.

Publications

Industrial or trade publications received recently cover many fields of interest to engineers. For further information mail the reply card from this issue to The Engineering Journal.

Platinum Metals—The place of the platinum metals in industry is described in a booklet "The Platinum Metals". Major engineering uses are given. The International Nickel Company of Canada Limited, Toronto.

Carboloy Tools—An 8-page price list for the complete line of standard tools and blanks in Carboloy grade 300 series, with prices and stock grades for grade 330 series (bulletin SBT-7C). A 16-page bulletin showing specifications and prices for Carboloy toolholders, throw-away inserts, and on-end inserts (SBT-17A). Carboloy and Metals Section, Canadian General Electric Co. Ltd., Toronto.

Cable Suspension Idler—"Limberoller" belt idler booklet LD-105 contains design and application data for users of belt conveyors for bulk materials handling. Describes and suggests applications for the idlers and various brackets. Joy Manufacturing Company (Canada) Limited, Galt, Ont.

Fastening Tool—The "Canadian" fastening system features the only powder tool made in Canada. Four-page bulletin describes equipment and applications. Taylor, Phipps and Company Ltd., Toronto.

Testing Instruments — Reference book "Measurement Equipment Catalogue" covers 80 different devices in the field of testing instruments from simple thickness gauges to the mass spectrometer leak detector. Canadian General Electric Company Limited, Toronto (and branches).

Silicones—Silicone rubber compounds for rapid one-step thick section curing known as "Union Carbide" K-1025 and K-1028, have low compression set; uses include roll-covering. X-1034R silicone rubber compound fully meets requirements of Aeronautical Materials Specification 3301B; can be moulded, extruded or calendered with conventional or special catalysts. Data sheets available for these compounds.

Eight-page illustrated booklet describes silicones for the shell moulding process; parting agents available are LE-46 silicone parting emulsion, LS-46 parting solution, and L-46 modified silicone stock, a 100% silicone oil. Linde Air Products Company, Division of Union Carbide Canada Limited, Toronto.

Moulded Asbestos—Brochure describes Canadian production, in Sarnia, of "Caposite" moulded Amosite asbestos pipe-covering and block insulation. Products and their applications are illustrated and described. Cape Asbestos (Canada) Ltd., Toronto.

Fixture Hangar—New hook-on hangar for commercial and industrial fluorescent fixtures described in bulletin H-61-199. Canadian Westinghouse Company Limited, Lighting Division, Montreal.

Industrial Wastes—Illustrated Manual "W" outlines causes and effect of uncontrolled dumping of wastes, lists common waste materials, shows how to select the right type of device to intercept waste, illustrates the devices, and gives installation details. Josam Canada Limited, Toronto.

Flexible Steel Strap—Illustrated brochure describes Stelco "Constrap", a flexible steel strap for bridging joists, in place of wood braces. The Steel Company of Canada Limited, Hamilton, Ont.

Heaters and Fans—New 36-page catalogue describes range of industrial, commercial, and domestic fans and heaters (in French and English). Canadian Armature Works Inc., Montreal.

Refractory Concrete — Two new pamphlets from The Lafarge Aluminous Cement Company Limited are: "Monolithic Underground Flues in Refractory Concrete" and "Foundry Floors in Refractory Concrete". Canadian representative, Ciment Fondu Lafarge (Canada) Limited, Montreal.

Adhesives—Twenty-four ways of improving product design are described in "Only One Material on Earth", which illustrates the applications of adhesives, coatings, and sealers in industry. Minnesota Mining and Manufacturing of Canada Limited, London, Ont.

Water Pumps—Booklet MS-56 "'There's No Place Like Home' With Lots of Water" shows a complete line of water systems, pumps, and water softeners. The F. E. Myers and Bro., Co. (Canada) Ltd., Kitchener, Ont.

Resin Structural Panel—Folder 26-A-9 describes Stypolite resin structural daylighting panel reinforced with glass fibres. Panel matches profiles of all available corrugated industrial roofing and siding. Robertson-Irwin Limited, Hamilton, Ont.

Control Instruments—Bulletin 7202 describes Tel-O-Set quick-connect miniature controlling and recording instruments. Catalog 1531 "ElektroniK Controllers" and 1521 "ElektroniK Recorders and Indicators" describes range of industrial instruments. Minneapolis-Honeywell Regulator Co. Ltd., Toronto.

Teflon Tape—Cementable Teflon tape available in thicknesses as low as 0.005 in. described in catalogue AD 158. Garlock Packing Company of Canada Limited, Toronto.

Wood Preservation — Booklet marking 20th anniversary of the company also records activities and applications. Osmose Wood Preserving Co. of Canada Ltd., Montreal.

Drill Steels— Technical improvement, performance, and economy of drill steels and drilling noted in folder "Hard Facts About Sandvik Coromant Drill Steels". Atlas Copco Canada Ltd., Montreal Airport.

Air Conditioning—New 32-page catalogue gives data on unit dimensions and performance of air conditioning units. Alpha Manufacturing Co. Limited, Winnipeg.

Cranes — Illustrated 40-page handbook covers electric overhead travelling cranes and other handling equipment. Information given on latest developments in crane manufacture, classification of cranes, runways, electrical equipment and other data. Publication M-100. Dominion Bridge Co. Ltd., Montreal.

Expansion Shells—Dempsey expansion shells for rock bolts with details of types available described in leaflet. The Steel Company of Canada Limited, Hamilton, Ont.

the E.I.C., and given by Queen's University. This began when 19 Junior E.I.C. members wanted a P.D course. They were going to have a general course this winter, but decided to wait a year.

Cornwall: There has been one year of the Queen's course, above mentioned completed by Cornwall members; and they will continue in the second year.

Kingston: Seventy members have enrolled for this fall in the Queen's course.

Saguenay: P.D. has been available for four years. This branch uses correspondence courses to fill in when they cannot get a speaker. They have had public speaking, business administration, "How to Invest". This past year they had two courses, one in public speaking, and a chemical engineering refresher course. with a total enrolment of 20.

Saskatoon: Here there seems to be an annual enrolment of about 40. This is the first year of engineering at the university, and they use as their textbook the ECPD. publication "Speaking Can be Easy for Engineers, too . . ." and it is run by Professor Mantle. He now reports that he wishes to add a general knowledge P.D. course at Saskatoon and to start a P.D. in Regina.

Toronto: Like Hamilton, Toronto has completed its fifth year. Usually Toronto has two groups and one year had three. The enrolment varies from 80 to 100. Toronto follows the original P.D. plan. The Field Office gets the speakers for the first year and does the organizing of the course. P.D. II has some vocational speakers and several evenings of Harvard "cases".

Last year in Toronto there were 20 lectures in P.D. I, such as: The Political Situation in the Middle East, by Brigadier Quillian, O.B.E.; Communism Inside Canada, Assistant Commissioner McClellan, RCMP.; Criminal Law, Magistrate Tupper Bigelow; Ladies Night, with a lecture on "You and Your Husband's Job", by Dr. Lillian Gilbreth, Hon. M.E.I.C.; Reading for Pleasure and Profit, Dr. Sanderson, chief librarian, Metropolitan Toronto; Appraisal of Real Estate, Murray Bosley; Human Psychology, Dr. D. C. Williams. Other subjects were: investment, life insurance, good manners, public speaking, and a visit to the art gallery.

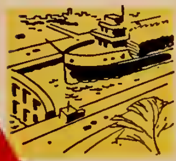
Regional Conference

Because Niagara Falls wishes to re-establish a P.D. course, it was decided to hold the 4th Regional Conference there on May 12, 1956. Twenty-one attended and it was an excellent meeting. This is an annual meeting of committee chairmen and officers at the end of the course year, to discuss problems and future programs.

Everyone connected with P.D. anywhere is invited but because of distance, it is usually a meeting of the Southern Ontario members. (Minutes are sent to all branch secretaries.) The meeting takes most of one day. This conference becomes more valuable and stimulating every year, and it is planned to hold the 1957 conference in London, Ont.

Looking Ahead

Any branches interested in operating a P.D. Course in 1956-57 may obtain further information and assistance from the Field Secretary's office, 236 Avenue Road, Toronto, Ontario.

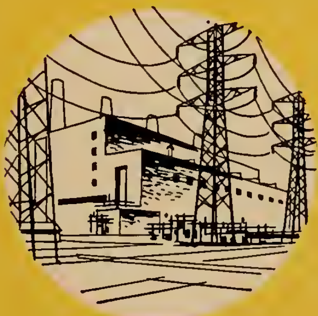


If you needed a starting point, you might say it all began at Craigellachie, B.C. on November 7th, 1885. In this tiny village the hammer blows that drove home the last spike of the Canadian Pacific Railway resounded around the world to announce the "coming of age" for Canadian engineers. Since that time, there have been many notable "Canadian" engineering achievements. The ingenuity that resulted in the telephone and the incandescent light has been a rich inheritance upon which to build. Shipsaw compares on all counts with any power project in the world. The Orenda jet engine and the CF 100 that it powers have blazed a trail across the pages of world aviation history. And now we talk of whole new towns to be planned on the new banks of a St. Lawrence that will be most unfamiliar to the ghost of Champlain —a St. Lawrence that will open the Canadian interior to the traders of the world and supply Canadian industry with the power to produce the needs of the world.

Canadian Engineers have been "Major League" for 69 years

CANADA WIRE ENGINEERS HAVE BEEN SETTING THE PACE

The complex projects of Canadian engineering development become simpler with the assistance of specialists at Canada Wire who have solved countless problems in high voltage power transmission and the development of every type of electrical conductor.



When a cable was needed to transmit the output of two 106,000 h.p. generators from the transformers in the heart of a mountain 2,000 feet through a cable tunnel to the high-voltage switch-yard at Alcan's Kemano River basin, Canada Wire engineers produced one. This cable is single conductor 301 kv. All-Aluminum oil-filled cable; hollow core conductor, low-viscosity, oil-impregnated paper, seamless Aluminum Sheath. This is the first 301 kv. cable system designed in the British Commonwealth.

When the new Richard L. Hearn Steam Generating Station, first of its type in Canada, was completed at Toronto, Canada Wire engineers produced two high voltage underground cable circuits 120 and 161 kv. to deliver 60-cycle power underground, to the Leaside-Thorncliffe Transformer Station. The hollow conductors used facilitated both the charging of the system and the maintaining of the insulation under nitrogen gas pressure.

When the St. Lawrence stood as a barrier to power transmission (a distance of 32 miles underwater) from Bersimis on the north shore of the river to the great new copper mining area in the Gaspé, Canada Wire engineers became pioneers both in design of the submarine cable, its manufacture, the unique "flaking down" and wharf handling procedures and the underwater installation. This is the largest high-voltage submarine cable system in the world.

The modern jet aircraft requires over 12 miles of wire. High tension cables for engine and ignition systems, low tension cables, conductors carrying current to fire rocket charges, and steel wire control cables all provide the muscles and the nerves for Canada's aircraft. Canada Wire is engineering and producing these essentials which are fulfilling the "rigid performance specifications" necessary to meet the demand for greater speed, greater safety and manoeuvrability.

Canada Wire

REG'D. TRADE MARK

CANADA WIRE AND CABLE COMPANY LIMITED

Factories: Toronto, Montreal, Smiths Falls, Vancouver
Sales Offices From Coast to Coast

CANADA WIRE ENGINEERS HAVE THE "KNOW HOW" FOR CANADIAN CONDITIONS

Design of the Frobisher Yukon Project

(continued from page 1183)

highway would be built connecting the area with Juneau, Alaska, approximately 100 miles south on the Lynn Canal. The hearings were adjourned, to be continued in Victoria later.

Dr. Charles Camsell, M.E.I.C., representing the Frobisher - Ventures group in November 1955 at hearings before the Gordon Commission on Canada's Economic Future, stated negotiations were proceeding with a number of strong associates. He said the 5 million horsepower from Yukon - Taku was more than was needed to exploit the mineral resources of the Yukon and Northern British Columbia.

Meantime a dispute over the flow of international rivers crossing the boundary between British Columbia and the States of Washington and Idaho, and between Alaska and the Yukon, had arisen, which even the International Joint Commission was unable to resolve. A permit would be required from the United States before Frobisher Ltd. could divert part of the flow of the Yukon into Canadian territory. Fear was that the United States would claim downstream benefits on the Yukon. Thus the Nass project was studied as an alternative to the first stage of Yukon-Taku. It would involve less than 10 per cent of the total horsepower obtainable from the Yukon-Atlin-Taku development.

The south flowing Nass with its drainage area in British Columbia is entirely within that province, thus posing no international problems. It has the advantage of having a Canadian seaport within 25 miles distance at Alice Arm, B.C., for many years the site of a large mining operation. The townsite is east of Ketchikan, Alaska and almost due north of Prince Rupert, B.C.

The proposed power site on the Nass is a mile from Grease harbour. Two dams some 60 and 100 miles upstream will create storage reservoirs at Meziaden and Bowser Lakes. The average flow of the river as recorded over the past 18 years is 28,400 cubic feet per second. A head of 215 feet will be developed. Access to the power site will be over a new road from Terrace, B.C. which is projected to within 6 miles of the site.

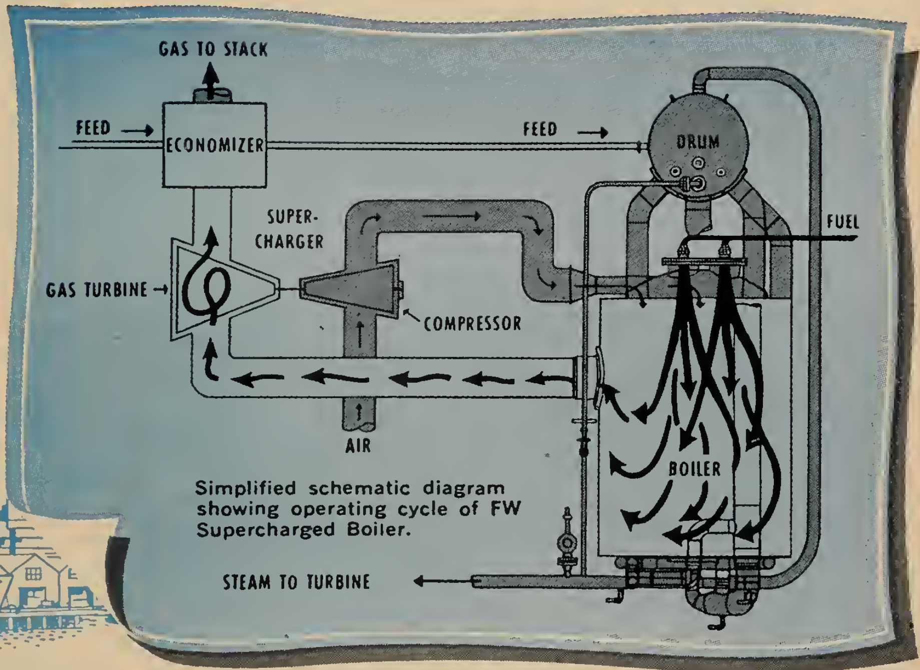
Nearly half a million dollars was to be spent during the summer of 1956 by Quebec Metallurgical Industries Ltd., an affiliated company, to bring the Nass power project as near as possible to the design stage, and for definitive surveys including diamond drilling on the Yukon-Taku project. Concentrating equipment installations will be expanded on three creeks of the B.C. Columbium Uranium project, where at least 65 million cubic yards of pay-gravel have been outlined.

Division of Power

During the early months of 1956 both Canadian and United States governments were looking for some face-saving formula for an exchange of Yukon River power for territory at tidewater in Alaska. In May, delegate E. L. Bartlett from Alaska proposed to U.S. Secretary of State

New SUPERCHARGED Boiler

- *Up to 75% less weight*
- *Improved cycle economy*
- *Up to 25% lower cost*
- *Shorter startup time*
- *Quicker load response*



Simplified schematic diagram showing operating cycle of FW Supercharged Boiler.

Foster Wheeler has developed a new supercharged boiler of far reaching significance to the marine industry.

In the supercharged cycle, diagrammed above, high pressure combustion gases leaving the boiler are used to drive a gas turbine which, in turn, compresses combustion air for the boiler. Spent gases from the turbine pass through an economizer and thence to the stack.

The following advantages are inherent in this supercharged boiler cycle.

1. Due to higher heat absorption rates and a reduction in refractory of up to 95%, a supercharged boiler may weigh from ½ to ¼ as much as a conventional boiler of equivalent capacity.

2. Since combustion air is supplied by the supercharger, cycle economy is increased by the saving in power that would otherwise be required for operating the fans of a conventional boiler.

3. Smaller size and weight permits savings of up to 25% or more in first cost.

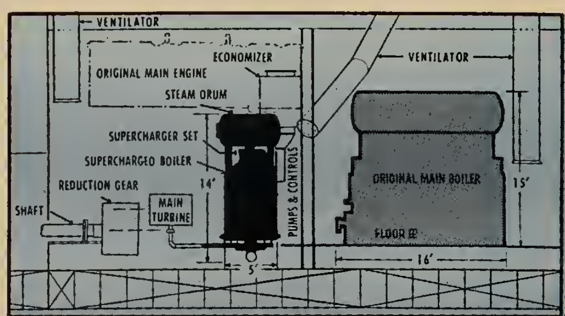
4. Small heat storage capacity results in extremely fast startup.

5. The supercharged boiler responds much more quickly to load changes.

The boiler unit is of exceptionally compact and symmetrical design, with boiler drum mounted above the furnace and connected to it by external risers and downcomers. The furnace is fully enclosed with waterwall surface and a metal baffle separates the furnace tubes from the convection section. Superheater pancake coils are located in the base of the firing chamber.

Foster Wheeler has built three supercharged marine boilers and a fourth is now under construction. All are for diesel fuel firing.

For complete information, write to *Foster Wheeler Limited, St. Catharines, Ontario.*



Supercharged boiler (black) for driving a 6,000 SHP turbine in a Liberty Ship. Conventional boiler (gray) has been left in to provide a comparison of size and space relationship. Boiler and supercharger weigh 35,000 lb and occupy 60 sq. ft. of floor space. This compares with two conventional boilers weighing 144,000 lb each and occupying 156 sq. ft. of floor space.

FOSTER WHEELER

HALIFAX - MONTREAL - TORONTO - **ST. CATHARINES** - WINNIPEG - EDMONTON - VANCOUVER

FW-56-12

Dulles that Canada be given a corridor through south eastern Alaska. The question had been raised in Canada's House of Commons some weeks before by Minister of External Affairs Pearson, but Parliament had displayed little interest.

Mr. Bartlett suggested both countries should divide the power from the Yukon-Taku development, since an all-Canadian development does not appear economically or politically possible. In exchange for power, he believes, the United States should allow Canada a corridor along the old Dalton Trail leading in Alaska, from where the Alaska Highway crosses into Canada from Haines. This corridor would lead east and southeast to the ice-free port of Pyramid harbour a few miles south of Haines and now a ghost town. No transfer of land would be involved but merely the granting of a long term lease to Canada for the corridor.

More Production for Frobisher

A. J. Anderson, who succeeded Thayer Lindsley as president of Frobisher Ltd. last year, told the annual meeting of the company in Toronto early in June that Frobisher's latent assets are being converted into producing operations as quickly as possible with a view to providing future revenue. The inception of milling operations by three subsidiaries during the first half of 1956 constituted the first reflection of this policy, he said.

Industry and Education

(continued from page 1191)

standards to about the level described and then to try to accept any applicant who can meet these standards. They admit frankly that they do not now know how they are going to do this, but they have faith that a way will be found. If they could know that their incomes would be sufficient to carry the burden of additional students as their registrations increased, the problem would be well on the way to solution.

How and where to get additional teaching staff would pose a question which would have to be answered. Here we think that other faculties and departments might adopt more extensively the practice common in medical and dental schools. These, though they may have four or five hundred students, get along with absurdly small staffs of full-time teachers and a large group of part-time instructors, drawn from the ranks of practising physicians, surgeons and dentists, each giving only a few hours a week to his own particular specialty. So highly are these part-time appointments regarded by their holders that they carry the smallest of salaries and there is much competition for them.

Most of our universities and colleges are located in cities where all kinds of professional talent is available, if industry would only release that part of it which it controls. Why should not many subjects in engineering, pure science, commerce and journalism, for example, be taught be those who are daily using the principles they would expound?

Granted that a knowledge of one's subject does not necessarily make a good teacher, it is the first requisite. Our slight contact with part-time teachers makes us feel that a relatively short period of teaching experience, plus the help they can get from their full-time colleagues, will make quite acceptable instructors of them in most cases.

To summarize, we would like to see our industrial concerns get together and intensify their already great contributions to education. We would like to see this done in a systematic way, instead of in bits and pieces as at present. If any such action does come about, engineers will have a good deal to do with it, because, as executives and administrators, they occupy so many key positions. If they decide something should be one, it is fair to assume that it will be done.

R. DEL. FRENCH

Technical Papers in the October Issue

There will be five technical papers in the October issue of The Engineering Journal; the titles of these papers and their authors are given below.

Growth and Development of Large Electric Power Systems

W. R. Way, M.E.I.C., *vice-president and chief engineer, The Shawinigan Water and Power Company.*

Application of Welded Design to Hydraulic Turbine and Valve Manufacture

J. G. Warnock, *head, Hydraulic Department, English Electric Company Limited.*

Lateral Rigidity of Steel Building Frames

J. L. de Stein, M.E.I.C., **J. O. McCutcheon,** M.E.I.C., *Dept. of Civil Engineering, McGill University.*

Analysis of a Magnetic Control Circuit

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Growth and Development of Large Electric Power Systems

W. R. Way, M.E.I.C., *Vice-President and Chief Engineer*
The Shawinigan Water and Power Company, Montreal

Read at the 70th Annual General and Professional Meeting, The Engineering Institute of Canada, Montreal, May, 1956

CHARLES F. BRUSH of Cleveland is given credit for establishing the first commercially successful enterprise supplying a series arc lighting system. In 1879 Edison produced the incandescent lamp which was intended for parallel operation. Such lamps could be operated in series but under such conditions dangerously high voltages would have been required in the home.

By 1882-5 commercial plants using direct current and the Edison incandescent lamp operating with the parallel connection became a reality. It was soon realized that, although the direct current system was ideal for distributing electric current within a limited area, alternating current had many advantages.

The transformer was invented in Europe in 1883 by Guillard and Gibbs, and a short time later George Westinghouse and Charles Stanley developed it into a practical device which could be used advantageously in industry. In 1886 the first commercial transmission of single-phase alternating current took place at Great Barrington, Mass. In 1888 Nicola Tesla invented the polyphase induction motor, and in 1893 the polyphase generator and transformer were successfully demonstrated at the Chicago World's Fair. This permitted a real start to be made towards the use of electricity for power customers instead of for lighting purposes only as had been the case previously.

The Original Development at Niagara in the United States

Possibly one of the greatest advances in hydro-electric generation and transmission occurred in the United States when investigation of the Niagara Falls development was initiated by a group of New York financiers. Reference to this enterprise is included here since it had a bearing on subsequent developments across the Niagara River in Ontario.

The paper reviews the progress that has been made during the past fifty years in the growth and development of large electric power systems in Canada. Reference is made to significant pioneer achievements prior to 1900, a number of technical advances and current practices are outlined, and some possible trends indicated. Although the paper deals with progress in Canada generally, the descriptive matter is limited to the larger power systems in the Provinces of Ontario and Quebec. The intention is to present a story that may interest engineers of all categories rather than electric utility engineers specifically.

The project was of such magnitude at the time that the question arose immediately as to how the power would be generated, transmitted and distributed. To study and advise on the many problems, the International Niagara Commission was appointed with Lord Kelvin as its chairman. Many prominent engineers and scientists were called before the Commission to present their views.

In 1893 the Commission recommended the electrical method of development using alternating current, two-phase 25-cycle power. A transmission voltage of 11,000 volts was selected on account of the large amount of power that had to be delivered to Buffalo, twenty miles away. A two-phase system was chosen using the rotated-field type of generator construction. A frequency of 25 cycles was selected as a compromise between 16 2/3 and 30 cycles, both of which were suggested. The speed of the waterwheel had already been set at 250 r.p.m. and this, to a great extent, also fixed the frequency at 25 cycles using a twelve-pole unit.

As early as 1890, however, Westinghouse engineers had advocated 30 cycles as standard for general electricity supply purposes and that organization strongly recommended the use of 30 cycles in this case. Nevertheless, a frequency of 25 cycles was adopted. This original Niagara Development of 1894-5 must be considered important in that the 5000 h.p. units were large at the time and that it was the first polyphase hydro-electric development in the world.

Situation in Canada in the 1890's

In the late 1890's, generation and distribution of electricity in Canada was confined to a few small isolated hydro plants, often provided with a standby steam station. During the course of the next ten years, many outstanding engineers and financiers began to visualize the tremendous future possibilities of Canada's hydro-electric resources.

However, manufacturing facilities were just being developed in the United States and Canada and it was difficult to obtain the required hydraulic and electrical equipment. A considerable proportion of the generators, hydraulic turbines, and other equipment had to be secured from England, Switzerland, and other European countries. There was little or no possibility of interconnection with neighbouring systems, rural distribution was non-existent, street lighting was rare and when provided was inadequate. In many cases apparatus had to be improved or developed by the engineers directly involved, often in collaboration with the manufacturers. This applied to such items as disconnecting switches, insulators, and bushings. Such was the general state of affairs in this era. (Fig. 1.)

The potential power resources of rivers such as the Niagara, Saguenay, St. Lawrence, Gatineau, and St. Maurice were recognized, and since the present large power systems of eastern Canada have been developed around these major power sources, the background of some of the earlier and larger hydro-electric stations will be briefly outlined.

Early Canadian Niagara Developments

The first large hydro-electric plant at Niagara Falls, Ontario, constructed by the Canadian Niagara Power Company, came into operation in 1904-5, consisting initially of three 10,000 h.p. vertical units of Swiss manufacture operating at 135 ft. head. Eventually, eight additional units were installed to bring the total capacity up to 121,000 h.p.

Simultaneously, the Ontario Power Company development was carried out and on completion consisted of fifteen units of the horizontal type operating at 180 ft. head and having an installed capacity of 195,700 h.p.

The third project, constructed by the Electrical Development Company, later the Toronto Power Company, commenced delivery of power in 1906. The eleventh and final unit of this project was installed in 1914, operating at 137 ft. head, bringing its total installed capacity up to 160,500 h.p.

The Ontario Power Company and the Toronto Power Company were acquired by the Hydro-Electric Power Commission of Ontario in 1917 and 1922, respectively, forming the initial basic generation owned and operated by the Commission.

Initial Developments on the St. Maurice River by the S.W. & P. Co.

No. 1 Development — This was a 30-cycle station located at Shawinigan Falls. The plant was placed in service in 1902 and consisted of horizontal units of various sizes operating under a head of 145 ft. with an ultimate installed capacity of 40,000 kw. The generators were two-phase 2,200 volts. The transformers were Scott connected to increase the voltage from 2,200 v. two-phase to 50,000 v. three-phase to transmit power to Montreal. This development is mentioned here since in 1900 it was considered a very ambitious undertaking. Eventually when all the 30-cycle power was replaced by 60-cycle power this station was dismantled to make way for a more efficient and larger 60-cycle plant.

No. 2 Development — In 1911 the Shawinigan Company began operation of its No. 2 Development at Shawinigan Falls. This was a 60-cycle station in which were installed eventually five 18,500 h.p. horizontal hydro turbines connected to 15,000 kva., 6600 volt, three-phase generators. Transmission voltage of 110,000 volts was made possible through the use of 15,000 kva., three-phase transformers which, at the time, were said to be the largest in the world. (Fig. 2).

This station was noteworthy at the time due to the care taken by the designers to obtain complete flexibility and freedom from some of the ordinary sources of failure previously encountered elsewhere. Double busses, many bus disconnecting switches, and duplicate circuit breakers on both high and low voltage busses were provided. This is understandable in view of the unreliability of electrical equipment at that time, the lack of adequate relay protection, and the desire to ensure maximum service continuity. Oil circuit breakers were used, but arc control devices had not yet been developed and serious oil fires occurred occasionally due to circuit breaker inadequacy and resultant failure.

These two plants were the original installations from which the present extensive system of the Shawinigan Water and Power Company has grown.

Early Development on the St. Lawrence

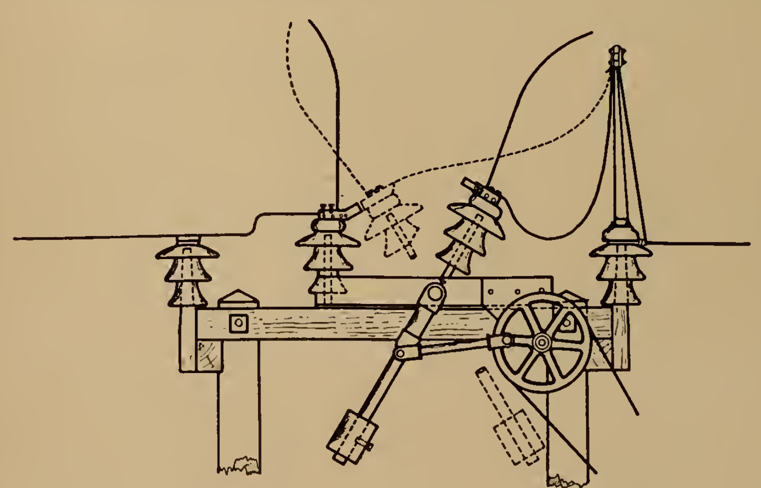
Another of the more important generating station undertakings was the development of the Cedar Rapids plant on the St. Lawrence River near Montreal by the Cedar Rapids Manufacturing & Power Co. The available head was 30 feet and the total output contemplated was 160,000 h.p. Work was started in 1912, and by 1915 the plant was ready to deliver power. The final installation comprised eighteen 10,800 h.p., 55.6 r.p.m. 63 cycles vertical units with a total capacity of about 200,000 h.p. (Fig. 3.)

This reference to the Cedars Station is included on account of the large physical size of the units with their 32 ft. diameter rotors and since it was the first large plant supplying the Montreal area then served by the Montreal Light, Heat and Power Company.

Initial Transmission

As the polyphase motor and transformer became readily available, load demands increased rapidly and this called for longer and higher voltage transmission facilities.

Fig. 1. Early horn gap disconnecting switch originated and utilized by The Shawinigan Water and Power Company.



50000 VOLT FULCRUM SWITCH
SHAWINIGAN FALLS
1908

For example, in 1897 the St. Narcisse-Three Rivers line in Quebec operated at 15,000 volts, and by 1898 the DeCew-Hamilton line was in service at 22,500 volts. In 1902, 60,000-volt lines were in operation between Niagara and Toronto and also between Shawinigan Falls and Montreal. A voltage of 110,000 was used for transmission by Ontario-Hydro and by the Shawinigan Water & Power Company in 1910 and 1911 respectively.

Concerning these earlier transmission lines, the properties of distributed capacitance, resistance, and inductance were recognized but, since electrical calculations were long and tedious, many short-cuts, as well as cut-and-try methods, had to be used to solve the problems that arose. Considering these factors, the early transmission systems operated with reasonable success but their performance fell quite short of present day standards.

Initially one of the great deterrents in extending the use of high voltage transmission was the type of insulators available. These were of pin-type design and limited the operating voltage to about 60,000 volts. The early insulators were made of dry process porcelain which was porous and in a short time became semi-conducting with eventual failure. Wet process porcelain was introduced about 1903-5 and this resulted in a greatly improved product but did not permit raising the maximum operating voltage materially.

It was not until 1907-8, when the cap and pin type suspension insulator was developed in the United States, that utilization of higher operating voltages was made possible. Subsequent improvements in design and manufacture together with rigid quality control has resulted in the modern high-strength suspension type of insulator which, since about 1920, has given excellent service.

Subsequent Developments in Generation, Transmission, Interconnection and Integration

System integration usually concerns the tying together of generating stations or major substations under control of the same organization by means of a grid or transmission network so as to make most efficient use of all facilities, to improve system service continuity, and to make more power available over a wider area than would otherwise exist.

System interconnection on the other hand usually refers to the tying together of electric power utilities, each of which is under the control of a separate organization, with the objective of obtaining better overall economy of operation as well as other important advantages. Full or partial co-ordination may be agreed upon, and the flow of power may be in one direction only or reversible.

Among the benefits to be obtained from interconnection and integration are the following:

(a) More efficient use of all available resources by taking advantage of the diversity in load, hydraulic conditions and generating capability.

(b) Better operating flexibility and improved equipment maintenance schedules.

(c) Increased system service security.

(d) Less combined spare generation needed and more complete utilization of surplus hydro energy.

(e) Possible deferment of individual system additions to generating facilities.

System Development—Province of Ontario

The Hydro-Electric Power Commission of Ontario was formed in 1906 with the intention initially of distributing power purchased from private power sources.

In 1914, visualizing the tremendous potentialities and the prominent role electric power would play in the future economy of the province, the Commission first considered a power development at Niagara Falls that would use the maximum economical head between Lake Erie and Lake Ontario. As a result of these studies construction of the Queenston-Chippewa development, now known as Sir Adam Beck-Niagara Generating Station No. 1, was started in 1917. The first 25-cycle vertical units operating at 292 ft. head were put into operation in 1922 and the tenth unit in 1930, bringing the total capacity of this plant up to 525,000 h.p. At the time this plant was built it was one of the largest hydro-electric developments in existence.

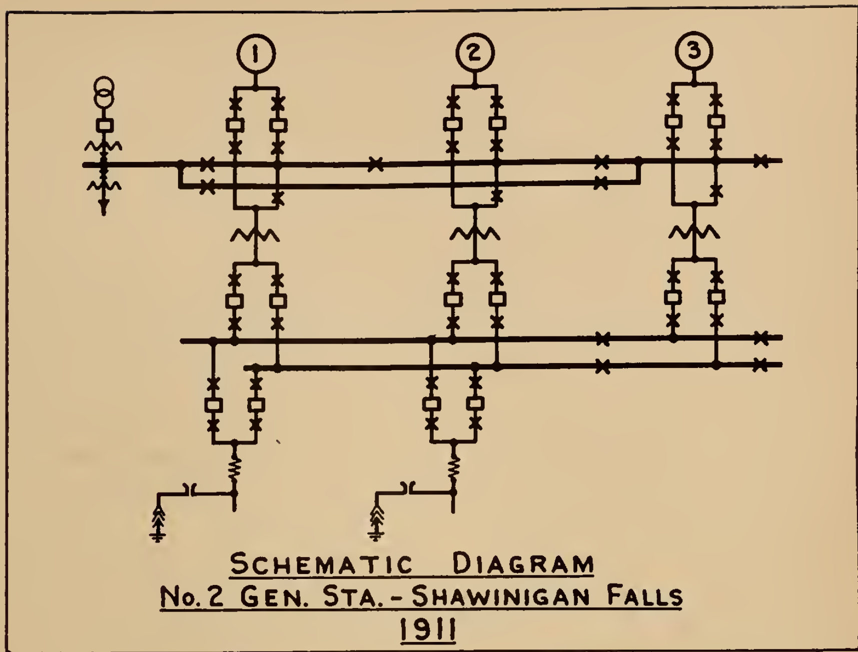


Fig. 2. Schematic diagram of an early generating station illustrating the use of duplicate switching apparatus.

With Queenston and other generating stations at Niagara as a base, the Commission embarked on a series of projects involving the purchase of large blocks of power from the Province of Quebec and the construction of additional generating stations of its own, all of which required an extensive high voltage transmission network.

For instance, the Gatineau Power Company carried out three hydro developments on the Gatineau River (Farmers, Chelsea, and Paugan) with an initial combined capacity of 528,000 h.p., of which the Commission purchased 340,000 h.p. To take delivery of this purchased power in 1928 the first 230,000 volt transmission line in Canada was constructed between the Paugan generating station and Leaside terminal station near Toronto. Subsequent installation of additional units has increased Gatineau Power Company's total generating capacity to about 735,000 h.p.

In addition, the first section of the Beauharnois development on the St. Lawrence River near Montreal came into operation in 1932 and commenced supplying part of its output at 25 cycles under contract to the Commission over another 230 kv. circuit to Leaside.

Since that time the system under control of the Ontario-Hydro has continued to expand and the Commission has added extensively to its generation and transmission facilities. The total load demand in 1955 was over 4 million kw. supplied through an integrated transmission network covering practically all settled parts of the province.

Among the larger generating stations constructed by the Commission in recent years were:

(a) The Chenaux, des Joachims, and Otto Holden hydro plants on the Ottawa River (699,000 kw.)

(b) The Richard L. Hearn steam station at Toronto (400,000 kw.)

(c) The J. Clark Keith steam station at Windsor (264,000 kw.).

(d) The Sir Adam Beck-Niagara Generating Station No. 2 on the Niagara River and its associated pumping generating station when completed in 1958 will have an installed capacity of 1,370,000 kw.

In addition, Ontario Hydro has interconnected agreements with the Ottawa Valley Power Company, MacLaren Quebec Power Company, Detroit Edison Company, and the Niagara Mohawk System, and is actively engaged in the construction of the Canadian portion of the international St. Lawrence power project near Cornwall. The Canadian plant will have a total installed capacity of 820,000 kw. in sixteen units, the first of which is expected to be in service in the fall of 1958. Thus the present power system controlled by Ontario Hydro ranks as one of the outstanding examples of modern and progressive interconnected and integrated systems in the world.

System Development— Province of Quebec

In the 1920's the Shawinigan Water & Power Company system developed rapidly with important additions to its hydro generating capacity, principally on the St. Maurice River. Although power had been supplied to Montreal for several years previously, a more adequate interconnection was established in 1923 with the former Montreal Light, Heat and Power Cons. system (now Hydro-Quebec) and with the Southern Canada Power Company's system in southern Quebec. (Fig. 4.)

The Saguenay Power Company's Isle Maligne plant on the Saguenay River was brought into operation in 1925 with eight 45,000 h.p. units, later increased to twelve and increasing the total installation to 540,000 h.p. In 1931 Shipshaw No. 1 was added with an installation of 300,000 h.p. The Saguenay Power Company contracted to supply 100,000 h.p. at Isle Maligne to the Shawinigan Company for transmission to Quebec City through a double circuit 187 kv. line 135 miles long. These circuits have since been reconstructed for 230 kv. operation and have been interconnected with the Saguenay Power Company's 154 kv. system through three 150 000 kva. three-phase auto transformers.

During the following years, many important additions to generating installations have been made, the majority of which feeds into an extensive 230 kv. and 115 kv. transmission network. Included in these additions on the Saguenay was the 1,200,000 h.p. Shipshaw No. 2 plant and on the Peribonka River were the Chute à la Savane and Chute du Diable plants with a combined installation of 550,000 h.p. On the St. Maurice River the Rapide Blanc, Trenche, La Tuque, and Shawinigan No. 3 plants were completed by the S.W. & P. Co. increasing that Company's present total generation, including Quebec Power Co., to 1,320,000 kw.

Thus at the present time this interconnected network in the Province of Quebec has a combined installed capacity of the order of 2,700,000 kw. It is noteworthy in that it is one of the few interconnected systems anywhere that relies on power and energy exclusively from hydroelectric sources.

Further Expansion in Quebec

There are several important developments projected or under construction in the Province which probably should be mentioned. These include the proposed addition of the 330,000 h.p. Rapide Sans Nom generating station on the Upper St. Maurice River (now Rapide Beaumont) by The Shawinigan Water & Power Company, as well as certain major projects now being carried out or under study by Hydro-Quebec.

The first section of Beauharnois was completed in 1948 with a total installation of 724,000 h.p. using 14 units. The second section was completed in 1953, so that the combined development now has a total installed capacity of 1,425,000 h.p. with twenty-six units. Six of these units operate at 25 cycles to supply power to Ontario-Hydro. Beauharnois is capable of further expansion by the addition of a third section with an installation of at least twelve more units or 640,000 h.p. so that the ultimate development at this plant will be of the order of 2,065,000 h.p.

Two important hydro developments are under construction by Hydro-Quebec on the Bersimis River which discharges into the St. Lawrence some 400 miles downstream from Montreal. These are known as the Bersimis No. 1 and Bersimis No. 2 projects.

Bersimis No. 1 plant will consist of eight 150,000-175,000 h.p. Francis type turbines operating at 785-870 foot head, driving a similar number of 120,000 kva. generators 277 r.p.m., 13,800 volts, 0.95 power factor, and providing an overall installation of 1,200,000 h.p. Delivery of power is expected by the fall of 1956 and all units are expected to be in operation by 1958 or early 1959. The generating units will be installed in an underground plant, the only one of its kind in the Province of Quebec, and similar in some respects to the Aluminum Company's plant at Kemano, B.C. Immediately outside the generating station will be located the 300 kv. switching station using air blast circuit breakers and the 24 single-phase 40,000 kva. transformers comprising 8 banks of 120,000 kva. each.

Transformers will supply the south shore, stepping down to 69 kv. to cross the St. Lawrence River using submarine cables some 31 miles long, and then stepping up again to 161 kv. to serve the Gaspe region about 140 miles away.

Two double circuit 300 kv. steel tower lines 235 miles long, using 21 suspension insulators per phase to support the conductors, are being constructed on the north shore of the St. Lawrence River to the Charlesbourg terminal station near the City of Quebec from which point a double circuit 300 kv. line 150 miles long will continue on to the new Bout de l'Isle terminal station on the island of Montreal.

The Charlesbourg terminal station will be equipped with four three-phase auto transformers of 150,000 kva. rating each, stepping the voltage down to 230 kv. to interconnect with the Shawinigan Company's extensive system at that point. These transformers will be equipped with load ratio control to regulate voltage and with phase angle control to adjust the load transferred through the transformers. Air blast breakers will be used throughout with ratings of 10,000,000 kva. at 300 kv. and of 5,000,000 kva. on the 230 kv. side.

At the Bout de l'Isle terminal station there will be installed six 100,000 kva. three-phase transformers with the required switching and auxiliary apparatus, thus adequately tying the Bersimis development to the present Beauharnois-Montreal-Shawinigan system at that point.

The Bersimis No. 2 development, on which construction has just started, will probably consist of five 165,000 h.p. generating units operating at 370 ft. head at a site some 25 miles below Bersimis No. 1 plant and is scheduled to be completed in 1960.

With the completion of these two Bersimis hydro developments, the total installed generating capacity of Hydro-Quebec will be over 2,800,000 kw.

To cope with the needs for still more power, and under study by Hydro-Quebec, are the possible development of Lachine Rapids on the St. Lawrence and Carillon on the Ottawa River near Montreal, completion of the third and final section of Beauharnois, and the harnessing of the Manicouagan River on the north shore of the lower St. Lawrence, with a combined potential installation of over 4,500,000 kw.

Summing up, therefore, by (say) 1965, when the plants now under construction and those contemplated will probably have been completed, the gross capability of the interconnected network in the Province of Quebec will be of the order of 8,000,000 kw. to 9,000,000 kw. with transmission extending to Gaspe in the east, to the Chibougamau area north-west of Lake St. John, southward to the U.S. border, and westward to the Ontario border. It is conceivable that, by that time, interconnection will have been established between the systems operating in the Province of Ontario and those in the Province of Quebec forming an interprovincial network or grid with a capability of possibly 16,000,000 kw. to 17,000,000 kw.

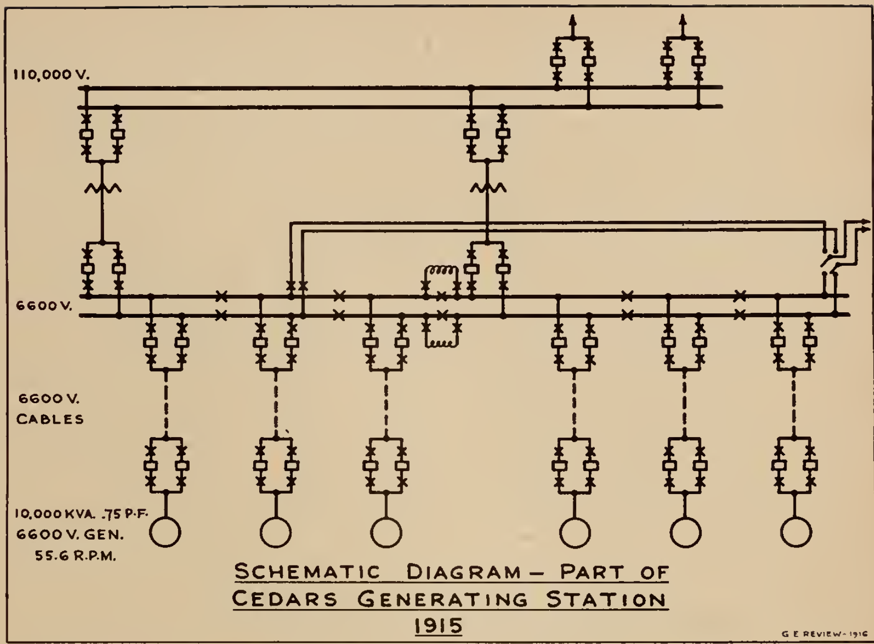


Fig. 3. Another example of the use of duplicate switching facilities.

Frequency

(a) Standards — In the early days there was no accepted standard frequency, and frequencies of 25, 30, 33, 60, and 66 cycles were used. During the 1920's, however, a trend developed towards the use of 60 cycles as a standard, and it was during this period that the Shawinigan Company changed over its 30-cycle system to 60-cycle operation. Near Montreal the Lachine plant, owned by the Montreal Light, Heat and Power Cons. had been constructed for 66-cycle operation, while the original power supply from Shawinigan was at 30 cycles. Parallel operation of these two systems was desirable, and in order to accomplish it, the 66-cycle system was operated at 63 cycles and the 30-cycle system was operated at 31½ cycles, permitting the two systems to be parallelled through 2/1 ratio frequency changers. These odd frequencies were maintained until 1927 when, by mutual agreement, the combined system frequency was gradually dropped over a period, and by March 1928 the 60-cycle standard was realized.

In 1949 a longer and a much more comprehensive and involved frequency-change project was started when the Hydro-Electric Power Commission of Ontario embarked on a program of converting the major portion of its 25-cycle system in southern Ontario to 60 cycles. The estimated time to completion orginally was fifteen years but great headway has been made and recent reports indicate that the entire job probably will be completed by mid-1959.

(b) Regulation — Frequency regulation, as such, was poor prior to 1922 compared with present standards. The 60-cycle frequency meters available usually had a scale of 10 cycles. Such variations did not normally exist, but extremely low frequencies and major variations did occur occasionally.

A contribution to frequency control was made in 1916 when Henry Warren of Ashland, Mass., was experimenting with a clock driven by a synchronous motor. He noted that when the clock was connected to the power company's system it lost some 10 to 15 minutes a day. It took some persuasion to convince the power company's operators that they were operating at a frequency lower than 60 cycles. The operating engineers of the power company, however, were quick to appreciate the value of this extra tool, which enabled them to keep much more constant frequency. Warren went on to develop various types of master clocks with which many are familiar.

The first Warren master frequency clock in Canada was brought into operation on the Hydro-Electric Power Commission of Ontario's system in 1922, and very shortly thereafter one was installed on the Shawinigan system. Following this development the whole matter of frequency regulation became more prominent.

About 1925 the first satisfactory

graphic frequency recorder was introduced, and from 1925 to 1929 power engineers became more conscious of the possibilities and necessity of closer frequency regulation. It became an accepted fact that power companies had to improve frequency regulation to reduce large load swings between plants and between systems to permit satisfactory system interconnection. Furthermore, the textile and newsprint industries were able to turn out more uniform products as frequency regulation improved. Under present conditions, in the Province of Quebec the 60-cycle frequency is maintained within a range of 0.2 cycles, and synchronous time is regulated within a maximum error of 10 sec.

Relay Protection

Effective relay protective schemes were practically unknown before, say, 1920 although the basic principles of overload protection and reverse power protection were known and utilized. On occasion, definite time and inverse time relays were employed but natural phenomena such as lightning and sleet caused many circuit interruptions and, with inadequate protection, played havoc with service continuity.

Considering the relatively complex nature of electric systems as they expanded or developed, and the necessity for substantial and essential improvement in the design of relays and relay protective schemes generally, great credit must be given to engineers such as Paul Ackerman for the pioneer work carried out in connection with the development of adequate relay protection and resultant improvement in service continuity, initially on the Toronto Power Company's system, then with the Hydro-Electric Power Commission of Ontario and finally with The Shawinigan Water & Power Company's system. Ackerman appreciated the necessity of isolating faults instantaneously and selectively, if power arc damage was to be avoided and system stability maintained, so that lines or equipment could be promptly returned to service and maximum customer service assured.

The important principle of the double-step directional impedance protection, now widely used by power companies, was discovered, developed, and applied by Ackerman in 1921-3 while he was associated with The Shawinigan Water & Power Company.

Although enormous strides have so far been made in perfecting relay protection schemes, the field is not static and new ideas are being constantly evolved, and new methods introduced. In general, the trend is towards greater speed and sensitivity. Whereas in the past electro-mechanical relays only were used, electronic protective schemes are now entering the picture. The use of automatic reclosing schemes will probably increase for both single-phase and three-phase applications wherever they can be advantageously applied. Carrier current as an adjunct of protection has been widely accepted and the use of micro-wave is becoming a competitor in this field.

Regardless of the improvements that have been made in protective relaying there is still much original development work to be carried out.

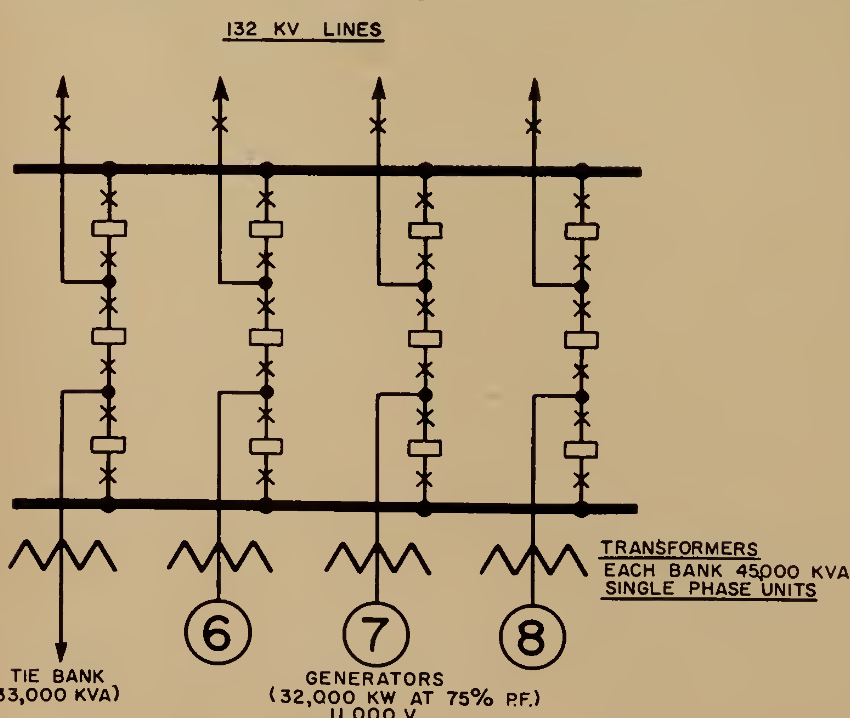
System Planning

To provide for system growth and the resultant rapid expansion of facilities, most large utilities have found it essential to set up system planning groups or divisions. The problems encountered are principally of a technical and economic nature. The system plan must be sound both from the immediate standpoint and from the long-term viewpoint and should be flexible to allow for changing conditions. Co-ordination of all factors is a major objective, including protective relay schemes as well as the proper selection of equipment such as circuit breakers and transformers to ensure suitable characteristics and adequate rating. Provision for service continuity and for satisfactory voltage, load, and frequency control is a major function of a system planning department. Substation and transmission line location, choice of voltages and installation levels could be added to a lengthy list.

The a.c. network analyzer is a valuable aid to system planning engineers and serves an important purpose in assisting in the design and operation of power systems. Essentially it is composed of small resistances, reactances, and a power supply, which may be set up and utilized to represent the power system in miniature under precise control. Use of the analyzer provides a suitable means for determining rapidly and accurately the behaviour of power systems including such features as, power and kilovar flow, voltage changes, losses, fault currents, and stability under various fault conditions.

Ontario-Hydro has had such a device installed since 1941, another is in service in British Columbia, a third is planned by the Calgary Power Company Ltd., and a fourth is under consideration in Quebec. A number of utilities in Canada, in the past, have been carrying out their studies

Fig. 4. Schematic diagram of a more modern generating station showing trend towards simplification with the low voltage circuit breakers eliminated.



using network analyzers on a rental basis in the United States.

System Control and Operation

Originally the chief operator at the principal generating station usually acted as co-ordinator as far as operation was concerned. When additional stations were connected to the system, however, or the system was interconnected with neighbouring utilities, it became necessary to set up a separate organization to handle overall operation and the load dispatching problems. Most large utilities have now adopted this form of operational control.

Today the system operating organization controls the load interchanged between systems and directs the operation of generating stations, transmission lines, and substations, using various types of communication facilities such as the open-wire telephone line, which was the original method of communication, as well as the more modern types of FM and AM space radio, multi-channel carrier telephony on power lines or telephone lines and micro-wave channels.

The system operator and his staff have switching diagrams available which indicate at all times the setup of the power system. Written procedures are prepared and distributed so that necessary operations mav be carried out according to a predetermined plan either with or without communication. The system operator's duties also include allocation of load to generating stations, supervision of the control of frequency, voltage and kilovars. Operation of storage reservoirs and pondage elevations on hydro systems, and scheduled outages of lines and equipment all come under his jurisdiction, while at the same time he maintains a variety of records. One of his principal duties is to supervise matters affecting customer service under both normal and emergency conditions.

System Security

With the rapid system growth in the 1920's utility engineers noted that the damage to equipment was becoming more extensive as short circuit values increased and users became much less tolerant of power interruptions or interference with service. Extensive research and development produced many technical advances all of which were to be reflected in marked improvement to system security and much better customer service.

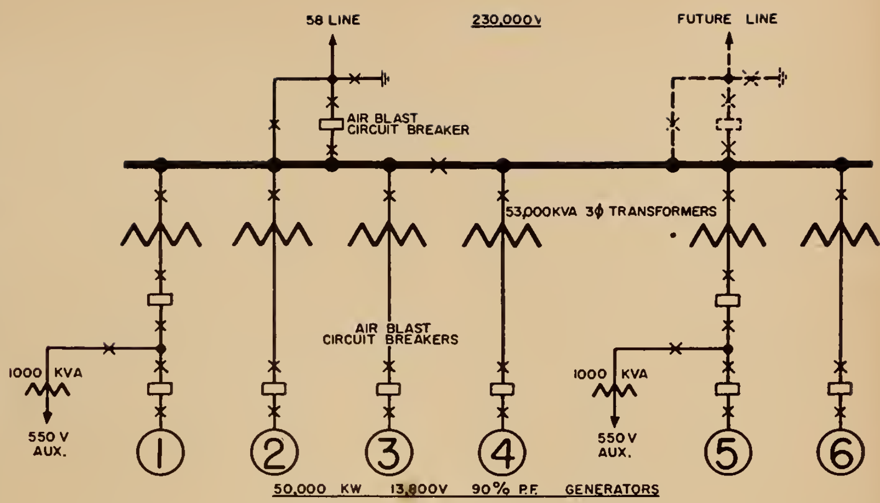


Fig. 5. Switching layout of the simplest design in a modern generating station.

Only brief comment can be made on a few of these improvements since the list is too extensive to be covered in any detail.

(A) Lightning

In the July 1930 issue of *The Engineering Journal* a paper entitled "Generation, Transmission, and Distribution of Electricity in Canada" reflected Canadian practice at the time in the use of overhead shielding wires on high voltage transmission lines and over substation structures, as well as practice in the use of lightning arresters, and the authors state: "Lightning presents a still unsolved problem for the transmission engineer".

At that time it was not fully realized that to attain maximum effectiveness, installation of overhead shielding wires should be associated with a lowering of the tower footing resistance using grillage bases, driven ground rods, or by connecting together the tower bases by continuous buried counterpoise wires. This concept, now accepted by utilities generally, was the result of extensive research by a number of manufacturers and utilities in the United States. Out of it came a much better understanding of the nature and behaviour of lightning, the magnitude of the currents and voltages involved, and improvement in the design and effectiveness of lightning arresters.

Application of these principles was carried out by one large utility in Canada whereby counterpoise wires were progressively added to its existing extensive transmission line system with great success and line outages were reduced to about one-tenth the original figures. (Fig. 6)

Today it is possible in most instances, using modern methods and suitable equipment, to design and construct high voltage transmission lines which are practically immune to damage or interruption from lightning, but study and research still continue.

(B) Circuit Breakers

The circuit breaker in combination with adequate relay protection, is the most important component of the power system to assure continuity of service, to protect equipment from damage, and to permit the removal or energizing of lines and equipment.

Until about 1930, in Canada, the high voltage circuit breaker in use consisted essentially of three tanks filled with oil in which separation of the contacts took place to interrupt the circuit. Time of arc interruption under fault conditions was of the order of 20 to 36 cycles on a 60-cycle base, but the rated interrupting capacity was not known with accuracy. During the 1930's and 1940's radically new methods were introduced by manufacturers to control the arc, using various forms of interrupters based on the principle of de-ionization of the arc path. By these means, operating times, internal gas pressure, and degree of carbonization of the oil were reduced quite markedly, and interrupting capability was increased considerably. Refinement in solenoid, motor-operated, and pneumatic mechanisms added to the reliability and reduced maintenance; staged field tests by utilities, in co-operation with manufacturers, helped the development.

Eventually there emerged the modern single-tank oil circuit breaker, a Canadian development, for voltages up to 138 kv. and rated up to 2½ million kva., 800 amperes, at 5 cycles. For 230 kv. operation, three-tank oil circuit breakers were introduced with ratings of 5 million kva., 1200 amp., 3 cycles, and in 1955 a number of 10,000,000 kva. oil circuit breakers were placed in service by Ontario-Hydro.

Air blast circuit breakers, first developed in Europe, were introduced into Canada about 1939-40 by the Shawinigan Company at its La Tuque generating station and this type of breaker has since obtained wide acceptance by utilities in Canada. Canadian designs of air blast breakers are available in certain ratings; the most recent development being the one described at the Engineering Institute's annual meeting in Toronto, in May 1955 (see ref. 9). Circuit breakers of the "minimum oil" design, also a European development, are being used by a number of utilities in Canada, particularly in the 69 kv. and 138 kv. ratings.

Research and new developments continue with the trend towards higher interrupting capacities, reduced operating times, and increased reliability.

(C) Automatic Reclosing of High Voltage Circuits

An additional method of improving service continuity is that of rapidly isolating the faulted phase or phases and reclosing automatically within 15 to 30 cycles. Since about 90 per cent of all high-voltage line faults are of a transient nature, some utilities consider it quite advantageous to employ automatic reclosing to restore the transmission system to normal as soon as possible after the fault has cleared.

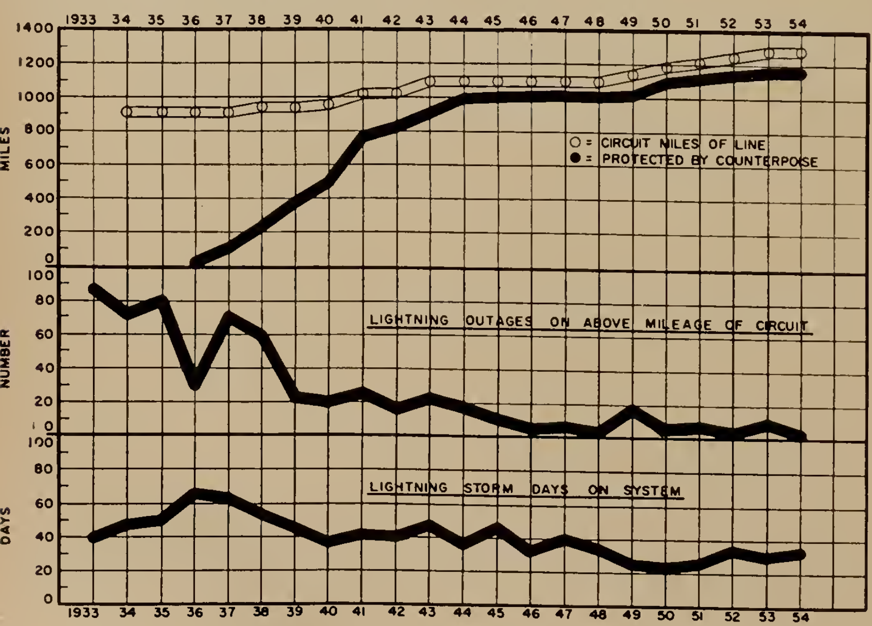
Although this scheme is not widely used in Canada, certain utilities are using the idea on 230 kv. circuits with resultant improved service reliability. On the lower voltages, particularly on radial lines, three-phase automatic reclosing is quite common.

(D) Transformers

Still another factor that has contributed markedly to service betterment has been the decided improvemen in reliability of the power transformer. This has been a gradual process. Improved cooling methods, such as forced-oil — forced-air or forced-oil with water-cooled heat interchanger, have eliminated the use of the iron, brass or copper cooling coils used originally in water-cooled transformers. Such coils occasionally developed leaks, causing failure and service interruption. Use of silicon alloy steel for the core, as well as better insulating materials and improved techniques, has resulted in a more compact and mechanically stronger unit with greatly reduced weight per kva. and greatly increased reliability.

Research in the high-voltage laboratory by manufacturers, including impulse testing of bushings and coils, has given the designer a better understanding of the electrical stresses.

Fig. 6. Curve illustrating the effectiveness of counterpoise installation in reducing lightning outages on transmission lines.



Summing up, therefore, the modern high voltage transformer is a most efficient device of such reliability that, when properly shielded from lightning and equipped with suitable lightning arresters, it ceases to be a factor of concern to utilities when appraising possible interference with service continuity.

(E) Miscellaneous Devices and Methods to Improve System Service

During the last fifteen or twenty years there have been a number of miscellaneous devices and methods utilized to improve the continuity or quality of service to the consumer. Here are a few briefly described.

(a) Fault locators of various designs to locate permanent or transient faults on transmission lines quickly and accurately.

(b) The permanently installed automatic oscillograph which, after system disturbances or interruptions, gives a graphic record of the magnitude of currents and voltages, phases involved, fault clearing times, etc.

(c) Automatic synchroscopes to eliminate the personal factor and to reduce time in synchronizing units or systems.

(d) Relay indicators to show which relays have operated and thus permit accurate analysis of the disturbance or interruption.

(e) Automatic switching schemes to reduce time of customer outage to a minimum by transfer to an alternate source.

(f) Transmission line tools to permit maintenance work to be done alive on high voltage transmission lines up to 230 kv.

To this list could be added: Improved centralized control of load, voltage, and frequency; system service analysis to study, record and appraise the cause and effect of all matters affecting service; supervisory control and telemetering; periodic testing and planned maintenance procedures to locate incipient faults, take remedial measures and thus assist in improving the quality of service to the ultimate consumer.

Possible Trends

Admittedly, one must be cautious in making predictions but here are a few observations and possibilities:

(a) Hydro Generation

Increased consideration will be given to constructing new hydro generating stations of the "outdoor" type, that is, with removable sections over the units as in the case

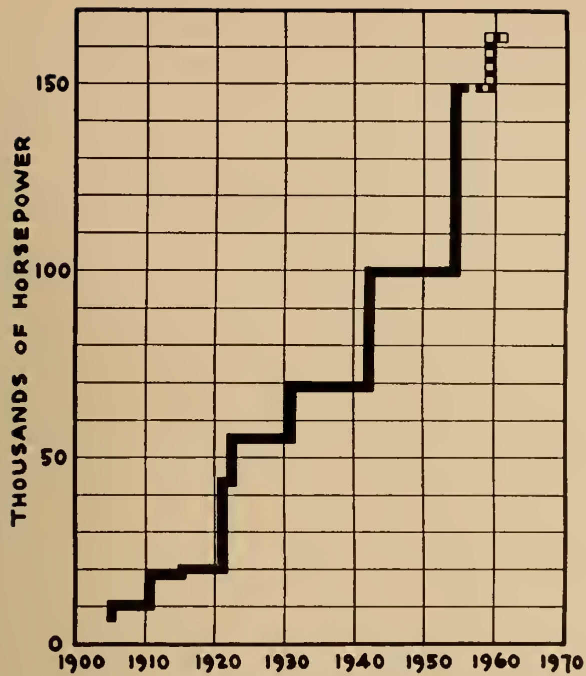


Fig. 7. Curve showing trend of growth in the size of hydro-electric generating units in Canada.

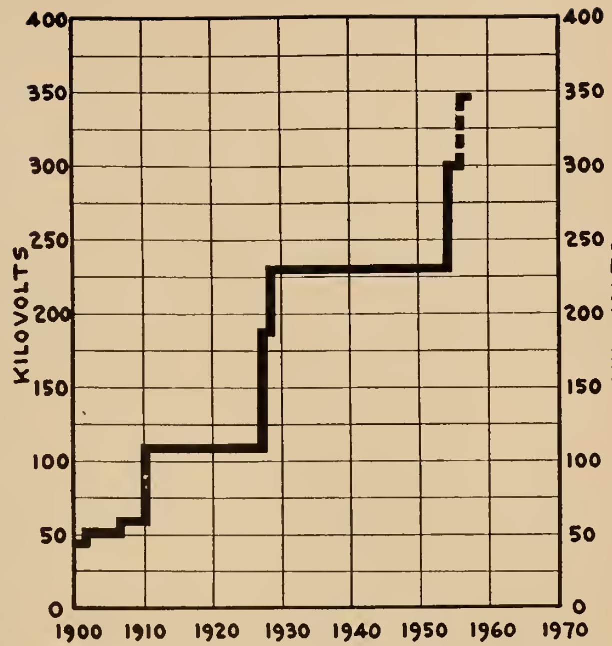


Fig. 8. Curve showing trend of maximum transmission voltage used in Canada.

of Chute du Diable and Chute à la Savane stations on the Peribonka River or at the projected St. Lawrence development near Cornwall. Where practical and economic, generators are being installed underground in the rock, examples of which are the Aluminum Company's Kemano station and the Bersimis No. 1 development.

The maximum capacity of hydro generating units, now just over 160,000 h.p., may increase considerably but such installations will be limited since there are few remaining undeveloped sites with sufficient potential outputs to justify any great increase in size. (Fig. 7.)

Generator voltage rating will probably continue at 13,800 volts for some time with the units totally enclosed, water-cooled and relayed so as to be isolated, shut down, and brakes applied automatically in case of failure. Great advances have already been made in newer types of insulation for generator coils and in the methods of coil construction, as well as in testing methods, both a.c. and d.c., to permit evaluation of the condition of the insulation from time to time. Research is continuing with the objective of improving still further the reliability and life of generating units in hydro plants.

(b) Generation other than Hydro

Improvements in the efficiency of thermal generating units together with the fact that most of the favourably situated hydro sites have already been developed, excepting those in British Columbia and Quebec, would indicate that more fuel-fired generating stations will have to be installed in Canada in future to supply the estimated needs. Dr. Hearn, of Ontario Hydro, announced recently that the Commission would proceed immediately with the addition of a 200,000 kw. unit to the Richard L. Hearn steam station in Toronto. Additional thermal generating capacity is planned for the Atlantic and the Prairie Provinces.

The gas turbine is attracting increased attention of engineers in Canada as a prime mover for the production of electric power. This is particularly apparent in the Western Provinces where abundant supplies of natural gas and oil are available under favourable conditions. The installation of a 6200-9375 kva. unit at Vermillion, Alberta, was completed in 1954 and projected installations at Calgary, Vancouver, and Edmonton have been announced. The two units for Edmonton are to be the largest in the world, each having an output of 25,000-37,500 kva. depending on outside air temperature.

Regarding the use of atomic energy as a source of heat for the production of electric power, active research, development, and plant construction are being carried out in Canada as well as in several other countries. Canada's first nuclear power station, with an estimated output of 20,000 kw., is to be installed near Chalk River, Ontario, as a joint effort of Atomic Energy of Canada Ltd., Canadian General Electric Company, and Ontario Hydro. It is expected to be in operation in 1958-59.

Dr. Hearn recently stated that in studying the development of future power resources, it is assumed that in 1965 nuclear fuel-electric stations will be more economical for base load operation than conventional fuel-electric stations.

In an article in the December 1955 issue of the *Electrical Digest*, entitled "Nuclear Power Outlook for Canada", James H. Goss summarizes the situation in a very concise manner. In this article are two significant statements, namely: (1) nuclear power will never be as cheap as efficient hydro-electric power, and (2) the impact of nuclear power will be a slow and steady one during the 1960's and 1970's and always on top of a growing base of power from conventional sources.

The trend appears to be that, beginning about 1965 in some areas of Canada, steam electric stations using nuclear fuels will begin to supplement and eventually replace steam electric stations using conventional fuels.

(c) Transmission

Transmission losses will get more attention due to rising power costs.

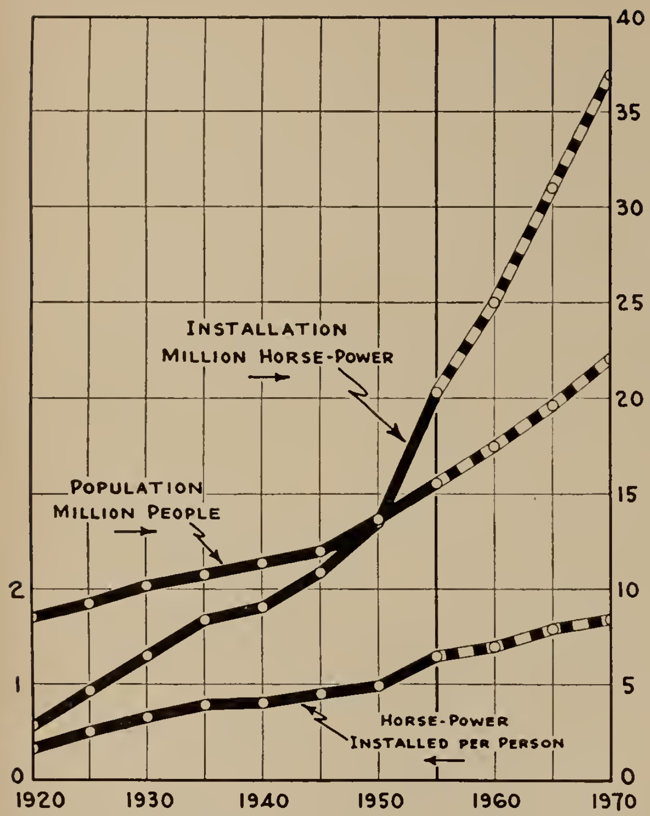


Fig. 9. Curve showing trend in the growth of electric power installations and population in Canada.

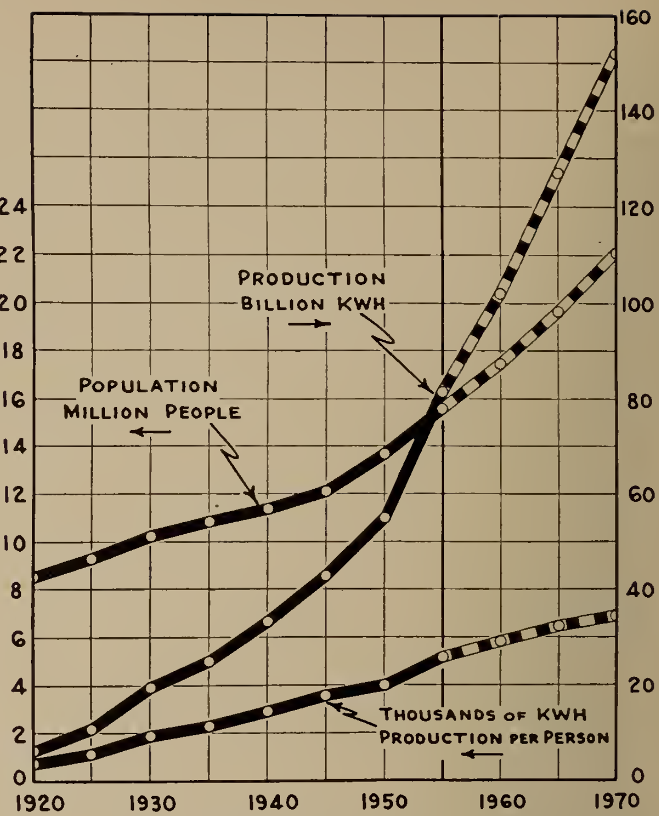


Fig. 10. Curve showing growth of total production of electric energy in Canada and energy production per person.

With increasing loads on power systems, the trend will continue in the use of higher voltages for transmission, distribution, and utilization to improve transmission efficiency. Transmission voltages of 300 kv. at Kemano and on Hydro-Quebec's Bersimis-Montreal system will be exceeded on the B.C. Electric Company's system by the new 345 kv. line which is to go into operation next year. In Europe, 400 kv. lines are in successful operation and some manufacturers are willing to quote on supplying equipment for 500 kv. operation. (Fig. 8)

As the number of high voltage transmission lines increases, especially through settled country, we will probably see more double circuit construction used on account of the greatly increased cost of right-of-way.

The fundamental basis on which high voltage transmission lines in Canada have been designed and constructed, has not changed materially for many years but the whole subject is now under review. The result will probably be a modification of existing standards and practices on a more realistic basis with the objective of reducing transmission line costs and still maintaining satisfactory electrical and mechanical performance. Special consideration will be given to evaluating the frequency and intensity of natural phenomena such as lightning, sleet, snow and wind storms in various areas.

(d) Kilovar Supply

Greater attention will be paid in future to the supply and control of reactive kilovars by utility engineers due to the increased distance involved in high voltage transmission, heavier circuit loadings, and desire to improve transmission efficiency.

There will probably be increased acceptance and use of high voltage shunt capacitors to counteract the effect of line reactance. One large utility has a number of such installations in satisfactory service at voltages from 11 kv. to 69 kv. in blocks up to 20 megavars, and plans to install even larger units in the near future for use at 115 kv. The use of shunt capacitors at receiving stations results in lower line losses, improved system capability and better voltage control. Synchronous condensers are equally effective, but shunt capacitors have the advantage of being lower in cost per kilovar, have negligible loss and require little attention. Furthermore they may be installed in increments and are silent in operation.

The selection of suitable switchgear for high voltage shunt capacitor installations is important in order to avoid or reduce restrikes or overvoltages that could result in service difficulties. Air blast breakers seem to be particularly suitable for capacitor switching.

(e) High Voltage Cables

There appears to be increasing acceptance and use of high-voltage cables in Canada, both of the underground and submarine types. Hydro-Quebec has several miles of 115 kv. cable in service in the Montreal area, as well as the recently completed 69 kv. submarine installation more than 30 miles long under the St. Lawrence River near Rimouski. The B.C. Electric Company is installing in the near future some 17 miles of 132 kv. submarine cable from the mainland to Vancouver Island and has announced recently its decision to install, by 1957, about ten miles of 230 kv. single core oil-filled cable in the city of Vancouver. The Aluminum Company has had its 300 kv. cable installation in service at Kemano since 1954.

(f) System Integration

Integration and interconnection of power systems will continue, particularly where the cost of providing the interconnection is small when compared to the potential benefits to be derived. These include increased firm capability as well as greater combined efficiency and economy of operation. Many of you here will, no doubt, see the large electric power systems in the Provinces of Ontario and Quebec adequately interconnected and normally operating in parallel with an estimated combined capability, say, in 1965, of 16,000,000 kw. to 17,000,000 kw. Conceivably, this network might be extended to include Manitoba and the Maritimes.

(g) Research and Standardization

Continued consideration probably will be given to standardization and interchangeability of equipment and various component parts to effect increased efficiency and reduction in costs. More automatic equipment and control devices will be developed and utilized to conserve manpower and to permit more effective control of operation. Continued research will ensure that new and better materials and methods are found and this will be reflected in lighter, stronger, and more efficient equipment being introduced. Silicon iron alloys, with vastly improved electrical characteristics, used in the construction of transformers and generators, the many new types of synthetic resins such as the polyvinyls and polyesters, and the silicones used for electrical insulation, are examples of what has been accomplished in recent years by manufacturers.

Utility engineers, as well as the many committees of the Canadian Electrical Association and the Canadian Electrical Manufacturers' Association have made important contributions, principally in the application field. The Research Bureau of Ontario-Hydro and the National Research Council have made many notable contributions in many phases of the electric utility field. In the broader aspects of standardization the Canadian Standards Association continues its excellent work as Canada's national standardization body.

(h) Future Growth

The steady growth of population in Canada from the present figure of 15.6 million to an estimated 22.1 million in 1970, and the continuing increase in the standard of living in Canada will certainly result in increased consumption of electricity. (Fig. 9) There is every indication of continuing and rapid growth in the utilization of electrical energy and saturation seems to be far off.

Annual domestic consumption, it is estimated, will increase from 3,500 kwh. per domestic customer in 1955 to about 5,000 kwh. by 1970. Maybe this estimate is too conservative.

Latest Dominion Bureau of Statistics figures show a generating capability for all Canada of 14 million kw. with a probable increase during the next five years of 6 million kw. making 20 million kw. in 1960.

Total production of electrical energy in Canada for 1955, based on Dominion Bureau of Statistics reports, amounted to about 80 billion kwh. and is estimated to increase to over 102 billion kwh. by 1960.

For the twenty years prior to 1950 the percentage of fuel-fired installations producing electric power to hydro-electric installations was between 6 and 7 per cent. With the expected increase in fuel-fired installations there are indications that by 1970 thermal power will account for about 23 per cent of the total installations.

Conclusions

This review of the growth and development of large electric power systems has described a few of the advances that have been made, particularly during the past twenty-five years. Technical research, use of new materials, improved manufacturing techniques and experience have played an important part in the development, requiring the combined efforts and co-operation of manufacturers, and utilities, as well as engineering and technical associations.

In general in the past, there has been a tendency for the load growth in Canada to double every eleven years, which is between 6.5 and 7 per cent compounded annually, and there are indications that this trend will continue. The important problem now facing the utility industry is to keep pace with the prospective future load growth. Another important problem is to attract and train engineers and other personnel capable of administering, planning, and operating the extensive power systems of the future.

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Current Developments in Air Pollution in the United States

L. C. McCabe

President, Resources Research, Inc., Washington, D.C.

Read at the 70th Annual General and Professional Meeting of the Engineering Institute of Canada, Montreal, May 1956

Automobile exhausts, incineration, sulphur dioxide, and fluorides are currently of major interest to investigators of air pollution in the United States. The Government is stimulating research in the evaluation of pollution levels and their effect on health.

ATMOSPHERIC pollution activities in the United States were stimulated during the past year by legislative action at Federal, state, and local levels and by an impressive quantity of information from research institutions throughout the country. Notable for scope and excellence of material during this time were: the First International Congress on Air Pollution, held under the auspices of the American Society of Mechanical Engineers; the American Chemical Society's symposium on air pollution, at the annual meeting at Minneapolis last September; and the special program sponsored by the American Association for the Advancement of Science at its annual meeting in San Francisco in December 1955. The Air Pollution Control Association held its largest annual meeting in Detroit in 1955 and extended its services to its membership through its new Journal and APCA abstracts.

The petroleum and automobile industries through the Coordinating Research Council continued to support important research in the chemistry of air contaminants and the control of automobile exhausts. The Air Pollution Foundation sponsored investigations in a number of laboratories throughout the country and during 1955 published ten technical reports on basic aspects of air pollution.

The enforcement and research budget of the Los Angeles Air Pollution Control District was in excess of 2½-million dollars for the fiscal year ending June 30, 1956. Throughout the United States there was an increase in money spent for research and enforcement at the municipal and state levels. Salaries for air pollution officials and their technical staffs continued to improve, and more individuals with formal scientific and engineering training entered the field.

Atmospheric pollution has received increasing attention in the Congress during the past four or five years. In addition to California, concern was expressed over growing atmospheric pollution in New York City, New Jersey, Philadelphia, Florida, the Gulf Coast embracing parts of Louisiana and Texas, Detroit, Denver, and the states of Oregon and Washington. Many smaller cities came in for debate. The problems reported varied from place to place—hydrocarbons from traffic and petroleum processing, industrial dust and odours, smoke, sulphur dioxide, fluoride damage to crops and cattle, and the burning of combustible wastes, all were subjects of complaint. This led the President to suggest to the Secretary of Health, Education, and Welfare that he invite other federal agencies, the Atomic Energy Commission, Agriculture, Commerce, Defense, Interior, and the National Science Foundation to participate at the policy level in an ad hoc Interdepartmental Committee on Community Air Pollution. In a report released by the Public Health Service on April 8, 1955, this committee made recommendations regarding the role of the Federal, state, and local governmental agencies in controlling and regulating community air pollution. It was agreed that the Department of Health, Education, and Welfare should sponsor legislation and direct the Federal program, that a continuing Interdepartmental Committee on Community Air Pollution should be established and that certain scientific research of the agencies should be supported from any funds appropriated by the Congress.

Public Law 159, passed by the 84th Congress in July of 1955, "authorized to be appropriated to the Department of Health, Education, and Welfare for each of the five fiscal years during the period beginning July 1, 1955, and ending June 30, 1960, not to exceed $5,000,000" to provide research and technical assistance relating to air pollution. The Surgeon General of the Public Health Service was authorized to direct the program.

Other sections of the act provide that the Surgeon General may conduct research and develop methods of preventing and abating air pollution through the facilities of the Public Health Service and aid state and

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local government agencies and public and private organizations and institutions in similar activities. Contracts and grants-in-aid may be made to these organizations and to individuals for research, training and demonstration projects.

The last session of the Congress approved $595,000 for air pollution investigations in the regular budget of the Public Health Service and, following passage of Public Law 159, an additional sum of $1,190,000, making a total of $1,785,000 for the fiscal year ending June 30, 1956. These funds are allocated as shown in the accompanying table.

The kinds of projects which other Federal agencies have been asked to undertake are those needed by the Public Health Service to develop basic information or data necessary to solve specific air pollution problems and for which they are better qualified, by reason of staff competency or possession of special facilities, than is the Public Health Service. Generally, the projects are those in which the time required for the performance of the agreement can be stated and in which the limits of the work may be determined. The projects to be undertaken through memoranda of understanding with the other Federal agencies in fiscal year 1956 are as follows:

Bureau of Standards

(1) Development of methods of analysis and identification of gaseous contaminants. (Improved methods for sampling and analysis of gaseous pollutants are essential to both air pollution research and control efforts.)

(2) Reactions between pollutants at sources and among pollutants in the atmosphere. (Chemical combinations and separations are known to occur both within the plant site where air contaminants are generated — the "source" — and after emission due to the effects of solar radiation, moisture, pollutants from other sources, etc. An understanding of the nature and scope of these basic chemical changes is essential to developing knowledge of their effects and how these may be minimized.)

Bureau of Mines

(1) Incineration of combustible wastes. (The burning of community wastes — garbage and rubbish principally — contributes importantly to many local air pollution problems. Fundamental studies are needed on incinerator design and operating procedures to minimize the emission of pollutants from such sources.)

(2) Evaluation of sulphur dioxide removal processes. (Sulphur dioxide is a common air pollutant, emitted from combustion of most common fuels and from many industrial processes. Its removal in low concentrations from stack gases has been given considerable study, but no standardization of practice has resulted. Critical evaluation of available technical information will be of much value to control agencies and in determining the need for further investigative work.)

(3) Automobile exhausts evaluation. (Automobile exhaust gases are being implicated to an increasing extent as important factors in urban air pollution. Precise identification of exhaust gas components under varying conditions is being undertaken as a basis for further studies of effects and means of nullifying them.)

Weather Bureau

(1) Special participation in community investigations. (Non-routine meteorological observations as needed in assessing local air pollution problems.)

(2) Development of meteorological methods for forecasting critical air pollution conditions. (For practicable and economically acceptable air pollution control programs, it is essential that means be available for predicting the pollutant concentration in the atmosphere resulting from a known quantity of emission under critical weather conditions. Only with such knowledge can definitive determination be made in any control district of the maximum allowable emission of specific pollutants.)

Armed Forces Institute of Pathology

Survey of lung cancer types in relation to previous residence in areas characterized by high and low levels of air pollution.

Veterans Administration

Statistical studies of records of mortality and residence in areas characterized by high and low levels of air pollution.

The technical assistance program has been initiated by the Robert A. Taft Sanitary Engineering Center at Cincinnati, Ohio. Personnel have been assigned to assist the Los Angeles Air Pollution Control District through the Department of Health, State of California. Similar assistance has also been extended to Louisville, Kentucky. Requests for extensive investigations were received from 28 state governments and local communities in the first six months following passage of the act. The current resources are not sufficient to comply with all of the requests, though every effort is being made to participate in joint study of local problems to the extent of available trained manpower. Four short courses in the technical aspects of air pollution control were scheduled at the Sanitary Engineering Center during the first year of the act.

The direct research activities planned are being carried on directly by the Public Health Service in Cincinnati both at the Sanitary Engineering Center and the Occupational Health Field Headquarters. At the Sanitary Engineering Center, the nation-wide aerometric survey begun approximately two years ago is being continued and expanded. Preliminary estimates of classes and determinations of amounts of particulate loadings have been obtained from air samples collected on daily and weekly schedules in more than thirty representative communities. These include both urban and rural areas. Inorganic assays and quantitative analyses of certain organic constituents are made of the present particulate collections and it is

Allocation of Funds for Air Pollution Investigations

Engineering	
Direct research and technical assistance by Public Health Service	$ 435,000
Contract research with private institutions	50,000
Training of Public Health Service officials	40,000
Transfer to other Federal agencies for research work	400,000
Health	
Direct research by Public Health Service	160,000
Contract research with private institutions	200,000
Research Grants	
Health and engineering projects at universities, medical schools and research organizations	500,000
Total	$1,785,000

planned to supplement these by routine determinations of some of the non-particulate pollutants, i.e., gases and fumes.

At the Occupational Health Field Headquarters, work is already under way in determining the physiologic and toxicologic effects of certain chemicals, such as ozone, oxides of nitrogen, and sulphur-containing hydrocarbons known to be present in smog.

The $500,000 available for research grants in 1956 has been committed for support of air pollution studies. Most of these grants have been awarded for studies primarily related to the health effects of air pollutants. Investigations under way include broad epidemiological studies of the relation of human disease to air pollution, studies of the effects of specific contaminants such as fluorides and oxides of sulphur, and studies of physiological response to air pollutants. In the future, it is expected that research grants projects will include studies on the causes and prevention of air pollution as well as those concerned with its effects on health.

Dr. Justin M. Andrews, assistant surgeon general of the Public Health Service recently said: "The medical component of the community air pollution program is planning an extensive use of contract research to provide information concerning the health effects of subacute exposures to pollutants suspected to be harmful. This is probably the most important single fact to ascertain—yet it has been the most elusive thus far—as most air pollution control ordinances are written on the assumption that freedom from community air pollution will be healthful. It is hoped that organ function tests, especially pulmonary and cardiovascular, can be devised that are simple and accurate enough to be used on a mass basis. Such tests might be applied according to conventional epidemiologic patterns to population groups comparable in all important respects except for their exposure to high and low levels of specific air pollution. Similarly chest X-ray surveys may be made along epidemiologic lines to see whether lung cancer is more prevalent in populations exposed to continued, high levels of air pollution. Efforts are also planned to determine if tissue culture techniques offer a more sensitive indication of the toxicity of air pollutants than do intact test animals."

A current report of the National Cancer Institute states that: "One of several carcinogenic chemicals has been isolated from several agents representing variable chemical mixtures (soot, coal, tar and pitch, petroleum oils, gasoline and diesel engine exhaust). Wherever a definite identification of a specific causal agent has not been attained, the epidemiological evidence based on an evaluation of cancer incidence of relatively small occupationally circumscribed total populations at risk is sufficiently reliable to prove the presence of an occupational respiratory cancer hazard casually related to a specific industrial operation. Epidemiological, medical, and experimental data concerning these respiratory carcinogens attest to their high carcinogenic potency under occupational conditions, particularly when acting on humans. It is therefore reasonable to assume that inhalation of the same agents, in a mitigated form as air pollutants, by the general population is responsible for a considerable portion of the lung cancers attributable to such contacts."

Assignment of the direction of atmospheric pollution activities at the Federal level to the Public Health Service will have the effect of emphasizing the health aspects of problems, and, as the Service through long established procedures works through the health departments of the 48 states, there will be a tendency to strengthen air pollution work at the state level. The act provides for the assignment of Public Health Service personnel and for grants to support projects carried on by the states and local communities, and their personnel are being trained in Public Health Service laboratories. As the program expands, eligible individuals may be assigned to field service and demonstration projects throughout the United States for training.

Motor vehicles are considered to be the largest single source of air contamination in Los Angeles. The Air Pollution Control District estimates that 1050 tons of hydrocarbons are emitted to the air daily in the County from 2½ million automobiles, 200 tons from refineries, and 85 tons more in marketing. Contributions from other sources bring the total to about 1450 tons daily. The hydrocarbons react with ozone and the oxides of nitrogen in the presence of sunlight to produce a large part of the smog which reduces visibility, causes eye irritation and crop damage. Development of carburetor regulating devices or exhaust gas burners is well advanced. When such a device proves reasonably effective, no doubt it will be adopted for use on vehicles in that county.

Industrial installations for controlling air pollution at the source are increasing each year. It is estimated that, over the past eight years, industry in the Los Angeles area has spent $30,000,000 to control hydrocarbon losses, sulphur dioxide, dust, and fumes. Recovery of elemental sulphur from refinery operations now totals 450 tons per day in the county. Increasingly large sums are being spent in other industrial centres, possibly as much as $150,000,000 annually. The chemical industry alone estimates an expenditure of $40,000,000 per year in the control of atmospheric effluents.

Equipment development is keeping pace with the demand for more effective control devices. One manufacturer of control equipment states that more exacting requirements by the public bodies and more rigid enforcement of local regulations has stimulated the production of control equipment having efficiencies that were unheard of ten years ago. The small operation, the disposal of combustible rubbish, bus and automobile fumes, and the recovery of low concentrations of sulphur dioxide in large gas volumes are among the more refractory economic problems, but much research and development effort is being devoted toward their solution.

The technology of air pollution is now at the stage of water sanitation of perhaps a hundred years ago. It is probably a fair observation that progress is being made in the face of tremendous community and industrial expansion.

It is evident from recent studies that atmospheric pollution is fairly closely associated with density of population. At present, approximately 165,000,000 people live in the United States and 51 per cent of them live in 1.5 per cent of the total land area. The National Office of Vital Statistics forecasts a population of 221,000,000 by 1975. If present trends continue there will be an extension of the densely populated areas and a corresponding increase in the load of pollution the air must accommodate. This is one compelling reason for the continued activity in air pollution control.

Lateral Rigidity of Steel Building Frames

J. L. de Stein, M.E.I.C. and J. O. McCutcheon, M.E.I.C.

Department of Civil Engineering, McGill University

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The paper approaches the problem of required stiffness by means of rational analysis and on the basis of probable movements as related to building materials. The question of required rigidity for many buildings is at present rather empirical and tends to be left to judgment. The problem is topical, with the recent incorporation of new design methods in both British and Canadian design specifications and with the extensive use of continuous fenestration and panel-wall construction.

THE DESIGN of any building frame is concerned with the strength of the various members. For many frames the general rigidity or stiffness should also be a design consideration.

Members in a bent or a frame are designed for vertical loads, or for lateral forces such as wind, earthquake, or crane thrusts acting in combination with the vertical loads. The design of beams supporting vertical loads is often governed by a stiffness requirement. Depending on the materials being supported by the beam some building codes or design specifications limit the deflection to a specific amount, or place a restriction on the depth-span ratio of the member.

At present, North American design specifications place no limit on the deformation of a frame under lateral loads. For many frames the deformation could be relatively large without causing excessive stresses in the various components. However, some of the rather brittle cladding materials now in common use might be damaged by such deformations. Even with ductile or relatively flexible wall materials which are undamaged by frame movements, it may be that the limberness of the frame is not compatible with the functional use of the building. A rational design for certain building frames might accordingly include a consideration of lateral movement in view of the fact that it might establish the design or size of some of the members.

Mill buildings in the past were built both with masonry exterior walls and with clad walls, and it is likely that for many of these buildings the steel frame resists a considerable portion of the wind force. These buildings generally had travelling cranes with attendant stiff columns and relatively extensive lateral and longitudinal bracing, and where cranes were not used the bracing still tended to be extensive by modern standards. Because of the rigidity of these structures the lateral deformation is probably not excessive.

In the factory building of recent years the introduction of newer cladding materials, with translucent panels or continuous sash, has made the full exterior masonry wall an exception, and in general the frame must carry virtually all the wind force. Modern material handling methods require fewer travelling cranes, and the average frame is accordingly lighter. More exact design methods have also tended to lighten the modern mill building structure. A similar trend may be noted in the construction of commercial buildings where, with frequent use of panel walls and continuous fenestration supported from the steel, more wind load is brought to the frame. It follows that the modern building frame, tending to a lighter weight, and carrying a higher proportion of the wind force, may have excessive lateral deformations and correspondingly large plastic strains in the connections.

Experimental work has been done in recent years to establish rotation properties of common structural connections, such as web and top and bottom flange connections. With this information available, it is now possible to calculate the behaviour of frames with semi-rigid connections, including deformations and the stresses and strains in the various members. Such analyses may be extended to determine the adequacy of a particular connection and of a particular column size for a given frame.

In order to assess present design methods relative to building deformation, and to develop span and height limitations for various connections, some 64 single-storey building frames were designed using in each case the lightest member meeting the specification requirements. The lateral movement was then calculated for each frame.

Frame Analysis

The types of frames studied are indicated in Fig. 1 and in general consist of single bay bents, two bay bents, and three bay bents. Each unit was designed for 20 feet, 28 feet, and 36 feet spans, and with column heights of 15 feet, 20 feet, and 28 feet. This gave a total of 27 bay-span-height combinations. Each of these 27 combinations was

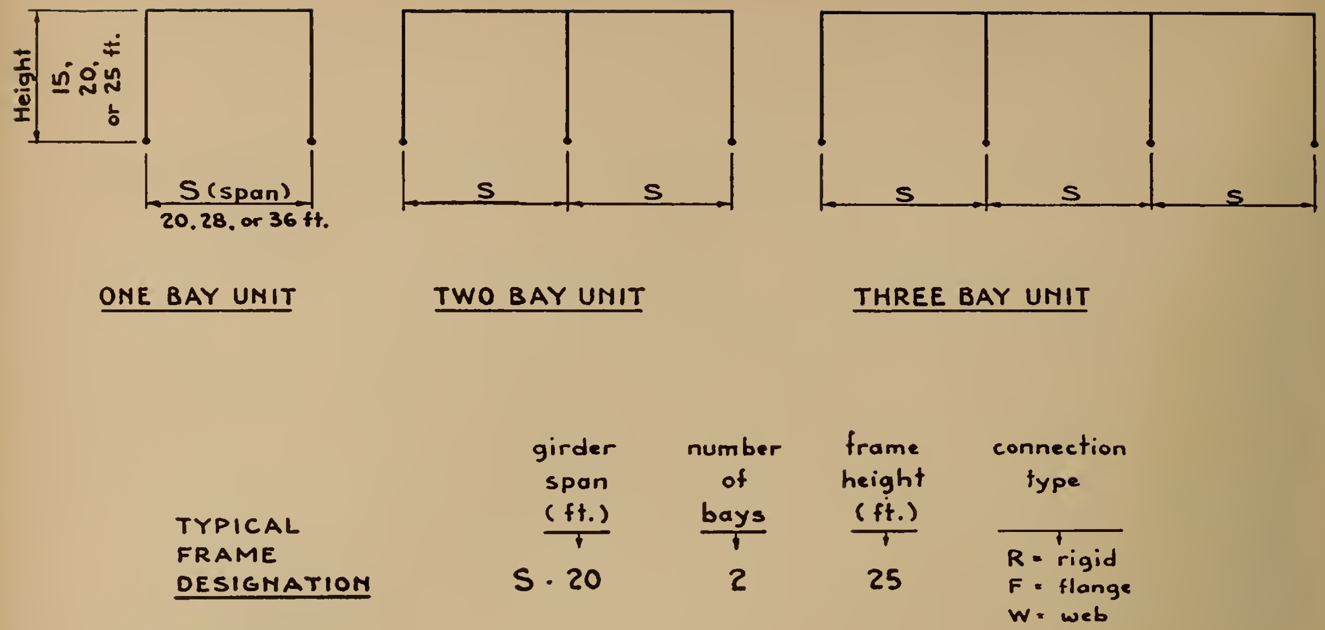


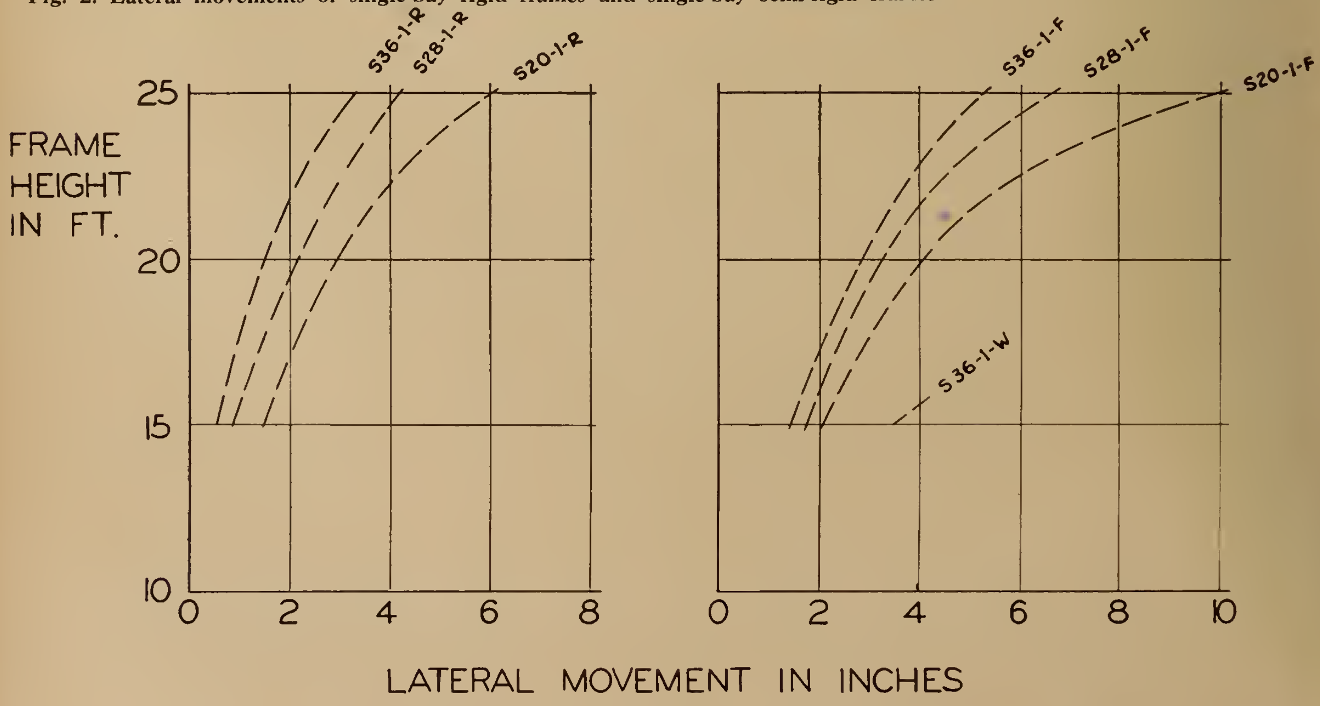
Fig. 1. Frame designations.

designed with rigid connections and re-designed with top and bottom flange connections and in some cases with web connections.

Each bent was considered to support a twenty-foot length of building roof and walls. Roof construction was assumed as tar and gravel roofing with insulation on pre-cast lightweight concrete slabs supported by steel purlins spaced from 6 ft. 8 in. to 7 ft. 3 in. on centres, giving a dead load, including steel, of 38 lb. per sq. ft. Snow loading was taken as 40 lb. per sq. ft. Wall construction was assumed to be cladding supported by girts framing into the columns so that the exterior columns had full lateral support about their weak axes. Wind loading was taken as 10 lb. per sq. ft. pressure on the windward wall and 10 lb. per sq. ft. suction on the leeward wall and was considered as acting on the steel frame from 3 feet above the base plates. The columns were considered to be pin-connected at their bases. For the rigid frames advantage was taken of the negative end moments in designing the girders while for the semi-rigid frames the girders were designed as simply-supported beams. The columns were designed taking into account connection moments induced from vertical and lateral forces but without restriction as to lateral movement. The Canadian Standards Association Specification S16-1954 was used for the design of the members.

The design and analysis of the frames with semi-rigid connections were based on moment-rotation (M-o) characteristics of web and of flange connections as obtained by test data. The connection details and the curves used for this work are shown and discussed in Appendix A.

Fig. 2. Lateral movements of single-bay rigid frames and single-bay semi-rigid frames.



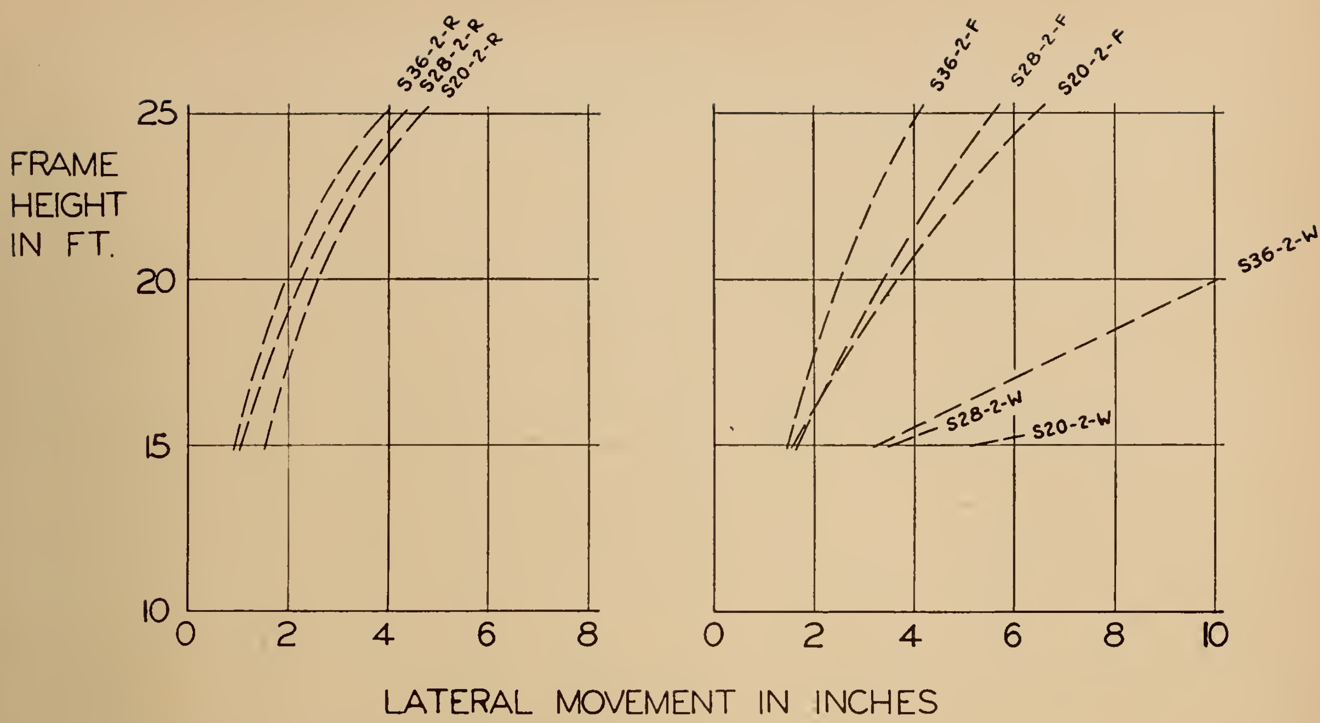


Fig. 3. Lateral movements of two-bay rigid frames and two-bay semi-rigid frames.

Using straight-line approximations for these curves, moment distribution was applied after stiffness and carry-over factors were obtained. Methods of analysis are outlined by Pippard and Baker[1], Johnston and Mount[2], and others.

It may be noted from the connecton curves in Appendix A that, within the working values, the ratios of relative rigidity of the top and bottom flange angle connection to that of the web connection are approximately as follows:

Beam Size	Relative Rigidity Flange Connection to Web Connection
14 WF	8 to 1
18 WF	6.5 to 1
21 WF	3.5 to 1

Results

Table I shows the results of the rigid frames study and Table II shows the results of the semi-rigid frames study. For each of the bents the economical beams and columns are listed, followed by the maximum moment on each connection and the calculated lateral movement of the building under the combination of dead load, half live load, and wind load. In Table II the total lateral movement of the semi-rigid frames has been broken down to show the amounts due to bending of the column, bending of the beam, and bending of the connection.

In Fig. 2, 3, and 4, lateral deformations of the building frames have been plotted against frame height. The single bay structures have been plotted in Fig. 2, with the rigid frame deformations shown separately from those of the semi-rigid frames. Figures 3 and 4 deal in a similar way with the deformations of the two and three bay structures.

Frame Deformations

The calculated lateral deformations of the rigid frames varied from 0.50 inch to 6.0 inches. These deformations result from bending of the girders and of the columns with the column contributing at least 75 per cent of the total. From Fig. 2, 3, and 4, it may be noted that for the 25-foot high frames the deformations are quite large and, even in the case of the three bay structures where the wind forces are resisted by four columns, these deformations vary from 3 in. to 5 in. Inspection of the curves indicates that deformations for the 20-foot and 25-foot frame heights do not vary appreciably for the one, two, and three bay structures considered.

The calculated lateral deformations of the frames with flange connections varied from 1.2 in. to approximately 10 in. It may be seen from Table II that in general, for the two and three bay structures, the deformation of the connection accounts for 15 to 20 per cent of the total movement of the frame, and for the higher single bay structures the connection deformation reaches 45 per cent of the total. The listed values indicate that even with semi-rigid flange connections, bending of the column still accounts for the greater part of the frame movements.

In the rigid frames where bending moment is a major factor in the design of the columns, the differences in lateral movement between the one, two, and three bay frames of a given height are not significant.

As might be expected, for any given height and girder span, the lateral movement in general decreases as the number of bays increases. However, where the depth of a column is changed, the general trend may reverse at that point. Because of the overlapping of depths in a weight listing of rolled sections, such discontinuities may be expected in design.

Some 15-foot and 20-foot high frames with web connections were designed and the results of their analysis are shown in Table II and in Fig. 2, 3, and 4. For some of the 20-foot and all of the 25-foot high frames it was impossible to obtain a design with web connections, as the moment on the connection either approached or exceeded the ultimate strength of the respective connection. The deformations of some of these designs are of unacceptable magnitude for a building frame. For the frames shown the connection deformation was responsible for 50 to 80 per cent of the total lateral movement.

For the three bay frames with web connections shown in Fig. 4, the deformations for the 15-foot high frames are similar, even though the connections for the various girders are quite different. At this height the moments on the web connections are quite small and the deformation is mainly from bending of the column.

Except for the single bay units, it is significant that the deformations of the semi-rigid frames with flange connection are not widely different from the deformations of the rigid frames. In the single bay rigid frames the deformations are approximately 60 per cent of those of the semi-rigid frames; the differences being mainly due to the larger columns required for the rigid frames because of the relatively high dead and live load moments on the columns.

It should be noted that wherever web connections have been used, the total deformation is 1½ to 3 times that of the corresponding frame with flange connections.

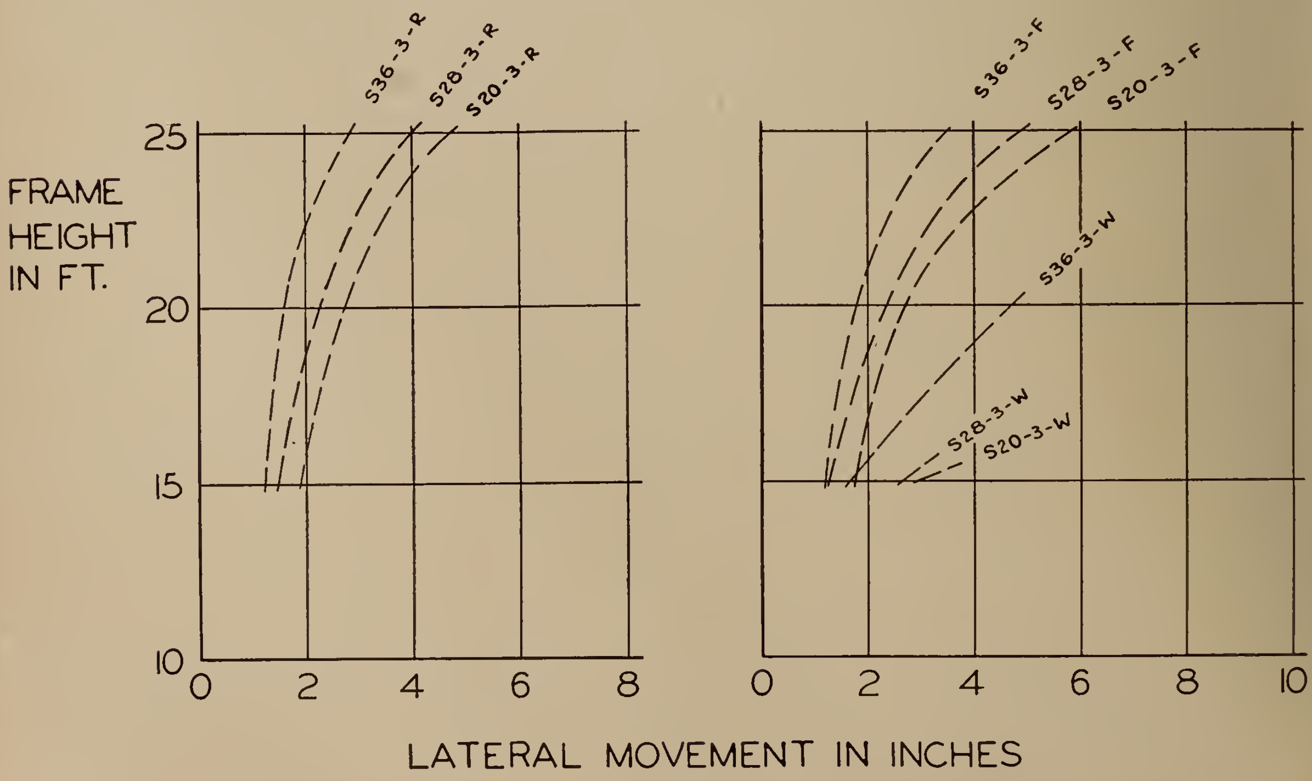
Table I—Rigid Frames

Frame Designation	Girder Span (ft.)	Number of Bays	Frame Height (ft.)	Girder	Exterior Column	Interior Column	Lateral Deformation (inches)
S 20-1-15	20	1	15	12WF27	8WF28	—	1.48
S 20-1-20	20	1	20	12WF27	10WF33	—	2.92
S 20-1-25	20	1	25	12WF27	10WF39	—	6.04
S 20-2-15	20	2	15	12WF27	6WF20	8WF24	1.54
S 20-2-20	20	2	20	12WF27	8WF24	10WF33	2.59
S 20-2-25	20	2	25	14WF30	10WF33	8WF35	4.65
S 20-3-15	20	3	15	12WF27	6WF20	6WF20	1.90
S 20-3-20	20	3	20	12WF27	8WF24	8WF28	2.30
S 20-3-25	20	3	25	14WF30	8WF28	8WF35	4.72
S 28-1-15	28	1	15	16WF45	10WF33	—	0.82
S 28-1-20	28	1	20	16WF45	10WF39	—	2.14
S 28-1-25	28	1	25	16WF45	10WF49	—	4.19
S 28-2-15	28	2	15	16WF45	8WF24	8WF24	1.03
S 28-2-20	28	2	20	16WF45	8WF24	10WF33	2.24
S 28-2-25	28	2	25	18WF50	8WF31	10WF45	4.26
S 28-3-15	28	3	15	16WF45	6WF20	6WF20	1.49
S 28-3-20	28	3	20	16WF40	8WF24	8WF28	2.25
S 28-3-25	28	3	25	16WF40	8WF28	8WF40	4.00
S 36-1-15	36	1	15	18WF55	10WF54	—	0.50
S 36-1-20	36	1	20	18WF60	10WF54	—	1.49
S 36-1-25	36	1	25	18WF60	10WF60	—	3.30
S 36-2-15	36	2	15	21WF62	8WF24	8WF24	0.93
S 36-2-20	36	2	20	21WF62	8WF24	10WF39	1.95
S 36-2-25	36	2	25	21WF62	8WF28	10WF49	3.92
S 36-3-15	36	3	15	18WF60	6WF20	8WF28	1.23
S 36-3-20	36	3	20	18WF60	6WF20	10WF39	1.66
S 36-3-25	36	3	25	18WF55	8WF28	10WF45	2.85

Connection Moments

Except for three cases, the maximum moment (dead plus full live plus wind) on the semi-rigid connections has not exceeded 65 per cent of the ultimate strength of the connection. It may be that in those cases where the moment on the connection is 50 to 65 per cent of the ultimate capacity of the connection, some designers would prefer a rigid connection or a stronger flange connection. However, it should be noted from the connection curves in Appendix A that a moment of 60 per cent

Fig. 4. Lateral movements of three-bay rigid frames and three-bay semi-rigid frames.



of ultimate corresponds to an angular deformation of about 25 per cent of the rotation at failure. A safe or reasonable design value to allow on the connection should take into account the ratio of design rotation to ultimate, the combination of loading, the lateral movement of the frame caused by the connection deformation, and residual deformation due to the plasticity of the connection.

If the deformation of the frame is acceptable, then it would appear that a design moment on the connection of 60 per cent of ultimate would be permissible.

Column Heights

As previously noted, the design and the calculations for lateral movement consider the columns to be pin-connected at the base. However a point of contraflexure may be some distance above the base, depending on the details. If, for a particular design, the location of the point of contraflexure can be approximated, the results of this study could be made comparable by deducting the distance to the point of contraflexure from the frame height.

Permissible Lateral Movements

The amount of lateral movement that might be tolerated in a given building should be related to the type of cladding material. In a building with masonry spandrel walls the amount of movement that might be tolerated would be quite small whereas in a building with some type of metal cladding a much larger movement might be acceptable. Where pre-cast cement or cement and asbestos units are used as cladding, the permissible amount of movement should be related to the bending properties of the material. Practical considerations might indicate that for some materials the permissible movement could range from 1/100th to 1/200th of the frame height. From Tables I and II it is apparent that many of the designed frames have lateral movements in excess of 1/100th of the height.

The calculated lateral movement might also be considered as a measure of the limberness of the frame. Where a lateral deformation of the order of 1/100th of the frame height may be satisfactory for the wall material the frame may still be too limber to be acceptable to the user of the building.

The whole question of permissible lateral movement is rather complex and, as mentioned earlier, there is no guidance available from the existing Canadian or United States specifications.

Conclusions

(1) This study has demonstrated that the analysis of a building frame with semi-rigid connections may be readily extended to include an exact calculation (within the limitations of the usual design assumptions) of lateral movements and of moments on connections where test data has established moment-rotation curves for these connections. However, there

Table II. Semi-Rigid Frames

Frame Designation	Girder Span (ft.)	No. of Bays	Frame Height (ft).	Girder	Exterior Column	Interior Column	Connection Type	Connection Moment (kip-ft.)	Lateral Deformation in Inches: Column	Beam	Connection	Total
S 20-1-15	20	1	15	14WF30	8WF24	—	Flange	34.9	1.41	0.21	0.43	2.05
S 20-1-20	20	1	20	14WF30	10WF33	—	Flange	54.9	2.18	0.52	1.32	4.02
S 20-1-25	20	1	25	14WF30	10WF39	—	Flange	77.5	4.40	1.15	4.40	9.95
S 20-2-15	20	2	15	14WF30	6WF20	8WF24	Web	18.8	1.24	0.14	3.80	5.18
S 20-2-15	20	2	15	14WF30	6WF20	8WF24	Flange	42.8	1.17	0.15	0.22	1.54
S 20-2-20	20	2	20	14WF30	8WF24	8WF31	Flange	50.7	2.75	0.26	0.63	3.64
S 20-2-25	20	2	25	14WF30	8WF31	10WF39	Flange	65.0	3.88	0.69	1.82	6.39
S 20-3-15	20	3	15	14WF30	6WF20	6WF20	Web	13.9	1.44	0.07	1.44	2.95
S 20-3-15	20	3	15	14WF30	6WF20	6WF20	Flange	37.4	1.57	0.04	0.16	1.77
S 20-3-20	20	3	20	14WF30	8WF24	8WF28	Flange	43.0	2.08	0.18	0.41	2.67
S 20-3-25	20	3	25	14WF30	8WF28	8WF35	Flange	50.6	4.67	0.34	0.81	5.82
S 28-1-15	28	1	15	18WF50	8WF24	—	Flange	38.5	1.41	0.11	0.22	1.74
S 28-1-20	28	1	20	18WF50	10WF33	—	Flange	61.4	2.18	0.26	0.79	3.23
S 28-1-25	28	1	25	18WF50	10WF45	—	Flange	85.8	3.70	0.59	2.35	6.64
S 28-2-15	28	2	15	18WF50	6WF20	8WF24	Web	11.9	1.25	0.07	2.25	3.57
S 28-2-15	28	2	15	18WF50	6WF20	8WF24	Flange	67.2	1.34	0.08	0.21	1.63
S 28-2-20	28	2	20	18WF50	8WF24	8WF31	Flange	73.5	2.73	0.13	0.50	3.36
S 28-2-25	28	2	25	18WF50	8WF31	10WF39	Flange	87.0	3.92	0.13	1.50	5.55
S 28-3-15	28	3	15	18WF50	6WF20	6WF20	Web	19.8	1.56	0.04	1.02	2.62
S 28-3-15	28	3	15	18WF50	6WF20	8WF24	Flange	60.6	1.02	0.06	0.18	1.26
S 28-3-20	28	3	20	18WF50	8WF24	8WF28	Flange	64.5	2.08	0.10	0.19	2.37
S 28-3-25	28	3	25	18WF50	8WF28	8WF35	Flange	72.5	4.06	0.18	0.66	4.90
S 36-1-15	36	1	15	21WF73	8WF24	—	Web	35.6	1.41	0.07	2.00	3.48
S 36-1-15	36	1	15	21WF73	8WF28	—	Flange	44.3	1.19	0.07	0.16	1.42
S 36-1-20	36	1	20	21WF73	10WF33	—	Web	56.0	2.18	0.16	15*	17*
S 36-1-20	36	1	20	21WF73	10WF33	—	Flange	66.9	2.18	0.16	0.50	2.84
S 36-1-25	36	1	25	21WF73	10WF45	—	Flange	91.6	3.70	0.37	1.20	5.27
S 36-2-15	36	2	15	21WF73	6WF20	8WF28	Web	40.9	1.16	0.06	2.04	3.26
S 36-2-15	36	2	15	21WF73	6WF20	8WF28	Flange	90.8	1.22	0.07	0.18	1.47
S 36-2-20	36	2	20	21WF73	8WF24	10WF33	Web	50.1	2.01	0.13	8*	10*
S 36-2-20	36	2	20	21WF73	8WF24	10WF39	Flange	101.5	1.85	0.17	0.48	2.50
S 36-2-25	36	2	25	21WF73	10WF33	10WF45	Flange	106.8	3.06	0.18	0.81	4.05
S 36-3-15	36	3	15	21WF73	6WF20	8WF24	Web	35.7	0.87	0.03	0.74	1.64
S 36-3-15	36	3	15	21WF73	6WF20	8WF24	Flange	82.6	1.04	0.03	0.12	1.19
S 36-3-20	36	3	20	21WF73	8WF24	8WF31	Web	40.9	1.91	0.04	2.75	4.70
S 36-3-20	36	3	20	21WF73	8WF24	10WF33	Flange	88.3	1.41	0.08	0.29	1.78
S 36-3-25	36	3	25	21WF73	8WF28	10WF39	Flange	96.2	2.88	0.14	0.45	3.47

* — approximate

is a need for the accumulation of additional test data for different sizes and types of connections.

(2) In Table II, it may be seen that for some of the frames where the lateral movements are large the connection deformation has been significant. In general, this indicates that the connection has reached its useful limit. The movement of the frame in these cases cannot be appreciably improved by stiffening the columns unless the connections are also stiffened. If the columns were stiffened without changing the connection, the dead and live load connection moments would be increased and the rotation of the connection under lateral forces would be greater.

(3) From Table II and Fig. 2, 3, and 4, where the building frame must resist a considerable proportion of the wind force, it would appear that web connections should not be used for the main column connections on single-storey buildings 20 feet or more in height and less than three bays wide.

(4) The results of this study may have some significance in the consideration of plastic design methods. The elastic design method applied to both rigid and semi-rigid frames has in general resulted in columns that are too flexible. If a plastic design or a limit design method results in a more flexible structure then it is apparent that a plastic analysis has little practical application for these single-storey frames.

(5) For buildings one, two or three bays wide, if the column design is based only on design specifications, the lateral movement of the buildings under wind load would in many cases be quite large. For the three bay structures (four columns resisting the wind) with heights of 25 feet, the lateral movements vary from 1/50th to 1/90th of the frame height. This ratio of movement to height is larger for the one and two bay structures. Within the combinations studied, if the lateral movement is limited to 1/100th of the height it may be stated that lateral movement would be a design criterion for the following rigid frames:

(a) all the 25-feet high structures

(b) the 20-feet high structures with 20-feet and 28-feet girder spans.

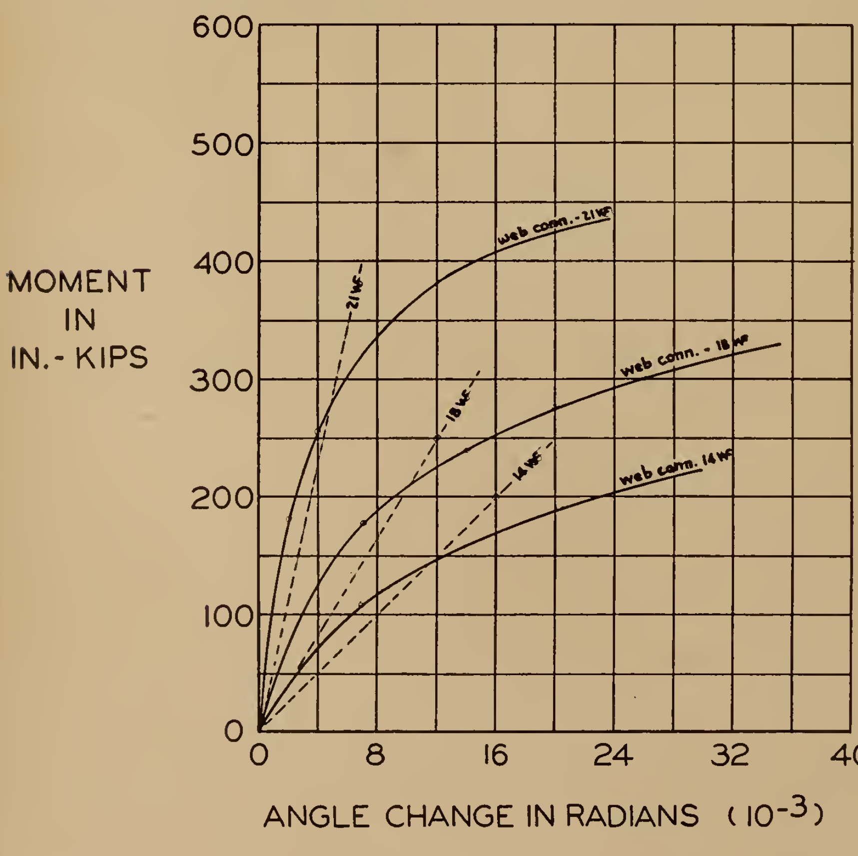
(c) the 15-feet high structures with 20-feet girder spans; and for the following semi-rigid frames:

(d) all the 25-feet high structures

(e) all the 15- and 20-feet high structures except the three bay 36-feet girder span.

If limited to 1/200th of the height, lateral movement would be a design criterion for every building designed in this study.

Fig. 5. Moment-rotation characteristics for web connections.



APPENDIX A

Figure 5 gives the moment-rotation characteristics (M-o curves) for web connections for the three beam sizes used in this analysis and Fig. 6 gives the corresponding top and bottom flange angle connections characteristics.

The curve for the 14 WF web connection was taken from Hechtman and Johnston[3] test No. 3 which used two 6″ x 4″ x ⅜″ x 8½″ angles on a 12 WF beam with ¾ rivets and with the 4″ leg on the column flange. Experimental data and a stress consideration shows that the width of the leg on the beam web is not an appreciable factor in the rotation properties. The bending of the leg attached to the column and the deformation of the rivets in that leg are the principal factors in the rotation and these would not be expected to vary significantly with the standard 4″ x 3½″ x ⅜″ angle. The corresponding curve from Rathbun[4] specimen No. 4, using two 4″ x 4½″ x ⅜″ x 9″ angles on a 12″ I with ⅞″ rivets showed good conformity.

The curve for the 18 WF web connection was taken from Hechtman and Johnston[3] test No. 8 which used two 4″ x 4″ x ⅜″ x 1½″ angle on an 18 WF with ¾ rivets.

The curve for the 21 WF web connection was taken from Rathbun[4] specimen No. 6 using two 4″ x 3½″ x ⅜″ x 15″ angles on an 18 I with ⅞ rivets. The number of rivets and the rivet spacing was identical to the A.I.S.C. standard for a 21 WF. Because of the use of ⅞ rivets and because the curve appeared somewhat out of line with the 14 WF and 18 WF curves, it was decided for the purposes of this study to modify Rathbun's values. Thus the ordinates of the curve for the 21 WF in Fig. 5 represent 80 per cent of the corresponding values reported by Rathbun.

The curve for the 14 WF top and bottom flange angle connections

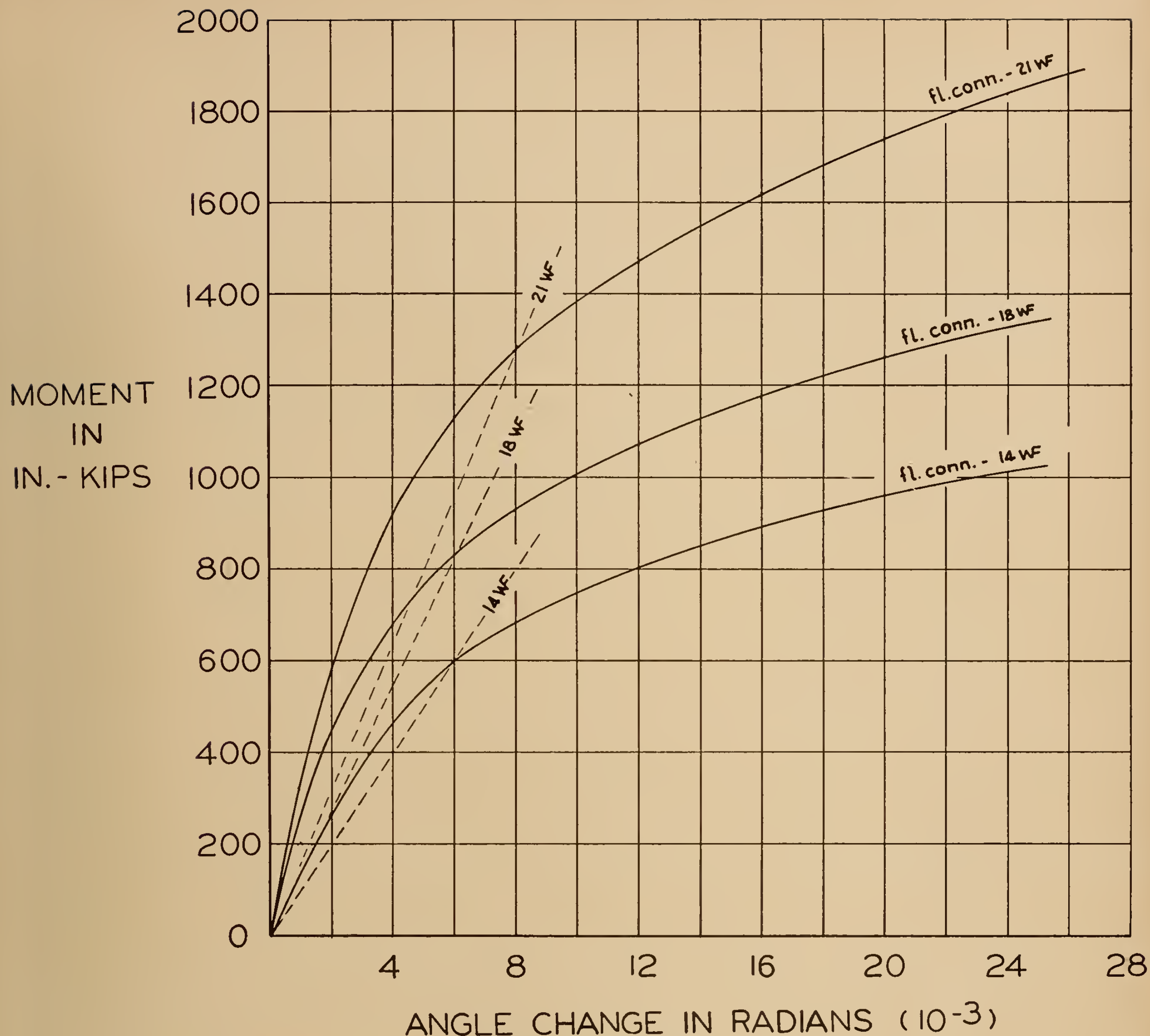


Fig. 6. Moment-rotation characteristics for flange connections.

was taken from Hechtman and Johnston[3] test No. 20 which used a 6" x 4" x ⅝" x 12" top angle with ¾ rivets on a 14 WF and with the 4" leg on the column.

The curve for the 18 WF top and bottom flange angle connections was taken from Hechtman and Johnston[3] test No. 9 which also used a 6" x 4" x ⅝" x 12" top angle with ¾ rivets on an 18 WF and with the 4" leg on the column.

The curve for the 21 WF top and bottom flange angle connections was taken from Hechtman and Johnston[3] test No. 25 which used a 6" x 4" x ¾" x 14" top angle with ⅞ rivets on a 21 WF and with the 4" leg on the column. Because of the use of ⅞ rivets and the ¾" angle thickness, it was decided to modify the curve in a similar way to that of the 21 WF web connection; the ordinates being 80 per cent of the reported values.

A straight line approximation for the working range of each curve has been shown in Fig. 5 and 6. The use of these lines simplified the moment distribution while the curves themselves were used for the deflection calculations. The modifications made to the 21 WF connection characteristics (M-o curves) do not appreciably affect the results.

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DISCUSSION

The editor invites discussion of papers appearing in the Journal.

Readers may contribute to this section by sending appropriate comments to the editorial office.

Application of Welded Design to Hydraulic Turbine and Valve Manufacture

J. G. Warnock, *Head of Hydraulic Department,*
English Electric Company of Canada Limited

Read at the 70th Annual General and Professional Meeting of The Engineering Institute of Canada, Montreal, May 1956

The design and manufacture of hydraulic turbine and valve equipment, in common with practically every branch of mechanical engineering, has benefited considerably from the substantial advances made during the past thirty years in the techniques of electrically welding steel plate.

We have now reached the stage where some hydraulic turbine designs may incorporate up to 80 to 85 per cent of their total weight in the form of welded steel plate components, whereas in the early 1930's a comparable figure of 50 to 60 per cent would be considered relatively high. In the case of other associated hydraulic equipment, the percentage of steel plate components may be even higher, and all-welded large hydraulic valves are certainly a feasible proposition.

Application of Welded Design to Turbine Construction

There has been, however, in the water turbine field, fairly wide variation in the extent to which the various manufacturers have adopted this modern medium of construction. It is interesting therefore to review the factors influencing decisions whether to adopt fabricated construction in preference to iron and steel castings.

The principal reasons that must be taken into consideration by the designer may conveniently be summarized as follows.

(1) To overcome persistent difficulties in obtaining sound material and accurate form in castings.

(2) To improve structural design.

(3) To reduce the net weight of components.

(4) To reduce material and production costs.

(5) To provide a convenient means of manufacturing large, slender components, such as scroll cases, draught tubes, pit liners, etc.

(6) To provide corrosion and erosion resisting surfaces locally within large components.

(7) To improve surface finish within water passages.

(8) To extend manufacturing by foundry capacities.

Of these eight factors, only the first might be termed "negative". The positive advantages of the fabricated design greatly outweigh the negative, but disappointments in the quality of steel castings have provided in many instances the incentive to make the break with cast designs. From that point onwards, however, the advantages of the welded construction have established and consolidated it entirely in its own right.

It does appear that the standard of iron and steel castings conveniently available to a manufacturer may have a profound bearing on his design. There are, for instance, Canadian manufacturers who have been fortunate in obtaining castings from foundries where a high proportion of output was hydraulic machinery, which meant an incentive to the foundries to develop reliable techniques and to maintain a high standard of product. Unit costs were kept low and the serious disadvantages of casting rejections on manufacturing programs largely avoided.

An additional factor favouring the use of castings in Canadian water turbine production and in favour, too of the successful solution of foundry production problems, has been the opportunity for concentration on low and medium head developments involving a large number of units of repetitive design.

On the other hand, our own experience until 1952, in common with several other European and North American water turbine manufacturers, has been a scarcity of both steel and iron foundries specializing in water turbine and other hydraulic equipment castings; and also, of developments involving more than, say, three or four units over which pattern costs had to be divided. Gradually since the early 1930's, welded steel plate construction has supplanted more and more of the components which were originally cast. Now, even although thoroughly competent steel foundries may be available and multi-unit developments are being handled, the author's company finds little or no incentive to revert to cast designs.

The diagrammatic cross sections in Fig. 1 show the trend which has brought the reaction turbine, for instance, to its present state of over 80 per cent of welded design.

There has been a very wide and almost universal application of welded steel plate fabrication to three main components of water turbines which are produced from large conical and cylindrical forms, namely, scroll cases, draught tubes, and pit liners. The use of this method of construction for scroll cases and draught tubes was merely an extension of rivetted steel plate practice and began practically simultaneously with all manufacturers in the 1920's. The stage of final acceptance of all-welded joints over part-rivetted construction has, however, varied considerably. Now, with the better quality plate, electrodes, and weld-skills available, and with the application, where necessary, of radiographic control and even local low-temperature stress relief, field welded radial (and on occasions longitudinal) joints, are widely accepted on all but the heaviest steel plate casings.

The war years introduced for our company, and others, additional special problems in the supply of high quality steel castings; and this, no doubt, contributed to the impetus given to the development of fabricated designs which, by 1945, were commonly applied to speed rings, base rings, lower distributor rings, and guide vanes. At this stage, 55 to 68 per cent of the total net weight of medium head turbines comprised fabricated construction.

Large fabricated speed rings, such as that for a 35,000 b.h.p. Kaplan turbine, were demonstrating the advantages of smooth, rolled and formed steel plate sections for water passages throughout the turbine throat. Figure 2 shows the inner and outer head cover sections and regulating ring, all of fabricated construction, in position during the shop assembly of this Kaplan machine.

The past ten years have seen the ultimate extension of fabricated design to the complex construction of water turbine runners, and even to minor conventionally cast components, such as bearing housings, wicket gate levers, links and other sundry items.

Development of 18/8 austenitic stabilized stainless steels and of 12 to 14 per cent chromium ferritic and austenitic type of alloys has given us materials highly resistant to erosion and cavitation wear. Stainless clad steel plate in partciular is a recent development which has attained a high degree of reliability and adaptability to water turbine design. The bulk of clad plate has been produced from a process which entails coating a stainless steel slab with mild steel electrode deposit. Against this prepared surface is placed a mild steel plate, and a second coated

The paper reviews the progress of the past thirty years in the application of welded design to water turbine manufacture, with examples of the possible wide use of fabrication in almost every item of modern plant, and the advantages of this type of construction. Extensive use of electrically welded steel plate is being made in the manufacture of the main turbine and valve components for three of Canada's major hydro-electric developments — the Bersimis, Niagara - Sir Adam Beck, and St. Lawrence projects. The manufacture of the twenty-six major turbine units and eight straight-flow valves is being carried out by a Canadian company employing advanced techniques of welded design and production methods.

stainless slab is placed face to face with the first, "sandwiching" the stainless material between two mild steel layers, which are then welded along the edges to exclude air from the critical stainless surfaces. The assembled sandwich is rolled down to the required thickness and proportion of stainless cladding. The adhesive characteristics of this material even under hot forming have been found to be very satisfactory. Stainless steel and stainless clad steel plates have been extensively used in distributor facing plates. It is, however, in the construction of the higher specific speed runners in the medium and high head ranges that the most interesting applications of welded stainless alloy plates is to be found.

There has been a marked trend towards the application of higher and higher specific speeds for given head conditions. Cavitation tendencies with these higher specific speeds can be conveniently controlled by increased submergence or, within limits, by the application of stainless steel to the critical areas of the runner blading. There is a demand for the complete protection afforded by all stainless runners.

Solid stainless steel castings are, for the majority of developments, too costly. Fabricated runners, including all solid stainless steel materials, generally cost even more to produce. Some compromise has therefore been necessary, and this can best be reaized by the use of composite stainless and mild steel construction with a wide application of stainless steel clad plate.

The runner shown in Fig. 3 is for a 74,000 b.h.p. turbine operating under 392 feet, and is fabricated from cast and plate components. The runner crown, approximately 10 ft. 6 in. diameter, is cast in mild steel and partially machined prior to assembly. The runner blades are hot pressed from stainless clad mild steel plate and the skirt ring is formed from a lower band of stainless clad material with an upper rolled ring of mild steel forming the inlet to the skirt.

A fabricated runner assembly such as this requires the application of the highest welding skills and techniques. All the main junction welds of the runner vanes to the crown are carried out in a downhand position involving repeated repositioning. A strict welding sequence must be maintained to minimize distortion and the build-up of locked up stresses.

The high degree of accuracy associated with fabricated runners depends primarily on the initial forming of the runner vanes. Attaining the necessary standards of accuracy from the pressing operation shown in Figure 4 calls for the most careful control of preheating and pressing temperatures, transfer time to dies, and the pressing time. The blade being formed here has a maximum thickness of 2¼ in., and an area of 26 sq. ft. The initial shaping of the plate to approximate aerofoil section can be seen. The blades as formed require little additional grinding and a high degree of surface finish can easily be maintained.

An interesting variation of fabricated runner construction is the use of cast stainless steel blades and plates for high head reaction turbine runners in the head ranges above 800 feet. A typical runner in this category is shown in Figure 5 and is one of five 45,000 b.h.p. wheels

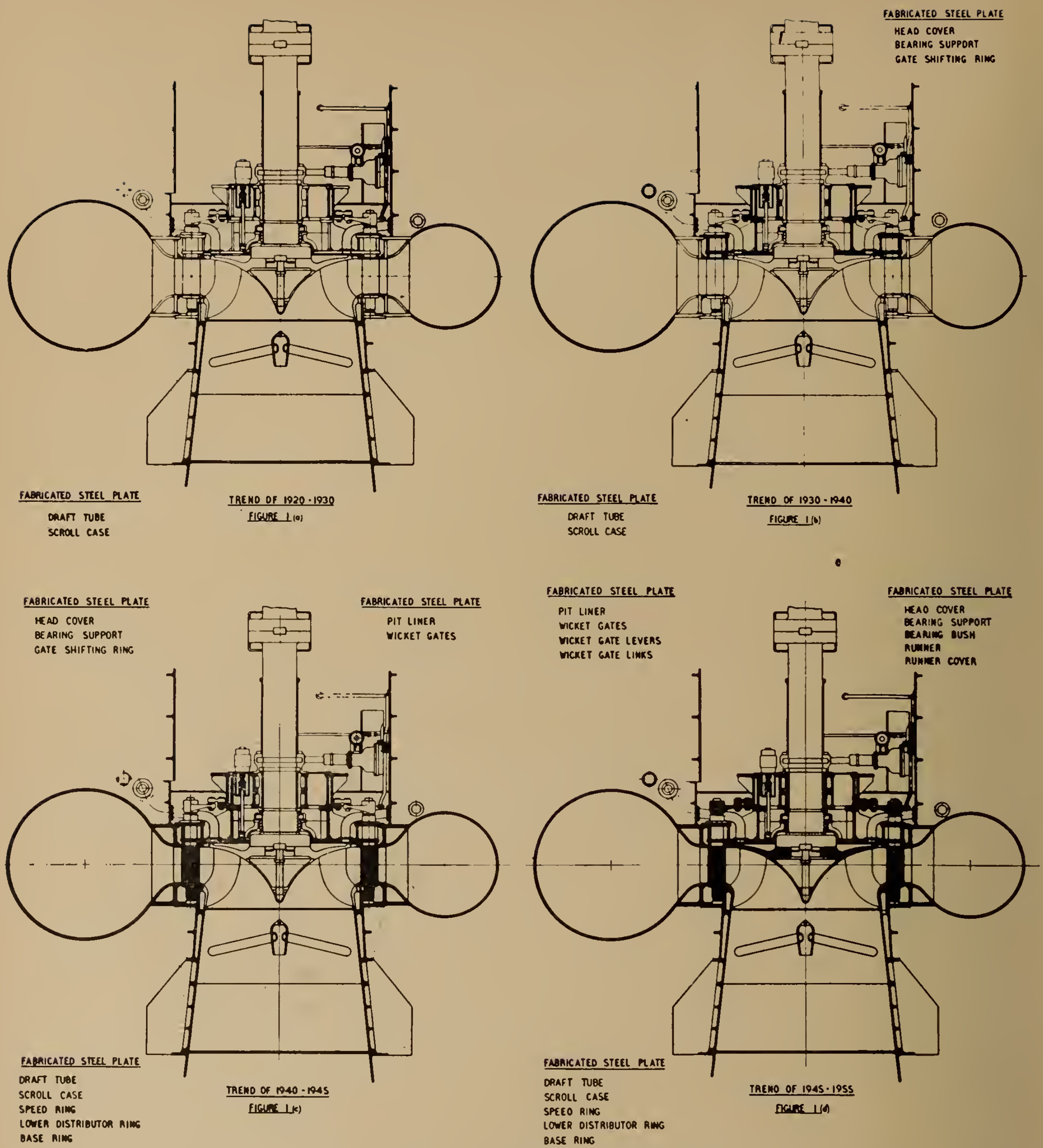


Fig. 1. Trend of application of welded design.

supplied to the North of Scotland Hydro-Electric Board.

With reaction runners of this low specific speed the problem arises of grinding blade forms within the very narrow exit passages. By casting the blades separately in stainless steel the surfaces can be easily prepared, and nose and tail forms conveniently shaped before assembly and fabrication.

The blades are then set to the correct pitch and water passage opening, and temporarily supported by the lower skirt band and seal ring. The vane edges are pre-machined for shaping prior to welding in the remainder of the water passage surfaces in the form of pressed and shaped stainless steel plates.

The heavy crown of the runner carrying the torque to the main turbine flange was cast in mild steel and securely key welded to the stainless steel water passage portion below. Alloy steel seal rings are then shrunk on to the crown and skirt rings.

With this form of construction a very high degree of accuracy throughout the water passages can be maintained.

We have, then, in the past thirty years seen the extension of plate steel fabrication from the simplest components of water turbine construction to the most complex parts such as reaction runners.

Design Considerations

The designs which have been involved, of course, do not necessarily follow conventional casting practices or shapes.

The principles of the use of rolled or knifed cylindrical or conical shapes are followed as widely as possible throughout fabricated design, but where necessary for hydraulic considerations, economic use may be made of relatively complicated forming shapes using pressing dies. The plate shapes produced by any of these methods — rolling, knifing or die forming — result in surfaces which require little or no further dressing or grinding to bring friction effects within acceptable limits.

The homogeneity and increased strength of steel plate has the greatest appeal to the designer. In comparison with cast iron, too, the additional rigidity must be taken into full consideration. By virtue of its higher elasticity modulus, a steel section has approximately 2½ times the rigidity of a cast iron member of identical cross section. It is from this factor that the substantially lower weight of fabrications for equal or improved rigidity arises.

In comparison with cast steel, improved consistency of good material and surface finish are the most important factors favouring mild steel plate fabrication. Allowable working stresses from 20 to 25 per cent higher than those adopted for steel castings may be safely used for plate of average tensile strengths. In many cases, too, there is no need with fabrications for casting considerations to take precedence over selection of sections for strength and rigidity considerations alone. Structural design may be thereby improved.

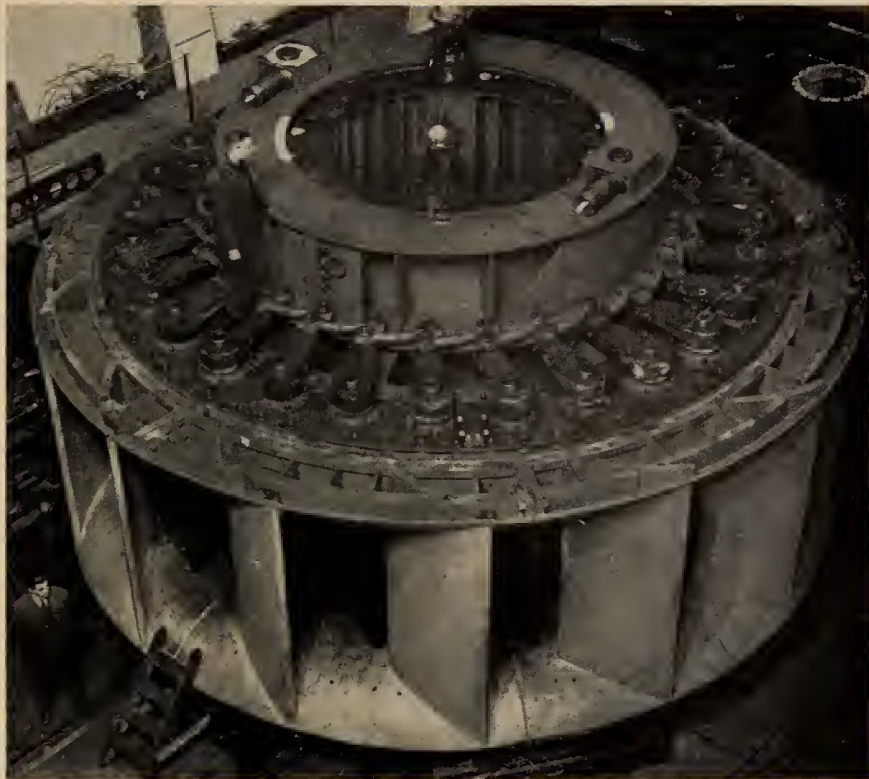


Fig. 2. Shop assembly of Kaplan turbine parts.

Accurate stress calculation in design of either cast or fabricated components of water turbines presents some difficulties, and this factor has contributed, no doubt, to the adoption of relatively low working stresses and high factors of safety.

Fig. 3. Fabricated runner for 74,000 b.h.p. medium head Francis unit.

Stress Analysis by Model Testing

The author's company has found during recent years that very useful information can be derived from the stress analysis, by strain gauge methods, of precisely scaled models of welded steel plate structures. Strain gauge testing of full size components, either in operation or on hydrostatic pressure test, has in the past provided useful stress data, but too often difficulties and doubts arise from the great care which must be applied to the placing of strain gauges on the stressed component. This work is better suited, we feel, to true laboratory conditions; and by doing this with scale models of approximately one-sixth full size, we believe that we have established a thoroughly reliable means of obtaining stress and deflection data. An additional advantage, of course, is that a far wider variation of designs can be tested before coming to a final conclusion and before manufacture begins.

The structural models used in our strain gauge analysis are true to scale in all general dimensions and have plate thicknesses correct to within 7 to 10 per cent. The selection of model plate thickness is made to the thinner, closest available standard size and thus will result in test results higher than actual values in the prototype.

The limit to the scale of the model is to a large extent determined by the smallest size of weld that can be produced to the correct form. It will be immediately obvious that it is not possible, for instance, to make welds smaller than 1/16 in., giving for general structural minimum sized welds of ¼ in. to ⅜ in., a minimum scale factor of 1 to 6. With extremely large and heavy plate components, scale factors may be increased to 1 to 10.

The stresses induced in the model due to the external loads applied on test are equal to those on the prototype structure. The deflections on the other hand are proportional to the scale factor, that is, the prototype deflections are approximately six times those measured during model testing.

Allowance is made for the fact that the model stresses due to the weight of the model components are smaller than the equivalent stresses on the prototype. These are, again, proportional to the scale factor. In applying loads to the models, forces proportional to the square of the scale ratio must be used. The moments are proportional to the cube of the scale factor.

In order to obtain a complete picture from the test results, both deflections of the model and principal stresses along all the main sections must be determined. It is found that interpretation of the experimental results is assisted if a fairly complete calculation of the stress distribution has been previously carried out. This enables account to be taken of any boundary effects which may influence results during the tests, and to make due allowance for these in predicting prototype performance.

Fig. 4. Die pressing of fabricated runner vane.

A very considerable amount of work has already been carried out in connection with deflections and stresses in standard components such as head covers, gate shifting rings and other turbine and valve parts of conventional fabricated design. Careful investigations are made on all major new designs. One example tested was a model of the inner and outer head cover sections for the St. Lawrence power project fixed blade propeller turbines. These turbine will develop 75,000 b.h.p. under 81 foot head and have a head cover diameter of 28 ft. 5 in. The load is applied to the model as full water pressure to the whole area of the head cover and gives in this respect more exacting conditions than would in fact occur in practice. Figure 6 shows this model on test, with the deflections directly measured by clock indicators. A large number of strain gauges determine radial and tangential stresses in cover plates and stiffeners. A series of comparative tests has also been run to determine deflections and stresses on a plain flat plate with various degrees of edge support and loading. This information gave a useful supplement to accepted formulas for this type of stress calculation.

Fig. 5. Fabricated runner for 45,000 h.p. high head reaction turbine under 880 ft. head.

In addition to model tests on structures of fairly conventional design, we have applied this same technique to assist in the development of new forms of structures.

An excellent example of this is the

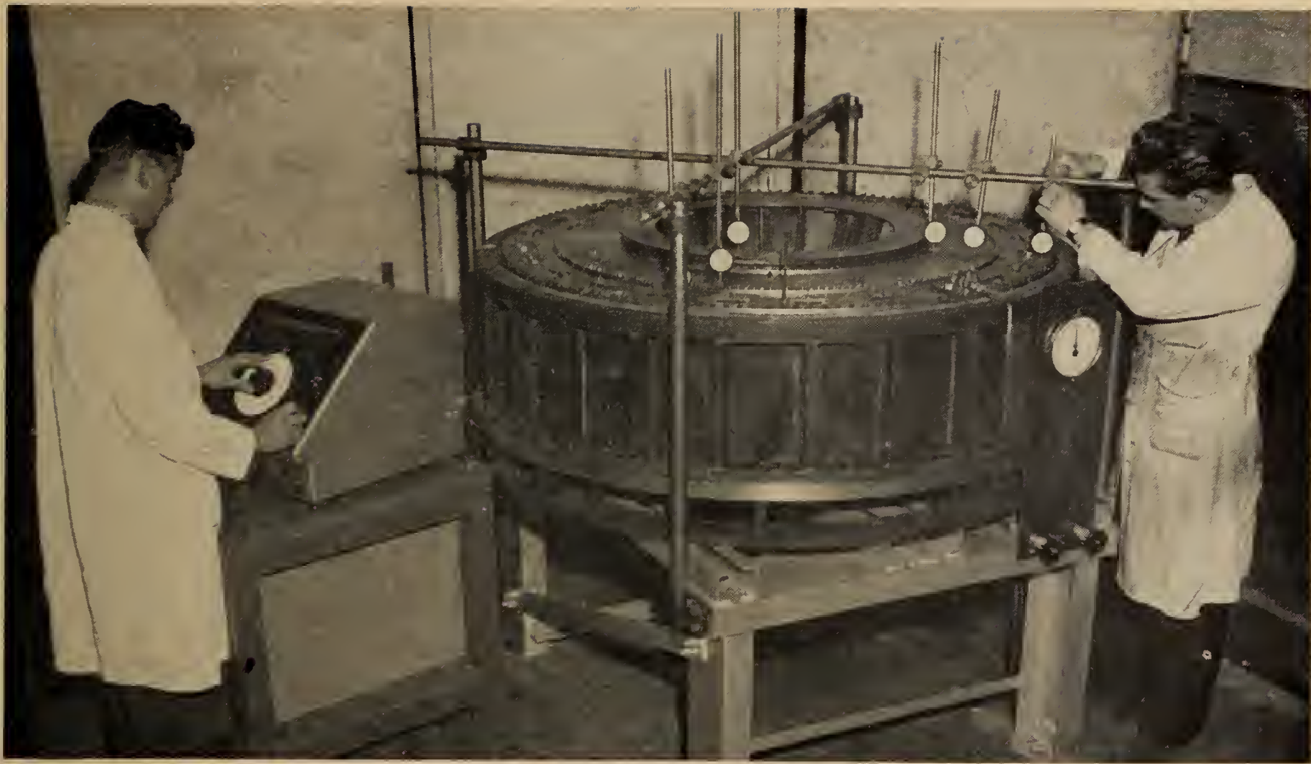


Fig. 6. Head cover model test in progress.

recent work carried out to assist the design of the speed ring diffuser of the reversible pump-turbines being supplied to the Hydro-Electric Power Commission of Ontario for the Sir Adam Beck-Niagara pumping-generating station. These units are of a special design developed specifically for this scheme, and will develop 45,000 b.h.p. under a head of 83 feet. When operating as pumps in reverse, a discharge of the order of 5,000 c.f.s. can be maintained over the full head range.

The pump-turbine units involve many unique features, both of design and construction, and extensive strain gauge testing was carried out on major components. In particular, elaborate tests were performed on the speed ring, both with and without scroll case plates in position, to determine plate stresses and to prove the method used for transmitting the heavy generator and concrete loads through to the foundations.

Fig. 7. Model testing of Niagara pump-turbine speed ring-diffuser.

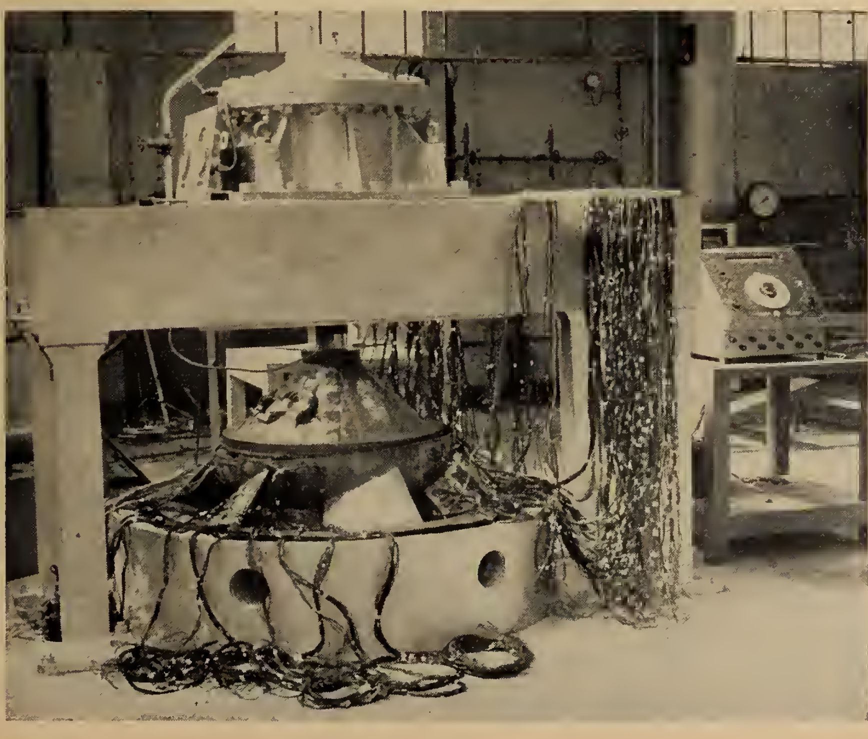


Figure 7 shows the test rig with the scale model supported on foundations of identical form to the prototype, and the loading applied by a hydraulic cylinder through a conical adapter. For this particular test, about 750 strain gauge rosettes were used, and a very thorough analysis of the stresses in stay vanes, upper and lower contour plates was obtained.

The strain gauge analysis proved the adequacy of the general design and the necessity for minor modifications and additional stiffeners in the closure section.

Manufacture of Large Welded Components

From the model we turn now to the prototype, and Fig. 8 shows the shop assembly of one of the large steel plate scroll cases for the Niagara pump-turbine development. This first casing was arranged for field rivetting, but subsequent units have been of modified design arranged for site welding. The casings are shipped in the largest possible sections to minimize the length of field-welded longitudinal joints.

In 1954, the author's company was favoured with the order for the six reversible pump-turbines for this contract, and the work on this unique plant, together with the manufacture of the four 175,000 b.h.p. turbines for the Bersimis development being constructed by the Quebec Hydro-Electric Commission and the sixteen 75,000 b.h.p. St. Lawrence power project turbines for the Hydro-Electric Power Commission of Ontario is being carried out in our Toronto plants. Each of these developments involves a relatively large number of units; four Bersimis turbines, eight straight-flow valves, six pump-turbines, and, giving the most excellent opportunities for manufacture, sixteen St. Lawrence units. The approximate proportions of fabricated construction in these designs are from 65 to 85 per cent of the total by weight.

Each development, too, involves special and interesting problems of its own. We have seen the basic development of the design of the speed ring for the Niagara pump-turbines. Fabrication of the thirty-six one-sixth sections represents the most exacting work of this type that we have yet undertaken in the water

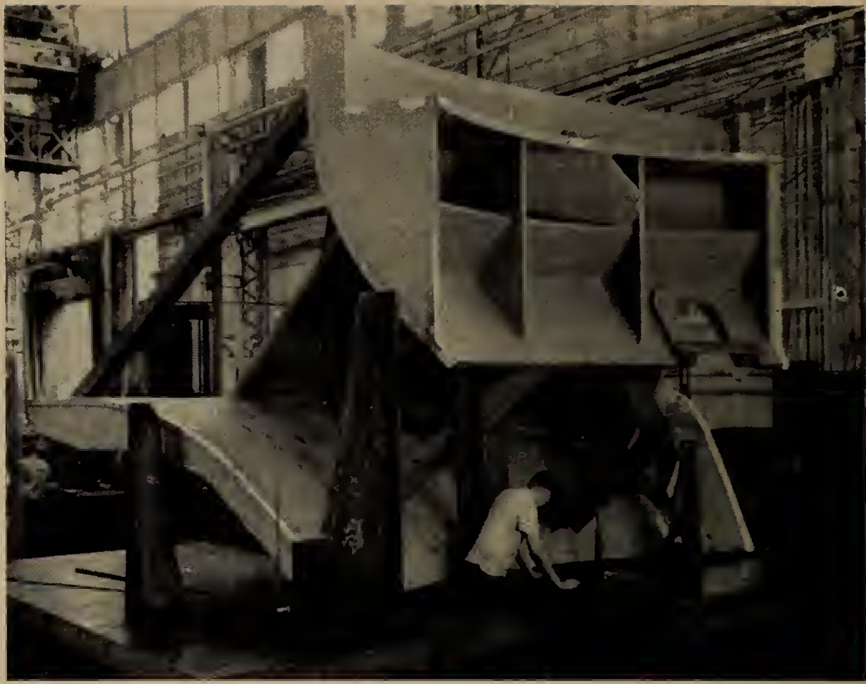


Fig. 9. Completed section of Niagara pump-turbine speed ring.

turbine field, and the ultimate accuracy of these components speaks highly for the methods used. The general form of this design involves conical water passages leading from an oblique scroll case. The physical dimensions of the major components, divided even into six segments, ruled out cast construction, and the design

Fig. 8. Shop assembly of Niagara scroll case.

was therefore developed from the outset on the basis of speed ring-diffuser, scroll case, head cover, runner envelope and discharge ring, all of welded steel plate design.

Geometrically, the design of the speed ring-diffuser section is difficult, involving intersections of spherical and annular curved surfaces with the irregular conical form of the stay vanes. The layout and assembly of each segment in turn would have involved repetition of elaborate development and measurement, as well as dangers of variations in the contours of mating sections. By preparing accurate fabrication jigs, however, the minimum amount of dimensional layout was required, and a high degree of consistency was maintained in the accuracy of sections. At the height of production of these components, four assembly jigs were in use, on which the formed plate was located and welded into upper and lower segments with their stiffeners and joint flanges. Stiffeners and joints are located in permanent slots and clamps, and the formed plate sections tacked into position.

By selection of closely approximate simple flat surfaces, the track for automatic gas-cutting torches was developed to fit the contour of the diffuser plates, which enables the slots through which the stay vanes were fed to be prepared with a high degree of accuracy and fit.

It is of interest to note that the major downward loadings are transmitted to the foundations of the unit directly through the formed plate stay vanes which project above and below the contour plates from the generator support ring to the foundation grillage. Figure 9 shows a completed segment being marked out on a layout table. The joint flange machining and drilling again employed jigging principles, which, after the first few segments had been individually proved, dispensed with this layout operation.

Figure 10 shows the completed speed ring being machined on the large 42 ft. diameter table vertical boring mill, installed by the author's company to handle work of this nature.

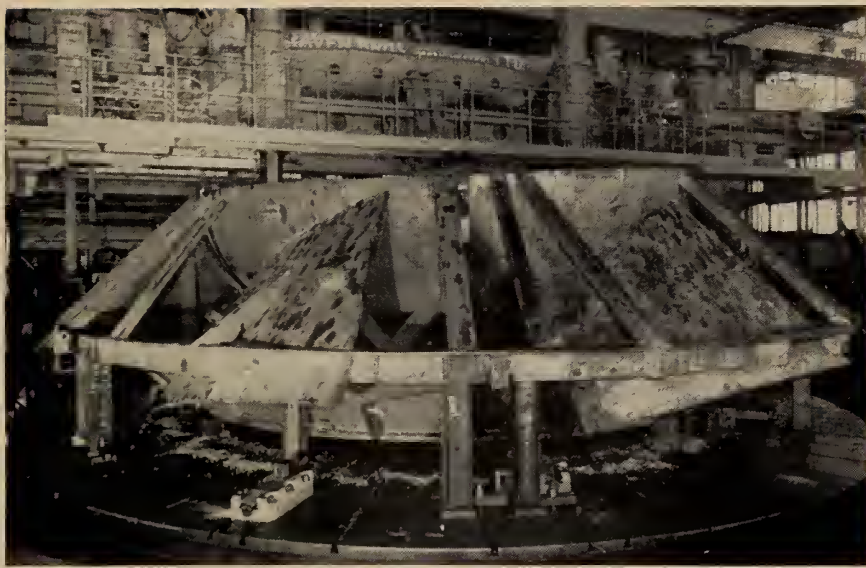


Fig. 10. Speed ring assembly during machining operations.

In the design of the runner envelope with its spherical surface in which the impeller blades rotate, another advantage of recent fabrication technique has been employed. The area of close running clearances is provided with added protection in the form of stainless clad steel plate into which the spherical form is machined. By utilizing plate sections dished in a type 405 non-air-hardening stainless cladding material forming over 40 per cent of the total thickness of the composite plate, we were able to secure outer ribbing and joint flanges to a mild steel surface, thus employing relatively simple weld procedures, and yet have a composite fabrication which could be safely thermally stress-relieved. Other grades of stainless steel with coefficients of expansion at wide variance with mild steel would have raised further difficulties.

Fig. 11. Fabricated head cover for Niagara pump-turbines.

Figure 11 shows the fabricated head cover for the Sir Adam Beck-Niagara pump-turbines. The construction of this component derives some advantage from the conical form of the water passages over the conventional "flat" head cover normally used in water turbine design. The rolled cones strutted apart with column members and radial beams give a very rigid construction. In view of its very large diameter, the head cover is fabricated in halves.

Other fabricated components include draught tube, discharge ring, pit liner and main generator thrust bearing support. The latter item incorporates heavy rolled beam sections carrying the thrust bearing loadings direct to the upper ring of the speed ring-diffuser. A more unusual application of welded plate in the design of these machines was to the main wall of the servomotor used to control the runner blades. Here we found it convenient to use a rolled steel plate of 5 in. thickness with a single heavy J-weld to replace the originally cast steel design. All six cylinders have been welded, radiographed, and stress-relieved successfully.

The extensive use and advantages of large formed steel plate sections in streamlined water passages is clearly evidenced by the Niagara pump-turbines, where the demands of the flow conditions have been adequately met.

Turning now to the design and manufacture of the eight large straight-flow valves for the Bersimis development, we find further interesting applications. These valves, weighing about 150 tons complete, have an internal bore of 93 in., and are designed for a working pressure of 540 p.s.i. The fabrication assembly of the main body is seen in Fig. 12. The outer shells are of spherical form pressed from heavy plate, section dished with a high degree of accuracy, involving the minimum of trimming and adjustment on assembly. Flanges and stiffeners are flame cut from steel plate of thicknesses up to 7 in. and fitted to the outer surfaces of the spherical shell before the heavy cast-steel shaped trunnion blocks are entered and welded into apertures flame-cut to accurate shape. The other main section of the valve body, the downstream half, was formed from conical pressings and was mounted on rotating equipment during final welding operations.

Fig. 13. Fabricated scroll case of 175,000 b.h.p. high head reaction turbine.

With the heavy plate sections involved, extensive preheating of welds was necessary. Submerged arc semi-automatic welding was used with success on more accessible circular joints, using both mechanical and hand traversing methods. By and large, however, hand welding was employed and attention concentrated on selection of optimum varieties of electrode for sound and economic welding. The main valve body welds are subjected to spot radiographic examination to maintain a high degree of quality control. As is the case with all major fabricated components, these pieces were thermally stress-relieved.

Fig. 12. Fabricated straight-flow valve body.

The closing member, or doors, for these high head valves are also fabricated from formed plate.

The application of welded construction to the manufacture of straightflow valves was concurrent with the basic development of the valve design, and hence many of the features have been entirely unaffected by transitions from cast to welded construction. In these valves, as in the pump-turbines, therefore, we have examples of basic welded design.

The manufacture of the 150,000/175,000 b.h.p. turbines for the Bersimis development during 1954 and 1955 represents the heaviest scroll case plate fabrication yet undertaken in Canada. The selection of maximum plate thickness of 2⅛ in. was made possible by use of high joint efficiencies with full radiographic examination of longitudinal welds and thermal stress-relief. Field welding of radial joints was not considered in this instance, and heavy bolted flanges were provided between the half scroll case and the two mating quarters incorporating the inlet and closing sections. Figure 13 shows the fabrication assembly proceeding.

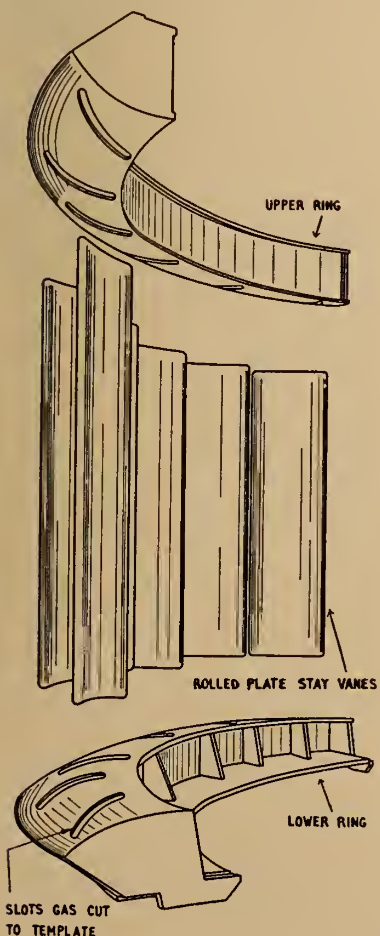
In the development of the high head reaction turbine, we have had experience of both heavy fabricated and cast steel scroll cases. From this experience, preference for the fabricated design is now well and firmly established.

Other major components which were fabricated from steel plate in accordance with our established practices were the head covers and gate operating rings for the Bersimis machines. In the case of the manufacture of these components, the advantages of batch production of weldments became apparent.

The manufacture of the sixteen St. Lawrence power project turbines has given subsequently a most excellent opportunity for concentration on the techniques of repetitive production. Sixty-four speed ring sections, thirty-two discharge ring halves, sixty-four outer head covers, three hundred and eighty-four guide vanes, all call for careful consideration of jig assembly fabrication procedures.

Taking, for instance, the speed ring section, the isometric diagrammatic view in Fig. 14 shows the three major sections which must be handled for sixty-four sub-assemblies. The upper and lower rings are fabricated from formed contour

Fig. 14. Isometric view of speed ring components.



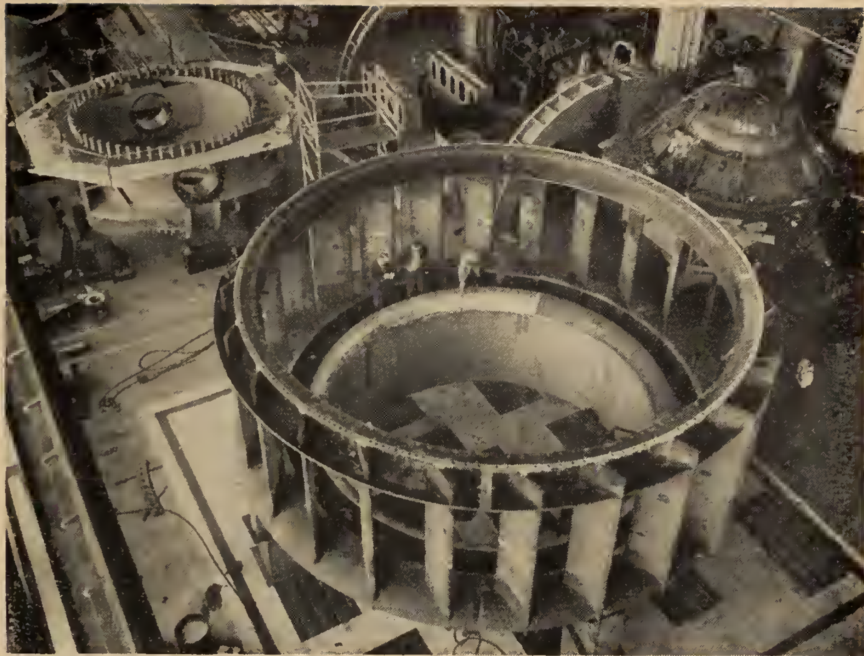


Fig. 15. Shop assembly of large fabricated components for St. Lawrence power project.

plates, ribs, and stiffeners in assembly jigs and completely welded before gas-cutting of the stay vane slots to metal templates. The rings are finally jig assembled with the stay vanes, and the speed ring quadrant fully welded.

Figure 15 shows the shop assembly of the two major embedded part components, the speed ring and discharge ring.

In the case of the St. Lawrence turbines, the size factor has weighed heavily in favour of the selection of fabricated construction. It is of interest to note that the predominance of welded components in these very large fixed-blade propeller machines is also apparent in recent manufacture in the U.S.A. of particularly large Kaplan turbines for multi-unit installations under similar head conditions and power station construction. There is little doubt that the adaptability of welded design has assisted in the extension of the manufacturing limits for hydraulic equipment.

Conclusion

For the future we can certainly predict an extension of the use of welded steel plate construction in the manufacture of water turbines and associated equipment. The author's company has already found from past experience that its merits are such that every endeavour should be made,

(1) to perfect applications to runner fabrication of all types, including perhaps impulse bucket wheels and components of Kaplan runners;

(2) to provide manufacturing facilities with heavy plate forming and welding capacity capable of handling sections of the largest reaction turbine components up to the limit of present day applications at about 1,500 foot head, and to the maximum diameters yet considered for low head ranges;

(3) to improve field welding techniques to take in heavier plate thicknesses.

In the Canadian water turbine field we have reviewed several important projects where fabricated design is applied to the fullest possible extent. It has been noted that this represents a break with Canadian tradition. There does not, however, appear to be any significant advance in the development, year by year, of the number, capacity or skills of steel foundries capable of handling major work of this type. It is likely, therefore, that in this country there will be an increase in the trend in the industry as a whole towards a much wider and more general application of fabricated design and construction.

In conclusion, I wish to record appreciation of the assistance, in preparing this paper, afforded by my colleagues in the English Electric Company Limited and our associated Canadian company, John Inglis Company Limited, where a major proportion of the fabrication work described was carried out.

Analysis of a Magnetic Control Circuit

C. H. R. Campling, M.E.I.C.

Department of Electrical Engineering, Queen's University

This paper presents an analysis of a control circuit which is related to the half-cyle-response magnetic amplifier introduced by Ramey in 1951. The analysis is presented in non-dimensional form, and the end results are curves of firing interval and normalized load current as functions of control circuit resistance. A distinguishing feature of the analysis is the combination of analytical and graphical methods.

THE basic half-wave magnetic amplifier introduced in 1951 by Ramey[1] is shown in Fig. 1(*A*). In this circuit the voltages e_{ac} and e_{ac}' are both derived from the same source and are related by the turns ratio of a transformer which is not shown in the figure. The same ratio exists between the turns of the reactor windings. In Fig. 1(*B*) there is shown a simplified version of this circuit in which e_{ac}' does not appear since it is the same as e_{ac}. The transformer has been eliminated, and the turns ratio of the reactor windings is unity. There is now of course no electrical isolation between the control circuit and the supply, but the principle of the circuit as a whole is unchanged.

The circuit of Fig. 1(*B*) can be rearranged and drawn as shown in Fig. 2(*A*). The control voltage e_c is assumed to be a half-wave rectified sinusoid. It is apparent that the effect of e_c can be obtained by inserting a variable resistor at these terminals. The resulting circuit is that shown in Fig. 2(*B*) with the additional modification that the core windings have been replaced by a single winding. No essential difference exists however since the turns ratio of the two windings in Fig. 2(*A*) is unity. The circuit of Fig. 2(*B*) has been discussed in qualitative terms by Attura[2].

The purpose of this paper is to present a complete analysis of the circuit of Fig. 2(*B*). The circuit has been referred to as an amplifier, but it may be more correct and more satisfying to call it simply a control circuit. The analysis presented here is quantitative (subject to the idealizing assumptions) and is carried to completion with a combination of algebraic and graphical methods. The results are presented in the form of normalized curves.

Analysis

Assumptions—It is common practice in the analysis and design of magnetic amplifiers and dynamic magnetic circuits in general to make certain idealizing assumptions regarding the core material. These assumptions may take various forms, but here it will be assumed that the core is of rectangular-loop material, that the saturation flux density and the remanent flux density are the same and that the winding on the core has zero inductance when the core is saturated. The rectifiers will be assumed to have infinite resistance in the reverse direction and zero resistance in the forward direction. The winding on the core will also be assumed to have negligible resistance. The assumptions regarding winding resistance and rectifier resistance are realistic to the extent that these effects can be included if necessary in the values assigned to the resistors R_C and R_L. It will also be assumed that the supply voltage e_{ac} is sinusoidal and of amplitude just sufficient to cause the core to cycle between positive and negative saturation when each of the resistors R_C and R_L is zero. This voltage will be designated as $-E_m \sin \omega t$. The sides of the dynamic hysteresis loop will be assumed to be vertical, and consequently the coil inductance is assumed to be infinite when a vertical side of the loop is traversed. The width of the loop can be taken as that corresponding to the frequency of the supply.

Equivalent Circuit

As a result of the assumptions stated the rectifiers may be treated as the equivalent of a single-pole double-throw switch which operates each half-cycle of the supply voltage at the instant when this voltage passes through zero. The equivalent circuit is shown in Fig. 3. The symbols shown in Fig. 3 are those which will be used in the analysis.

General

If the resistors R_C and R_L are not alike and if R_C is greater than R_L the core will traverse during each cycle of the supply voltage an asymmetrical hysteresis loop such as that shown in Fig. 4. During the so-called reset half-cycle the switch (Fig. 3) is thrown to position "*a*" and the current through the control resistor is determined for the most part by the hysteresis loop and is equal to I_c. At the conclusion of this half-cycle the flux in the core has been set to some value below the positive saturation level by an amount designated as ϕ_c. During the following or gating half-cycle the switch is thrown to position "*b*" and the current through the load resistor R_L is limited to the value I_c until the flux in the core reaches the positive saturation value. At this time the core is said to fire. The winding inductance becomes zero and the current drawn from the supply is limited only by the resistor R_L. It continues at a value determined by e_{ac} and R_L until e_{ac} is again zero and thereafter the same cycle is repeated. Any change in R_C causes a change in the flux excursion ϕ_c during the reset half-cycle which in turn will affect the time at which firing occurs in the gating half-cycle. If R_C is made very large, say infinite, no resetting occurs and the core remains saturated always so that maximum load power is obtained.

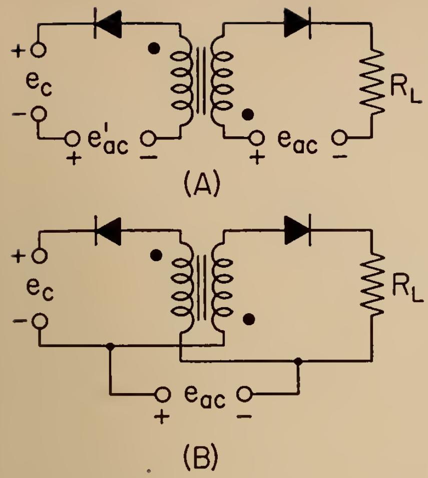


Fig. 1. (A) Half-wave Ramey amplifier. (B) Amplifier modified for unity turns ratio.

On the other hand there will be no firing in the gating half-cycle if $R_C = R_L$, and this is the condition for minimum output. The core in this case will traverse only a rectangular hysteresis loop just as it does if $R_C = R_L = 0$.

Reset Half-Cycle

A more detailed examination of the circuit will now be presented. If t_0 is taken as the time when the switch (Fig. 3) is thrown to position "*a*" then the waveforms of supply voltage, control voltage and coil voltage are as shown in Fig. 5 for the reset half-cycle. The points on the hysteresis loop corresponding to t_0, t_1, t_2 and t_3 are shown in Fig. 4. Between t_0 and t_1 the whole supply voltage appears across the control resistor since the coil inductance is zero. At $t = t_1$ however the coil inductance becomes infinite, and the current in it remains constant at the value I_c during the interval t_1t_2 while the voltage across the coil increases and then decreases in the form of a truncated sinusoid. In the same interval the core flux changes by an amount ϕ_c. At t_2 the coil inductance is again zero and the current is determined only by e_{ac} and R_C between t_2 and t_3.

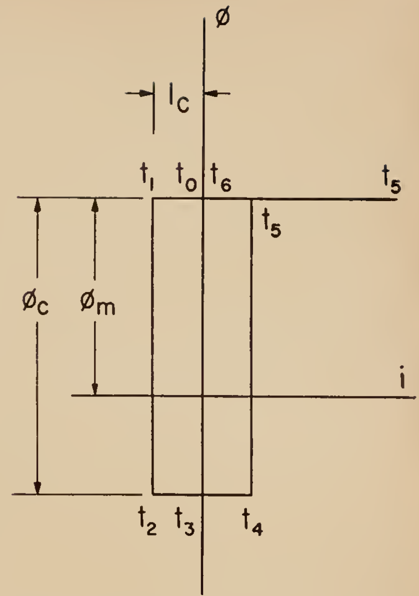


Fig. 4. Asymmetrical hysteresis loop for the magnetic core.

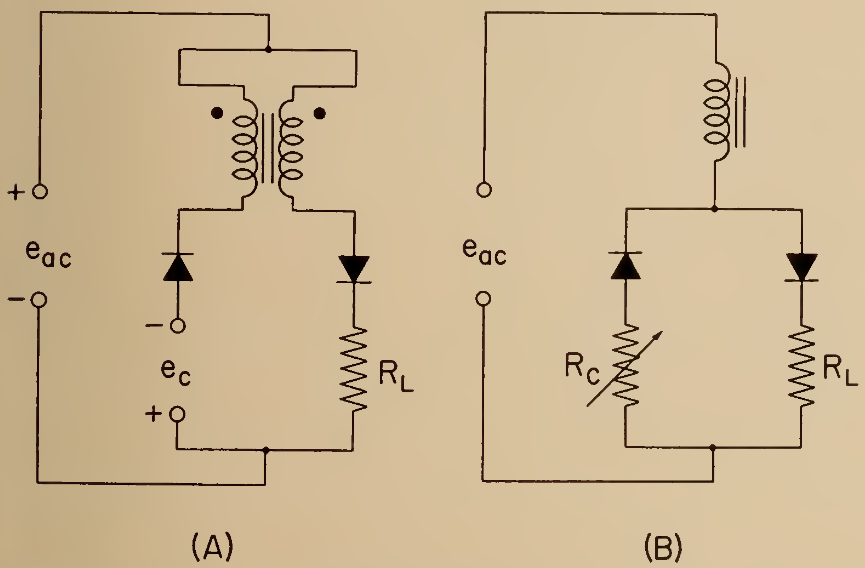


Fig. 2. (A) Alternative arrangement of Ramey circuit. (B) Modified circuit with resistance control.

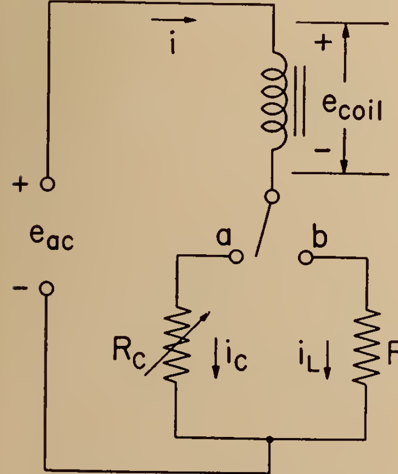


Fig. 3. Equivalent circuit for resistance control.

The following quantitative results apply. The time t_1 may be determined from:

$$t_1 = (1/\omega)\sin^{-1}(I_cR_C/E_m) \quad (1)$$

Between t_1 and t_2 the coil voltage is given by

$$e_{coil} = -E_m \sin \omega t + I_cR_C \quad (2)$$

and the flux change ϕ_c is given accordingly by

$$\phi_c = \frac{1}{N}\int_{t_1}^{t_2} e_{coil}dt$$

$$= (E_m/N\omega)(\cos \omega t_2 - \cos \omega t_1) + (I_cR_C/N)(t_2 - t_1) \quad (3)$$

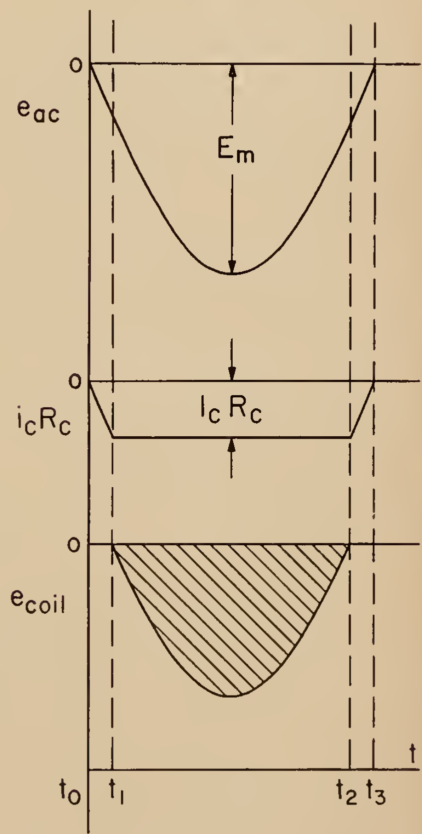


Fig. 5. Circuit waveforms for the reset half-cycle.

Between t_2 and t_3 the coil inductance is again zero and i_C is equal to e_{ac}/R_C.

Gating Half-Cycle

The waveforms for this half-cycle are shown in Fig. 6. At t_3 the switch (Fig. 3) is thrown to position "*b*". Between t_3 and t_4 the coil inductance is zero and no voltage appears across it. At t_4 however, just as at t_1, the coil inductance becomes infinite, the coil current is fixed at the value I_c, and the flux begins to change toward the positive saturation value. The time t_4 is given by:

$$t_4 = (1/\omega)\sin^{-1}(-I_cR_L/E_m) \quad (4)$$

The time interval t_3t_4 will be shorter than t_0t_1 so long as it is assumed that $R_L < R_C$. Likewise the drop I_cR_L will be smaller than I_cR_C.

During the interval t_4t_5 the core flux changes until it reaches the saturation value ϕ_m. It reaches this value when the area under the e_{coil} — waveform in Fig. 6 is equal to the area under the e_{coil} — wave form in Fig. 5. These areas are cross hatched. Between t_4 and t_5 the coil voltage is given by:

$$e_{coil} = -E_m\sin\omega t - I_cR_L \quad (5)$$

The flux change ϕ_c, which is of course the same as that which occurs in the reset half-cycle except for sign, is given by:

$$-\phi_c = \frac{1}{N}\int_{t_4}^{t_5} e_{coil}dt$$

$$= -(E_m/N\omega)(\cos\omega t_4 - \cos\omega t_5) - (I_cR_L/N)(t_5 - t_4) \quad (6)$$

Normalized Solution

Normalized Equations

It is expedient to present some of the results in normalized form.

Let

$$k = R_C/(E_m/I_c) \quad (14)$$

Then:

$$\phi_c = (E_m/N\omega)\left[k(\pi - 2\sin^{-1}k) - 2\sqrt{1-k^2}\right] \quad (15)$$

It will be recognized also that:

$$E_m/N\omega = \phi_m \quad (16)$$

Hence we have:

$$\phi_c/\phi_m = k(\pi - 2\sin^{-1}k) - 2\sqrt{1-k^2} \quad (17)$$

Now for further normalization it is desirable to express the load resistance in a nondimensional form.

Let

$$k' = R_L/(E_m/I_c) \quad (18)$$

Then we have:

$$\omega t_4 = \sin^{-1}(-k') \quad (19)$$
$$= \pi + \sin^{-1}k'$$

Hence:

$$-\phi_c = (E_m/N\omega)\left[(\cos\omega t_5 + \sqrt{1-k'^2}) - k'(\omega t_5 - \pi - \sin^{-1}k')\right] \quad (20)$$

The problem here is to find t_5 when the value of ϕ_c is determined from the results of the calculation for the reset half-cycle. This problem reduces to that of solving the equation.

$$\cos\omega t_5 = k_1t_5 + k_2 \quad (7)$$

where k_1 and k_2 are constants. An accurate graphical solution is possible and will be discussed later.

At t_5 the core saturates and the whole supply voltage appears across the load resistance. Between t_5 and t_6 accordingly the coil and load current is given by

$$i_L = -(E_m/R_L)\sin\omega t \quad (8)$$

At t_6 the load current reaches zero and the cycle repeats.

Determination of ϕ_c.

It has been shown that the flux excursion during the reset half-cycle is given by

$$\phi_c = (E_m/N\omega)(\cos\omega t_2 - \cos\omega t_1) + (I_cR_C/N)(t_2 - t_1) \quad (3)$$

Also:

$$t_2 = (\pi/\omega) - t_1 \quad (9)$$

Hence:

$$\cos\omega t_2 - \cos\omega t_1 = -2\cos\omega t_1 \quad (10)$$

And therefore:

$$\phi_c = (I_cR_C/N)(\pi/\omega - 2t_1) - (2E_m/N\omega)\cos\omega t_1$$

Now:

$$t_1 = (1/\omega)\sin^{-1}(I_cR_C/E_m) \quad (1)$$

Hence:

$$\phi_c = (I_cR_C/N\omega)\left[\pi - 2\sin^{-1}(I_cR_C/E_m)\right] - (2/N\omega)\sqrt{E_m^2 - I_c^2R_C^2} \quad (12)$$

For maximum output $\phi_c = 0$ and the condition required for this output is that

$$R_C = E_m/I_c \quad (13)$$

For this value of R_C both terms in the expression for ϕ_c become zero.

And:

$$-\phi_c/\phi_m = \cos\omega t_5 - k'\omega t_5 + \sqrt{1-k'^2} + k'\sin^{-1}k' + k'\pi \quad (21$$

By combining equations (17) and (21) it is possible to obtain an equation in which the firing angle ωt_5 is given in terms of the dimensionless quantities k and k'. Thus we have:

$$\cos\omega t_5 - k'\omega t_5$$
$$= -k(\pi - 2\sin^{-1}k) + 2\sqrt{1-k^2}$$
$$- k'(\pi + \sin^{-1}k') - \sqrt{1-k'^2} \quad (22)$$

It is interesting here to note that if $k = k'$ the operation of the circuit should be symmetrical and we should have:

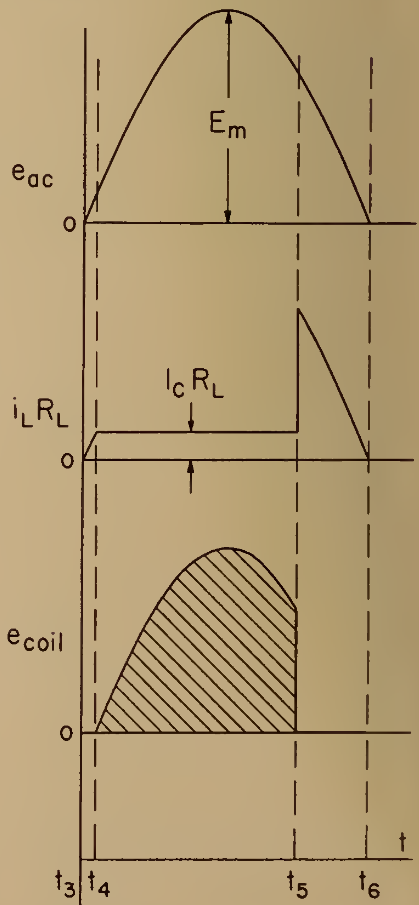
$$\omega t_5 = 2\pi - \omega t_1 = 2\pi - \sin^{-1}k \quad (23)$$

and

$$\cos\omega t_5 = \sqrt{1-k^2} \quad (24)$$

If these substitutions are made in equation

Fig. 6. Circuit waveforms for the gating half-cycle.



(22) the result is an identity as would be expected. In general however if $k = k'$ the ratio of ϕ_c to ϕ_m is given by:

$$\phi_c/\phi_m = k\pi - 2\sqrt{1 - k^2} - 2k \sin^{-1}k \quad (17)$$

This ratio is equal to two only if $k = k' = 0$, i.e. if both resistances are zero.

Determination of Firing Angle

The determination of the angle ωt_5 requires the solution of the equation

$$\cos \omega t_5 - k'\omega t_5 = f(k') + g(k) \quad (25)$$

where

$$f(k') = -k'(\pi + \sin^{-1}k') - \sqrt{1 - k'^2} \quad (26)$$

and

$$g(k) = -k(\pi - 2 \sin^{-1}k) + 2\sqrt{1 - k^2} \quad (27)$$

For any pair of values of k and k' the equation reduces to:

$$\cos \omega t_5 - k'\omega t_5 = K \quad (28)$$

where

$$K = f(k') + g(k) \quad (29)$$

and a solution may be found graphically from the intersection of the curve:

$$y = \cos \omega t_5, \quad (30)$$

and the line:

$$y = k'\omega t_5 + K \quad (31)$$

A generalization of this graphical solution may be obtained if it is recognized that for any particular R_L and k' the values of ωt_5 which correspond to various values of R_C and k may be found by drawing a set of parallel lines to intersect the cosine curve. Also for a certain k' we will have $f(k') = 0$. Let this value be designated as k'_o. Then:

$$y = k_o'\omega t_5 + g(k) \quad (32)$$

It is possible then to select a set of k's and find the y intercepts of the corresponding family of lines with slope k_o' by calculating only $g(k)$ rather than both $f(k')$ and $g(k)$.

Considcr another value of k' and call it k'_1. Also let

$$\omega t_5 = \omega t_5' - f(k_1')/k_1' \quad (33)$$

It follows that:

$$y = k_1'\omega t_5' + g(k) \quad (34)$$

Thus by shifting the y-axis by an amount equal to $f(k_1')/k_1'$ it becomes possible to plot a new set of lines having slope k_1' but for which the y-intercepts are the same on the *new* y-axis as those previously used for the lines having slope k_o'. By this process the rapid graphical determination of firing angles is made possible for all values of k and k'.

The form of the construction used is illustrated in Fig. 7. Note that the y-axis is shifted to the *right* by the amount $f(k')/k'$ because the value of $f(k')$ is itself negative. The results of this analysis are shown in the curves of Fig. 8 where the firing period, defined as $2\pi - \omega t_5$ is plotted against k, the normalized control resistance, for various values of the load resistance parameter k'.

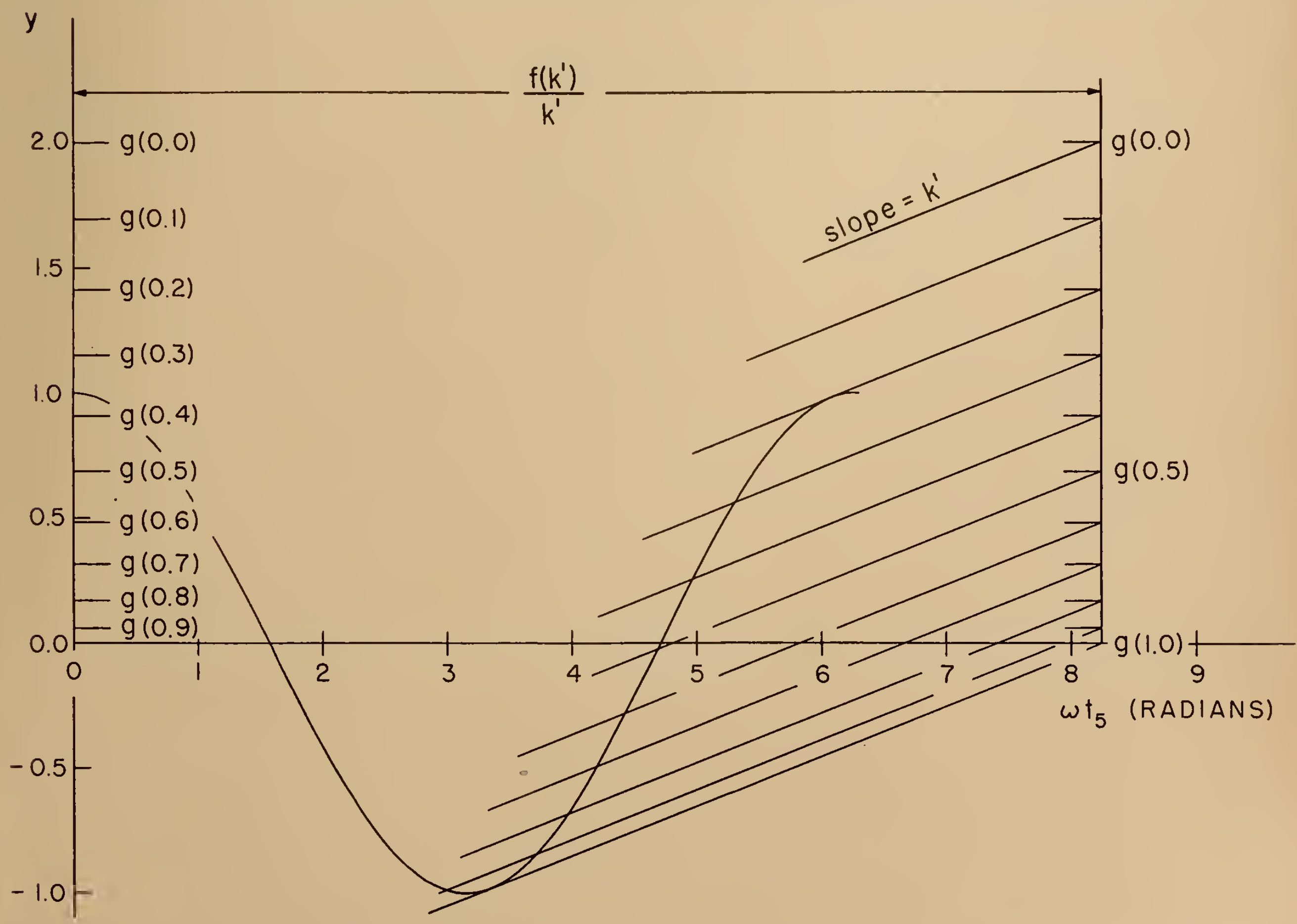
Normalized Power Output and RMS Current

The power developed in the resistor R_L is given by $I_{rms}^2 R_L$ and the rms current in the load is defined as usual by

$$I_{rms} = \sqrt{\frac{1}{2\pi}\int_{\pi}^{2\pi} i_L^2 d\omega t} \quad (35)$$

A complete expression for the square of the rms current may be found by piecewise integration. The result is shown in equation 36 (top of next page).

Fig. 7. Graphical construction for the determination of firing angle. Construction is shown for k′ = 0.2.



$$I_{rms}^2 = (1/2\pi)(E_m/R_L)^2 [(1/2 - k'^2)(\sin^{-1}k') + \pi(1 - k'^2) + \omega t_5(k'^2 - 1/2) - (k'/2)\sqrt{1 - k'^2} + (1/2)\sin\omega t_5 \cos\omega t_5] \quad (36)$$

The quotient $I_{rms}/(E_m/R_L)$ can be defined as a normalized or per-unit load current. If we call this normalized current k'' then k''^2 can be considered as a normalized load power since:

$$k''^2 = I_{rms}^2/(E_m/R_L)^2$$
$$= I_{rms}^2 R_L/(E_m^2/R_L) \quad (37)$$

The normalized current is given by (38):

$$k'' = \sqrt{(1/2\pi)[(1/2 - k'^2)(\sin^{-1}k') + \pi(1 - k'^2) + \omega t_5(k'^2 - 1/2) - (k'/2)\sqrt{1 - k'^2} + (1/2)\sin\omega t_5 \cos\omega t_5]} \quad (38)$$

Curves of the normalized current as calculated from the above expression are shown in Fig. 9. The value of ωt_5 is determined by the graphical method already described.

Interpretation of the Curves

It is helpful to relate the curves of Fig. 8 to the circuit waveforms in order to make their significance more clear and also to examine the performance of the circuit when $k > 1$ and when $k < k'$.

Let it be assumed that $k' < 1$. Then for all values of k between k' and unity the circuit behaviour follows the pattern already described. If $k > 1$ there is no reset action and the core is always saturated. Thus the curves of Figs. 8 and 9 are flat for $k > 1$. Note that the firing interval in Fig. 8 does not reach a maximum equal to π radians nor a minimum of zero and that in fact the maximum and minimum depend upon k'. This situation results from the definition of the firing interval. Its minimum and maximum values depend upon the breadth of the base of the truncated sinusoid formed by deducting $I_c R_L$ from $E_m \sin\omega t$. If the hysteresis loop is considered for this case ($k > 1$) it is found to have degenerated to a line at the level ϕ_m. The negative excursion of the coil current is now less than I_c and will reduce to zero if k becomes infinite. The positive excursion of i is equal to E_m/R_L.

When $k = k'$ the operation of the circuit is symmetrical and both the i_C and i_L waveforms are truncated sinusoids of amplitude I_c. If this state is approached by reducing k from some larger value the hysteresis loop when $k = k'$ will be a rectangle of width I_c. The positive flux excursion will be ϕ_m, but the negative flux excursion will be somewhat less. The total flux excursion will be less than $2\phi_m$ because k and k' are non-zero and because $2\phi_m$ corresponds to the volt-time area under one half-cycle of the supply voltage. If now k is made less than k' a transition process occurs. There will be first necessarily a greater flux change in the reset half-cycle, and the flux will decrease from $+\phi_m$ to some value closer to $-\phi_m$. Similarly in the succeeding gating half-cycle it will increase to a value somewhat less than $+\phi_m$. In other words the hysteresis rectangle shifts downward until its lower extremity is at the level $-\phi_m$. Because k is now less than k' the transition process is not complete until firing occurs in what has been called the reset half-cycle. Nevertheless if k' remains constant the power in R_L will remain constant and therefore the curves in Figs. 8 and 9 are flat at their lower extremities, i.e., for $0 < k < k'$.

The lower value of k'' at which the curves of Fig. 9 flatten can be determined analytically by setting $k' = k$ in equation (38). The value of ωt_5 which must be substituted in equation (38) in this case is:

$$\omega t_5 = 2\pi - \sin^{-1}k \quad (39)$$

The corresponding value for k'' is:

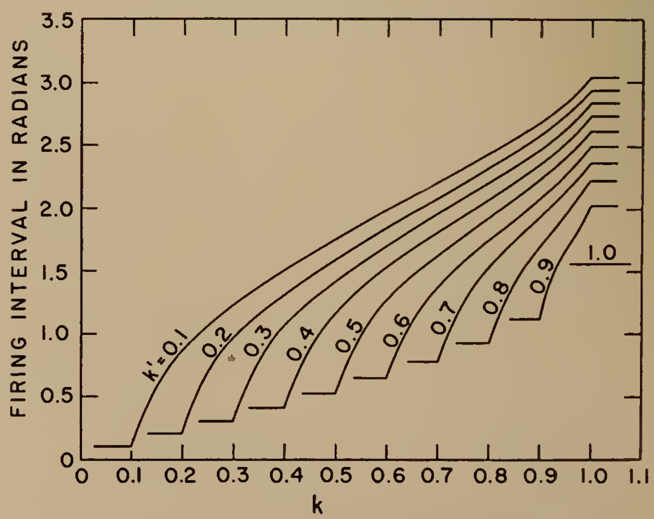
$$k''\Big|_{k = k'} = \sqrt{(1/2\pi)[\pi k^2 - k\sqrt{1 - k^2} + 2(1/2 - k^2)\sin^{-1}k]} \quad (40)$$

Alternative Load-Current Characteristics

Rather than plot the quantity k'' against k it is possible to plot the ratio I_{rms}/I_c. This dimensionless current ratio, which will be called α has the advantage that it does not itself depend upon k' in the same way that k'' does. In fact $k'' = k'\alpha$. The characteristics so determined give a better idea in dimensionless form of the orientation of the actual output characteristics for a specific circuit. These characteristics are shown in Fig. 10. For these curves the lower value of α at which the curves flatten is given by:

$$\alpha\Big|_{k = k'} = (1/k)\sqrt{(1/2\pi)[\pi k^2 - k\sqrt{1 - k^2} + 2(1/2 - k^2)\sin^{-1}k]} \quad (41)$$

Fig. 8. Firing characteristics.



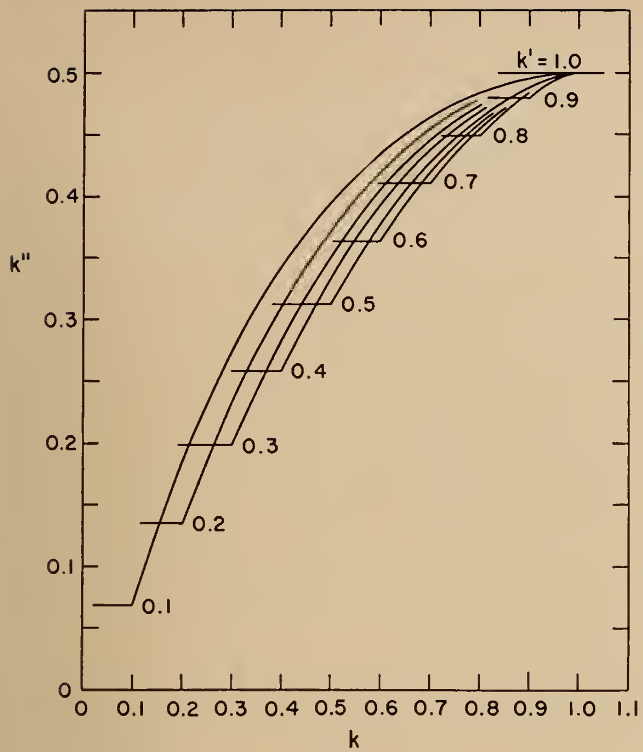


Fig. 9. Dimensionless output characteristics.

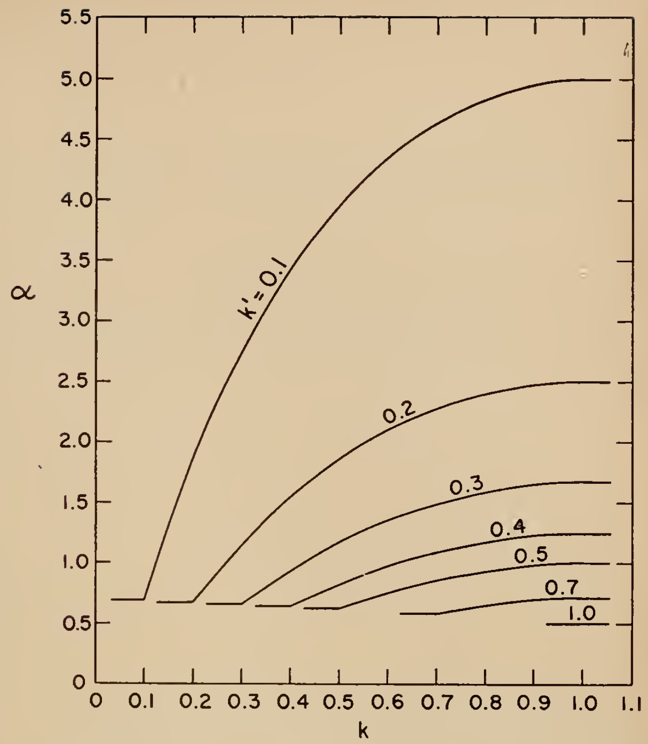


Fig. 10. Dimensionless output characteristics. Output variable independent of load resistance.

Conclusions

An analysis has been presented of a half-cycle-response magnetic control circuit. The circuit, while simple, is a building block for many of the more complex magnetic amplifiers which have been widely discussed in the literature. The control resistor R_C may be replaced by various other circuit elements including transistors, in which case the amplifying properties become more readily apparent.

The features of the analysis include:

(1) A combination of analytical and graphical methods.

(2) A solution in dimensionless form which is extended readily to all values of the control and load parameters by the nature of the graphical method used.

(3) A recognition of the transition process which takes place when the core changes from operation in which it is saturated in one direction to operation in which it is saturated in the opposite direction. This effect is discussed for the case in which the supply voltage is just sufficient to cause operation of the core between positive and negative saturation when the resistance in series with the core winding is zero.

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Nomenclature

e_{ac}	instantaneous supply voltage
e'_{ac}	instantaneous control-circuit supply voltage
e_c	instantaneous control voltage
e_{coil}	instantaneous coil voltage
E_m	maximum value of supply voltage
i	instantaneous coil current
i_C	instantaneous current in control resistor
i_L	instantaneous current in load resistor
I_c	coil current corresponding to the coercive force
I_{rms}	rms value of load current
k	$R_C/(E_m/I_c)$
k'	$R_L/(E_m/I_c)$
k''	$I_{rms}/(E_m/R_L)$
k_1, k_2	constants
N	number of turns
R_C	control resistance
R_L	load resistance
t	time
α	I_{rms}/I_c
ϕ	magnetic flux
ϕ_c	flux change during reset half-cycle
ϕ_m	saturation flux
ω	angular frequency

The Economic Position of Canadian Scientists and Engineers

John F. Haberer and F. L. W. McKim

Division of Administration, National Research Council, Ottawa

DURING the twentieth century Canadians have been steadily improving their standard of living. Originally this improvement depended almost entirely upon the export of basic raw materials and a triangular system of trade with Great Britain and the United States. However, since the Second World War, Canadian living standards have improved still further because of the very rapid development of secondary industries. As a result of this development, the present demand for scientists and engineers exceeds the supply, and interest in scientific research has never been greater. It is the purpose of this paper to discuss the professional and economic status of Canadian scientists and engineers over the last half century.

Growth of Research

It is difficult to determine accurately the amount of scientific research conducted in Canada since 1900. However, prior to World War I, it was limited and was connected mainly with primary industries and health. Government departments did some; university science faculties, overloaded with teaching responsibilities, did a little; and industry, which consisted mainly of subsidiaries of American and British firms depended chiefly upon foreign sources for new information.

World War I saw the establishment of the National Research Council, the first government agency whose objective was to promote scientific research. At first, its function consisted of granting monies for scholarships and research in the universities, in order to build up a corps of scientists and to stimulate the development of graduate schools. It wasn't until 1932 that the first of its present laboratories was opened. Growth was very slow during the depression years; by 1939 its scientific staff numbered only 79 persons. World War II saw a surge of government-sponsored research for defence purposes, and early in the war, the National Research Council was designated as the research laboratory of the Army, Navy, and Air Force. Since the war, government activity in all fields of scientific research has continued to increase, and at present, 564 scientists and engineers are employed in the laboratories of the National Research Council. The Defence Research Board and Atomic Energy of Canada Limited, two organizations that grew out of the Council's war efforts and that have since been established as separate units, employ 990 scientists and engineers. Thus in 17 years, one Canadian organization has become three separate establishments and the total staff has increased almost 20 times. Other research institutions (the universities, federal and provincial government departments and, more recently, industrial laboratories) have also shown phenomenal growth.

Organization of Research

In Canada the primary industries were the first to develop and, to meet their needs, research organizations were set up by the corresponding government departments, such as the Department of Agriculture. Secondary industries, which have come into operation more recently, are being served by federal and provincial research councils. Since many Canadian firms have parent companies in either the United States or Great Britain, with well established research institutions in the home country, Canadian industry has been slow to set up its own research organizations. As a result government support for industrial research is proportionately greater than in other industrialized countries. Federal government expenditures for research now total more than 100 million dollars annually, exclusive of the amount spent on defence development contracts.

Research work in the Canadian universities has also expanded greatly, and is supported largely by government grants from various departments. As an example, the National Research Council grants-in-aid and scholarships program has increased nearly twelve times since 1946 and now exceeds $3,500,000 per annum. An estimate of expenditures made by the Canadian Association of University Business Officers for 1954-55 shows that twenty-three universities and colleges spent a total of $7,280,000 on research projects. Over half of this amount was provided by government grants.

Until comparatively recently, industrial research activity has been the exception rather than the rule. The relatively very large pulp and paper industry, however, has organized a research association with its own laboratory. In other industries there is now a tendency for subsidary firms to establish research organizations in Canada, and an encouraging number of Canadian firms have recently built their own laboratories. Industrial research is growing rapidly, even though support by industry at the moment is still far behind that provided in other industrial countries.

The Scientific Profession

In 1911, the professional group as a whole made up approximately 4.4% of the persons actively engaged in all occupations in Canada. By 1951, this group had increased in size by more than 300% and its members constituted about 7.2% of those actively engaged in all occupations.

Figure I shows the distribution of various classes within the professional group. In 1911, approximately 6.6% of all professionals were included in the scientific and technological class. By 1941 this percentage had doubled and, by 1951, had tripled to 18.5%. In 1950, United States census data showed that more than 20% of the professional group was included in the scientific and technological class. In 1954, scientists and engineers made up about 35% of Russia's professional group.[1] The outstanding feature of the Russian scientific and engineering class is the large number of women that it includes.

A further indication of the growing importance of the scientific profession relative to other professions is shown by the number of people obtaining the doctor's degree. In 1925, the two largest Canadian universities awarded a total of 20 Ph.D.'s, 14 of which were in the scientific fields. In 1955, the number of doctor's degrees awarded to scientists by these same two universities was 126 out of 154 Ph.D.'s granted, 82% of the total and an increase of 12% in favour of the scientists in the intervening 30-year period.

Absolute numbers from census data show that there were twice as many persons included in the scientific and technological professions in 1951 as there were in 1941. The Technical Personnel Register of the Department of Labour shows that 32.344 engineers and scientists were registered in 1946, when registration was obligatory. In spite of the fact that registration is no longer compulsory, the number of scientists and engineers in the register has increased to 38,711 with 21,448 registered as professional engineers. Conservative estimates place the total number of professional engineers and scientists at between 55,000 and 60,000, with the professional engineering group numbering about 30,000. During the past few years university engineering graduates at the bachelor level have averaged about 1,300. In the fall of 1955 there were some 1,579 students registered for postgraduate work, 1,259 in pure science fields and 320 in the various fields of engineering.

Serious concern has been expressed over the years about the loss of Canadian scientists and engineers to the United States. The most recent figures available show that from 1953 to 1955 the total number of professional engineers emigrating from Canada to the United States averaged 280 per year — 8% of the total number of professional workers emigrating from Canada to the United States. Over the same period the immigration of engineers to Canada from the United States has averaged 140 and the total annual immigration of professional engineers into Canada has averaged 1,570. So over this recent period Canada has gained about six times as many engineers as she lost to the United States.

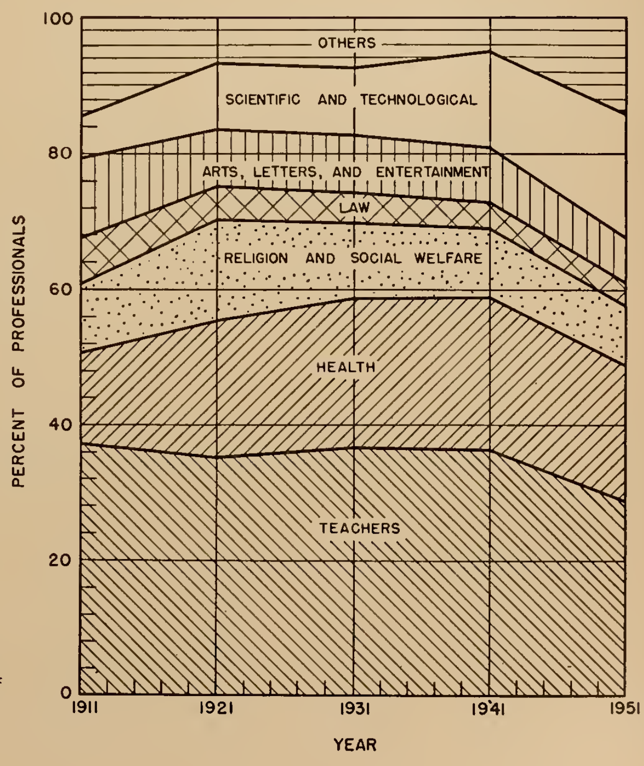
Salaries of Scientists in Relation to Wages

Figure II compares the relative change in the economic position of professional workers and wage earners in manufacturing over the period 1911-1955. The census data used in this figure is the only source of information on the earnings of professionals over this period. Although 1956 census data is not yet available, information obtained in recent surveys of scientific salaries indicates that, although the real earnings of the professional group have improved greatly in recent years, the percentage increase is still well below that of the wage earners. Over the forty-year period 1911-1951, real earnings of wage earners have increased nearly 250%. During the same time, the professional group improved its position by a mere 38%. The positive effect of unionization among the wage earners is clearly evident. The relative decline in the real earnings of professionals can be attributed also to the conditions of the thirties and

Fig. 1.

Distribution of Professionals.

1911-1951.



Source:
Census of Canada, Dominion Bureau of Statistics.

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1. "Engineering and Scientific Manpower in the United States, Western Europe, and Soviet Russia," United States Government Printing Office, Washington, 1956.

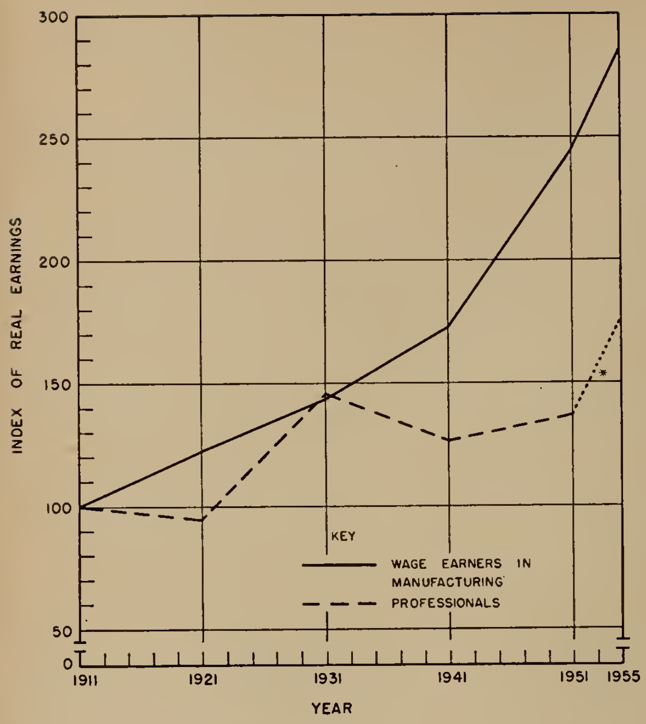

Fig. 2.

Average Real Earnings of Professionals and Wage Earners.

1911-1955

1. Real Earnings are found by dividing Index of Money Earnings by Cost of Living Index.

2. Professionals include—lawyers and notaries, physicians and surgeons, engineers, chemists and teachers.

3. Source: Dominion Bureau of Statistics.

*Increase in real earnings of scientists. Source—N.R.C. Salary Surveys, 1951 to 1956.

to the ensuing World War. Although not affected so severely by unemployment, the professional workers certainly suffered the effects of the depression through a decrease in real earnings. Later during the war period, professional salaries were frozen while wage earners continued to improve their position at an increasing rate; following the war and up to and including 1951, professional salary increases were largely offset by increases in the cost of living.

Since 1952 the consumer price index has held fairly steady while salaries and wages of both professional and non-professional groups have continued to rise. Between 1952 and 1955, wage earners in manufacturing increased their real earnings by 11%[2]. Average salaries reported in the National Research Council surveys of professional salaries indicate that scientists and engineers improved their position by 21% during the same period. Although there has been an upward trend to the advantage of scientific professionals in the past few years, over a longer period wage earners have done much better. This is further illustrated by Table I.

In 1955, Canadian Ph.D. scientists received an average of 1.93 times as much as wage earners in manufacturing as against 4 or 5 times as much in 1930. The 1955 ratio of American Ph.D.'s salaries to the earnings of non-salaried production workers in manufacturing was 1.8. United Kingdom Ph.D.'s are rewarded more liberally relative to wage earners in a selected group of manufacturing industries, their earnings being 2.65 times greater. The reports of recent visitors to the U.S.S R. indicate that a much higher ratio exists there.

Table I. National Research Council

Average Salaries for Various Categories of Staff as a Ratio of 1933 Salaries

Year at 1 July	Scientific	Prevailing Rate Workers
1933	1.00	1.00
1936	1.13	1.42
1939	1.08	1.70
1942	.89	1.77
1945	.94	2.19
1948	1.24	2.60
1951	1.50	3.12
1954	1.83	3.39
1956	2.07	3.68

Scientific Salary Spreads

It has been a common occurrence over the past few years for experienced professionals to find their salaries exceeded by offers made to new graduates. Competition for scientific personnel has caused the starting salaries for inexperienced people to increase at a faster rate than adjustments for experienced staff. This trend can be illustrated by a comparison of Ph.D. starting rates and the maximum salary for the senior research officer grade at the National Research Council. In 1939, new Ph.D.'s were offered $2,100 when the maximum senior grade salary was $5,200. The current starting salary for Ph.D.'s is $5.500, with the maximum for seniors at $9.000. Thus, from 1939 to 1956. the ratio of maximum scientific salaries to starting rates has decreased from 2.5 to 1.6. Another example of the compression of the maximum/minimum salary spread is found in the universities. In 1929, the maximum salaries of professors in the larger universities exceeded minimum salaries of lecturers by 4.3 times. By 1955, this ratio had been reduced to 3.1. While both starting and maximum salaries are higher, the monetary spread is still of the same order as in 1939. On the other hand money has only half the purchasing power it had and taxation is many times greater. (Table II).

The effect of compression is also felt at all intervening points. From 1952 to 1956, for example, in the

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2 Dominion Bureau of Statistics, Labour and Prices Division, Ottawa.

government services,[4] the ratio of salaries of Ph.D.'s at 10 years to Ph.D. starting salaries has decreased from 1.38 to 1.31. This is also true for bachelors; government in 1951 paid bachelors with ten years' experience salaries which exceeded starting salaries by 1.63 times. This ratio has been reduced to 1.51 within the last five years. Similarly, the comparable ratio for bachelor scientists and engineers in industry has been reduced from 1.84 in 1951 to 1.70 in 1956.

The period of man-power shortage for engineers and scientists through which we are passing has so far greatly benefitted the new graduate, but it has left the experienced man in a less favourable position in relation to his junior colleagues.

Salary Treatment by Type of Employment

Some general observations on average salaries of professional engineers and scientists in Canada, United States and the United Kingdom can be made from a study of Figure III. Trend lines have been plotted for the average salaries of persons with comparable training and experience in industry, government and university.

In all three countries the average salaries in industry are highest, followed by those in government and university. In both Canada and the United Kingdom, industrial salaries lead government salaries by from 5 to 15%, while in the United States the difference is less than 5%. Looking at university salaries, the average salary line for bachelors and masters in Canadian universities is shown to fall about 35% below the industrial average as compared with a 20% differential in the United Kingdom.

The average salary lines provide an indication of the rate of advancement in the three countries under the three types of employer. In spite of the fact that at the junior levels

Table II. Equivalent Salaries, 1939-1955

1939		1955	
(1) Gross Salary	(2) Net Salary After Income Tax*	(3) Equivalent Net Salary After Income Tax**	(4) Equivalent Gross Salary***
$	$	$	$
2,000	2,000	3,680	3,980
3,000	2,950	5,430	6,110
4,000	3,880	7,140	8,280
5,000	4,800	8,830	10,500
6,000	5,690	10,500	12,900
7,000	6,570	12,100	15,500
8,000	7,440	13,700	18,100

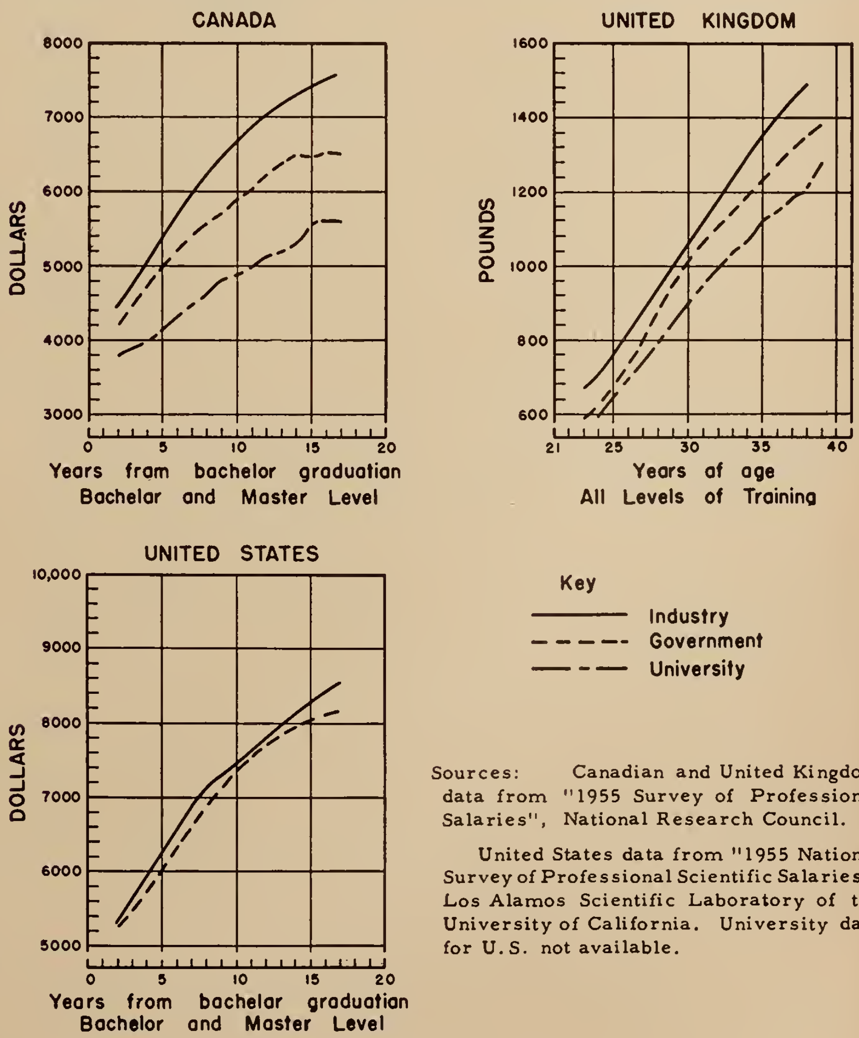
* 1939 Income tax includes Federal and Provincial income taxes for a married person with no dependents.

** Column 3 = Column 2 X $\frac{\text{Consumer price index (1955)}^3}{\text{Consumer price index (1939)}^3}$

*** Column 4 = Column 3 + 1955 Federal income tax for a married person with no dependents.

United States' salaries are considerably ahead of Canadian salaries, the rates of advancement over the first ten years are approximately the same (5% per year) in all three types of employment in both Canada and the United States.[5] In the United Kingdom, the rate of increase is slightly greater (6.5%) and continues at almost the same rate for sixteen or

Fig. 3. Average Salaries, Industry, Government and Universities, Professional Engineering and Scientific Staffs.



Sources: Canadian and United Kingdom data from "1955 Survey of Professional Salaries", National Research Council.

United States data from "1955 National Survey of Professional Scientific Salaries", Los Alamos Scientific Laboratory of the University of California. University data for U.S. not available.

3 Dominion Bureau of Statistics Labour and Prices Division, "Consumer Price Index, 1913-55," Ottawa, 1956.

4 "Survey of Professional Salaries," National Research Council, Division of Administration, Ottawa: 1952, 1953, 1954, 1955, and 1956. Confidential Report.

5 Average salary data for a broad sample of United States universities is not available. However, salary information from a few larger United States universities reported in "1955 Survey of Professional Salaries" National Research Council, Ottawa, indicates that the larger United States universities fall in line with United States industry and government.

Table III. Average Annual Salary, 1 July 1956[6]

(a) Bachelors & Masters

	Years from Bachelor Graduation 0	5	10	15	Median Year	Average Salary
Government	$4190	$5380	$6360	$7100	8	$6140
Industry	4270	5880	7200	7990	7	6530

(b) Ph. D.'s

	Years from Ph.D. Graduation 0	5	10	Median Year	Average Salary
Government	$5520	$6640	$7310	6	$6840
Industry	6520	7690	9130	5	8310

seventeen years, whereas in Canada and the United States there is a definite decrease in rate after the ten year level of experience.

Current Canadian Salaries

Engineers and scientists employed by government and industrial organizations in Canada have received substantial increases in salaries during the past year. Apart from starting salaries for new graduates, which increased by approximately 12%, the salaries showed increases from 7% to 10% over those for 1955.[6] Table III shows current average salaries from data supplied for the National Research Council 1956 Survey.

Average starting rates now paid by government for new bachelor graduates amount to $4190 while industry averages $4270. Both types of employers have increased their starting rates by more than $900 over the last four years, with half of that increase occurring within the last year.

United States industrial starting salaries for bachelors exceeded Canadian starting salaries by about $950 in 1955. However, during the last year, United States industrial starting salaries increased only to about $5,000 so that the gap between comparable United States and Canadian starting rates has been closed to about $750. Canadian-trained engineers and scientists have always been highly regarded in the United States. With the recent changes in Armed Service draft regulations in that country, the higher United States offers will be increasingly attractive to Canadian graduates.

Although government and industrial starting rates in Canada are competitive, the bachelor scientist or engineer in industry can look forward to a higher salary than can his counterpart in government employment. N.R.C.'s 1956 survey shows that ten years after graduation, industrial salaries exceed government salaries by about $800 or 13%. Moreover, the average salary for bachelors in industry is $400 greater than in government in spite of the fact that the average age of industrial employees is less than that of government employees.

In looking at the Ph.D. salary picture, Canadian government starting rates for Ph.D.'s are about $1,000 less than Canadian industrial starting salaries and United States industrial offers (in the neighbourhood of $7,500 per annum) exceed Canadian industrial offers by an additional $1,000. Increases of $500 in both government and industrial rates during the past year in Canada, show that Ph.D. salaries are receiving consideration but it is evident that there is need of still further adjustment.

The rate of advancement for industrial Ph.D.'s in Canada is slightly greater than for government Ph.D.'s, being about 40% vs. 33% respectively over the first ten years after Ph.D. graduation. The average salary in industry is $1,450 greater than the average salary for government and again we find that the average Ph.D. in industry has less experience.

In 1956, starting rates for Ph.D.'s in industry exceeded the salaries of bachelors five years after graduation by more than $600, whereas government Ph.D.'s starting rates were only $140 higher than those of bachelors with five years' experience in government service.

Conclusion

In Canada the growth of scientific research during the last half century has brought the scientific and engineering profession to a position of prestige and responsibility in the state. In spite of all this, the professional scientist and engineer has seen his economic status decline relative to the position enjoyed by the wage earner. Moreover, the scientist and engineer of today, after serving his employer for several years, often sees his salary being closely approached by that of the new college graduate. Many Ph.D. scientists receive little or no financial reward for their years of post-graduate training. It is also true that senior scientists have not yet received equitable salary treatment. However, many adjustments are currently being made and the remaining anomalies may soon disappear.

Acknowledgment

Particular acknowledgment is made of the interest and advice of Dr. F. T. Rosser, Director, Division of Administration, National Research Council, Ottawa.

6 "1956 Survey of Professional Salaries," National Research Council, Division of Administration, Ottawa: 1956. Confidential Report.

Future Annual Meetings

1957

Banff Springs Hotel, June 12, 13, 14

1958

Quebec, Chateau Frontenac, May 21, 22, 23

DISCUSSION

of Technical Papers

Growth and Development of Large Electric Power Systems

W. R. Way, M.E.I.C.

The Engineering Journal, 1956, Oct., p. 1329

Dr. René Dupuis, M.E.I.C. [1]

The paper just presented by Mr. Way, referring to large power systems, answers the ever pertinent questions:

From where and when did it start?

Where are we?

Where are we going?

The first question is history, the second is inventory, the last is almost speculation.

History started at many places and has been written around many successful experiments as well as failures, all occurring at about the same time. Except for slight differences attributable to later progress, the large systems throughout the industrial world are all in a high stage of effectiveness. Based on actual achievements as well as knowledge and combined with the possibilities of electronics, future developments may reach unforeseen and unexpected summits.

The talents of even such a writer as Mr. Way must have been taxed to present such an interesting tableau, selecting judiciously from such a wealth of material.

That history was made in many places at early dates can be substantiated easily by a few facts from the Quebec district.

1881 — Two newly formed companies — The Canadian Electric Light and the Quebec-Levis Electric — made electricity with steam on one of the main streets in Quebec City.

1885 (October 7) — The lure of the 220 - foot Montmorency Falls could not fail to attract hydro-electric-minded people who succeeded in generating power there and transmitting it eight miles to light the streets of Quebec.

1889 — Domestic lighting from the same source. The voltage was 52 volts and distribution was at night only.

1890 - 1900 — The Quebec district witnessed: 5,500-volt, 66-cycle, two-phase generators at Montmorency; the first electric cars in Quebec City and the first electric trains; 10,500-volt, 63-cycle, three - phase generators at Chaudière Falls, with a submarine rubber insulated cable of similar voltage crossing the St. Lawrence River; and power generated at Valcartier and transmitted at some 20,000 volts over a distance of more than 20 miles to Quebec.

Delving into history, a French writer once said; "If Queen Cleopatra's nose had been shorter, the fate of the world would have been different."

Recalling the time when alternating current was trying to disloge direct current, I wonder to myself what would have happened then in the choice of frequency if rotary converters had been as effective to convert 50 or 60-cycle power as they were to convert 8 1/3, 16 2/3 or 25-cycle power?

The trend in generation today is definitely towards the biggest possible powerhouses furnished with the largest possible equipment.

This system affords economic advantages not only in investments, but also in operation and maintenance costs. The Bersimis No. 1 and No. 2 power houses, with a total installed capacity of some 2,000,000 horsepower, and units of 150,000 to 165,000 h.p., are expected to be operated and maintained with a staff of less than 200 people. This means one person per 10,000 horsepower. Later on, when big power sites are taken up and we have to fall back on smaller power sites, I think we will have to develop automation or semi-automation to bring operating costs down to a decent level.

Although Mr. Way does not lay stress on it, our country has made many important contributions to the progress experienced in the evolution of large power systems. Manufacturers of generators, of transformers, of line equipment and protection have achievements to their credit next to none. Transmissions and operation problems of interest to the whole world have found their solution here through the co-operation of designers, manufacturers and operators.

One special achievement affecting large power systems very advantageously is worth noting because of the contribution made in this part of our country. I refer to storage reservoirs.

The Shawinigan Water and Power Company has pioneered in this special development. Already half a century old, its first experiments interested the Provincial Government and today form the basis on which actual developments stand. In all probability, it was considered nonsensical — even crazy—at that time to try this experiment on rivers believed completely frozen. Today, this experiment is an established practice that multiplies five or six times the minimum flow of our rivers, increasing thereby the firm capacity of our systems to the advantage of the electric utilities and of the industry at large.

It was announced recently that the third section of our Beauharnois plant would be completed even though the power canal is not sufficiently advanced to permit the low velocities necessary during freeze-up periods and in winter time. This will be possible by taking advantage of our Bersimis river reservoirs and plants. The run-of-the-river flow will

[1] Commissioner, Quebec Hydro-Electric Commission, Montreal.

be utilized during the summer, at night, and over week-ends to help re-fill the reservoirs at Bersimis. With proper installed capacities, these reservoirs will supply to the system necessary power that could not be obtained at certain periods at Beauharnois.

The interchange is taking place also between our publicly-owned power system and the Shawinigan Water and Power system as well as other private systems. You might be interested to learn that the best possible understanding exists here between public and privately-owned organizations.

I feel something should be said about nuclear energy and its possible influence on large systems. Nuclear power will surely play a major role in the large systems of the future. It is expensive at the present time because fission energy degrades itself to the lowest form of energy—heat—that has to build up to the higher form of "electrical energy". Transformation not only causes losses but is also very expensive. Could we hope that a short circuit or a by-pass will occur and that nuclear energy will be transformed directly to electrical energy? The latest I have heard from Dr. Lewis, the best informed scientist at Chalk River, is that nothing very promising has yet been noticed on the horizon which might indicate that possibility. He added, however, that hope should not be abandoned.

I assume it would be within the scope of this program for me to say a few words about the Lachine power development.

Long and serious study has been concentrated on this particular subject during the past 35 years, with Quebec Government and Hydro-Québec engineers participating in the deliberations.

Our experience has taught us that Lachine's problems are the most difficult along the entire St. Lawrence. We are not dealing here merely with a river flowing from upstream and disappearing quietly downstream. Instead, we have a river with a big downstream problem, because waters rise downstream during the winter, flooding 40 per cent of the head.

Further, we have to deal not only with one complicated river, but with three others: The Rivière-des-Prairies, the Mille-Iles, and the Ottawa rivers. The Ottawa has a flood flow of something like 300,000 c.f.s., which is 25 percent higher than the average flow of the St. Lawrence, and not far from the latter's maximum flow.

Add to this complication the ice problems that have already caused the failure of almost half a dozen electric plants in this district. Ice creates extremely delicate problems for us at the two existing power houses, Beauharnois and Back River.

There is another angle. The Lachine problem exists in the most densely populated area of the whole of Canada and, at the same time, involves the biggest inland port in the world. The interests of both must be safeguarded in any solution to the problem.

It is becoming increasingly evident daily that it was fortunate, as far as proper solution of the Lachine problems is concerned, that we proceeded with the new Bersimis power site. From it we will obtain the necessary power for Montreal requirements before Lachine could have been developed.

Incidentally, I may state now that the two million horsepower from Bersimis will have been installed and that from 60 to 75 per cent of its production will have been channelled to this district and absorbed by it *before* it would have been possible to realize anything from Lachine! This power is twice as much as will ever be firmed at Lachine.

Lachine's hydraulic problems are being studied most attentively since the decision was reached to proceed with regulation of the St. Lawrence in its International section. They are considered as part of the overall problem of the river. The solutions reached are engineering solutions worked out in the best spirit of co-operation by all parties interested. The flows of the river have been regulated to help solve the Lachine problems during ice-forming periods and plans for the Seaway channel have been modified towards the same end.

Actual studies for final plans are centered on a two-stage development —one at the foot of the Lachine rapids, with a 30-foot head, and the other below Victoria bridge, with a 20-foot head, if such proves economically possible. The major stumbling block will be the recession of the downstream waters, which might even flood the second dam under certain winter conditions. We are hopeful that this situation will be improved by means of deeper channels and proper ice-breaking operations.

Concentration of the full head at that point would have had to bear the ill effect of that downstream winter rise and, furthermore, would have imposed the building of dykes at elevation 80 on both sides of the river. These dykes would have extended from the foot of the Lachine rapids to a point below Victoria bridge — a distance of approximately eight miles.

With the two-stage development, the same dykes will be only at elevation 55 at the most. This will not only mean a big financial saving, but will also produce a bearable situation for the riparian population on both sides of the river.

There was another reason that induced us to put aside the concentrated falls. A considerable pool of water at elevation 70-72 would have been created in the Laprairie basin, raising the water by 50 feet at its lowest point. This would have exposed all the low lands, particularly on the south shore, to the grave dangers of infiltration; a real threat because of the geological formation in this district.

We are now pushing the Lachine studies diligently and carefully. We should be in a position to start actual construction as soon as the demand for power so requires.

F. L. Lawton, M.E.I.C. [2]

The author has presented a well-knit review of progress in the growth and development of large electric power systems since the early days of the power industry in Canada. In doing so, he has rendered a distinct service to the profession because an integrating type of paper, such as this, is valuable. Not only does it provide a comprehensive picture for younger engineers but it portrays, as well, the stature of the growth and development in the industry so as to foreshadow future developments of fascinating magnitude and nature.

It is all too frequently forgotten that many original and forward steps were first made in Canada, due to the visions of our engineering and financial forebears. Too frequently it is considered that the fountain head of engineerng advances in the power field lies in Europe and in our great neighbor to the south. We have benifited in no small measure but we have also contributed.

The paper foreshadows future developments in Canada in a manner

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[2] Chief Engineer, Power Department, Aluminum Laboratories Ltd., Montreal.

justifying the prediction that the day is not far distant when interconnected power systems will stretch across Canada from sea to sea and add their sinews to the steel rails which forged the bonds contemplated by the Fathers of Confederation. It also indicates the bright future which lies before those younger engineers who associate themselves with the development and operation of Canadian power systems.

The Author

I wish to express my appreciation for the two discussions which have been submitted by Dr. René Dupuis and Mr. F. L. Lawton. No doubt, if more time had been available, there would have been some interesting discussions from the floor.

Dr. Dupuis has emphasized the role which The Shawinigan Water and Power Company has played in the development and use of large storage reservoirs in increasing the output of the St. Maurice River. He has outlined further some of the possibilities that will exist in this respect as a result of Hydro-Quebec's new power developments which will be of great importance in providing adequately for the power needs of the Province of Quebec. Dr. Dupuis hhas also supplemented the information concerning the problems involved in the future development of the Lachine rapids which, heretofore, has not been given much publicity. Certainly, as Dr. Dupuis points out, the integration and interconnection of electric systems to take full advantage of the diversity of load and hydraulic conditions has been one of the outstanding developments and, in general, his remarks considerably augment the picture of the future which I attempted to present.

In regard to Mr. Lawton's discussion, I can only concur with him regarding the fine future open to the young engineer who associates himself with the development of power systems in Canada. Mr. Lawton further draws attention to the pioneer work done in Canada and to the contributions Canadian engineers have made in the field of development of electric power systems, and I thank him very much for contributing to the discussion.

The Metal Bonding of Aircraft Assemblies

J. J. Waller, *Canadair Limited*

The Engineering Journal, 1956, May, p. 603

W. M. Diggle[1], **M.E.I.C.**

Mr. Waller is to be complimented on an interesting report of the bonding process in use by Canadair, also on a comprehensive appreciation of the problems with which he and his associates had to cope. It is on the latter aspect that I would like to comment.

Firstly the almost-autonomous committee seems like a most efficient approach to a problem which was complicated by the short time factor. Committees sometimes seem to have too much to say; and although in many instances I would hazard that fewer words could be used, yet I am convinced that there is no more expeditious way to approach a complicated problem which involves several departments or conflicting ininterests. Sometimes I think that it is perhaps the only way in which the optimum solution can be achieved.

The committee's selection of the most suitable adhesive was no academic exercise. Mr. Waller probably could have told you also of the assessment of the several adhesives in each of the proposed applications on the aircraft. That the selection was adequate for instance in the temperature range can be proven finally only after the new aircraft has been in service for some time. However, I am sure that the members of the committee are sufficiently certain of their factors that they are not apprehensive in the least.

Mr. Waller has said that quality control is probably more important in metal bonding than in any other process. An airplane often does not get a second chance — it cannot pull over to the side of the road because something goes wrong. Therefore, workmanship and materials must be of dependably uniform high quality. The quality control procedures by which this is assured are especially difficult where deficiencies may not be obvious — a defective rivet or a poor weld. Therefore, the production processes which must be controlled within narrow limits and such inspection checks that are practicable must give every possible assurance of acceptable standard.

Bonding permits light construction. Mr. Waller's estimate of 1000 lb. extra structure would have meant considerable penalty to the airplane. There is a rough rule-of-thumb that one pound increase costs ten pounds to make the airplane as effective as before the addition of the one pound. This, on the basis of Mr. Waller's estimate, would mean five more tons of airplane, engine and fuel to give the same capability on its mission.

Finally there is one word of caution that I would like to give on the use of bonding. It is aerodynamically cleaner than rivets which are raised above the skin; and of course it is simpler than flush rivetting. Nor is there any undue trouble when the surfaces to be bonded permit the assembly to be cooled without distortion. There might be some aerodynamical difficulty, however, when the bonding is intermittent between the surfaces permitting a contraction of one surface to form ridges in the other.

[1]Wing Commander, R.C.A.F., Department of National Defence, Ottawa.

J. R. Gray[2]

Mr. Waller's paper provides a lucid description of the method of metal bonding used in the CL-28 and very adequately describes the many details of such an operation. The discussion of the mechanism of bonding and its effect on the surface preparation of the metal is particularly interesting since this is of prime importance and is probably the least understood phase of the process.

The more consistent results obtained with tape-carried adhesives may be due to two reasons not specifically mentioned in the paper. The first is a closer control of glue line thickness in comparison with the spreading techniques used with paste type products. The other is that the supporting tape assists in distributing the stress throughout the bond. Both of these are of more importance with large or complex shapes.

The advantages of metal bonding as a method of joining large structures such as honeycomb panels is only now being recognized by industries outside the aircraft field. In this connection it might be well to mention that there are now avail-

(Continued on page 1384)

[2] Head Office Chemical Division, Shell Oil Company of Canada Ltd., Toronto.

ABSTRACTS

BASED ON CURRENT LITERATURE AND EVENTS

POSSIBILITIES FOR DEVELOPING ECONOMIC SMALL REACTORS

Louis H. Roddis, Deputy Director, Atomic Energy Commission
Combustion, 1956, v. 57, n. 11, May.

The big question in the atomic power business today is — "what does it cost?" All predictions made now about cost of electricity produced from nuclear fuel are based on life expectancy estimates of widely varying degrees of validity. One method is to express all costs in dollars per kilowatt of installed capacity, a one-time total cost approach. Our people have worked up the following figures: For large steam plants averaging 224,000 kw. capacity, $700 per kw. of capacity; for small steam plants averaging 36,000 kw., $1,200 per kw.; and for diesel plants averaging 4,500 kw. in 4 units, $1,700 per kw.

With nuclear plants the variation is so wide that averages cannot be given. The range is from $220 to $960 per kilowatt. The first is for a proposed large N.Y. plant of Consolidated Edison. The second is for a military plant, the quite small Army Package Power Reactor being built at Port Belvoir, Va. Thirty years often is assumed as the life expectancy of nuclear plants.

Nuclear plant development is now bringing the first cost of these plants near the point at which they will be allowable in a competitive installation, and the biggest unknowns are in the region of operating costs. Hence the importance of getting on with the building and operation of some nuclear plants.

Following discussions of pressurized light water reactors, boiling light water reactors, aqueous homogeneous reactors, heavy water reactors, boiling heavy water, homogeneous heavy water, sodium-cooled heavy water types, organic moderated reactor type, liquid metal homogeneous fuel reactor, and gas turbine reactor plants, a table is given for estimated costs of some 17 nuclear power plants giving capacity, first cost per kwh., fuel used and total cost per kwh.

ATOMIC SPECULATION

***Engineering*, v. 181, n. 4708, June 1, 1956**

The game of speculation on inadequate information has a facination much like the pleasure of unravelling a detective story plot or reconstructing ancient civilizations on meagre archaeological evidence. The man outside the security fence is sometimes tempted, perhaps rashly, to play this game with atomic energy.

A good example is the Soviet announcement concerning their proposed atomic power station programme. In Mr. N. A. Bulganin's report to the 20th Congress of the Communist Party of the Soviet Union he stated, in a section covering work planned for completion by 1960, immediately after some figures for the electrical generating capacity of projected orthodox power stations: "A noteworthy feature of the Sixth Five-Year Plan will be the broad construction and utilization of atomic power stations."

The casual reader might expect that in Britain, atomic energy matters would be less clouded in security. But he would be mistaken. It is almost as difficult to see through the chicken wire round Harwell as through the now slightly perforated iron curtain, though perhaps the recent Open Days herald a more indulgent era. Again it is necessary to resort to speculation.

Advertisements are sometimes helpful, but could be very misleading since they are probably composed to give away as little as possible. Recently, for instance, Harwell was advertising for Scientific Officers "to work in a group engaged on research into novel methods of particle acceleration, in particular, methods capable of producing high beam intensities."

Since the Atomic Energy Research Establishment performs research generally with some practical object in view, and since accelerators are mainly used for fundamental research, it might be guessed that construction of a high-powered machine was envisaged for thermonuclear studies. As has previously been pointed out, hydrogen fusion reactions might be initiated in several ways; apart from methods employing pulsed electric currents through gases and shock waves caused by small explosions, particle accelerators could be used to give the high temperatures required (about a million deg. C.).

A further question relating to thermonuclear reactions concerns the purpose of the highlevel conference (which was called to discuss the fusion process, on June 4). Does this mean that the main problems of controlling the reaction have been solved?

Other problems which call for speculation are the future demand for electrical power in this country; the basis on which the published estimates have been made; and how economically nuclear power stations are likely to contribute towards the anticipated requirement.

Nobody doubts that power requirements will increase, but without knowing the method of analysis, industry cannot safely act on the conclusions.

New information on nuclear power costs is also due. In the White Paper (*Engineering*, vol. 179, page 240, 1955), it was suggested that the cost of electricity produced from the first commercial atomic station would be about 0.6d. per kilowatt-hour, so that nuclear stations would be competitive with coal-fired stations.

It is interesting to note that the Russians estimate the capital cost of nuclear stations to be 1½ times that of coal-fired stations, whereas in this country it is given as about double.

The future of the nuclear reactor as a means of propulsion is also worth considering. Its place in the air remains very doubtful owing to problems associated with the heavy shielding necessary and crash dangers. However, at sea the picture is quite different.

However, we cannot base industrial planning on our conclusions. A safe forecast can only be made on the basis of all available facts. That is the danger which follows from excessive security. No one can blame the Atomic Energy Authority; their orders come from a higher place, and scientists when free to be forthcoming are notoriously generous with their knowledge.

Nowadays firms can obtain information from the Atomic Energy Research Establishment, but presumably only if they know the questions they want to ask. This is sufficient for development but not for long-range planning; for this, a wide background knowledge is necessary, including data on current experiments.

GUIDES TO INVENTORY POLICY

Harvard Business Review, 1956, May-June.

This article, the third and final of a series, deals with a topic of key importance to many marketing as well as production executives: the amount of inventory needed to meet seasonal sales peaks.

Few companies are able to forecast seasonal fluctuations in demand with absolute accuracy, and so the problem inevitably arises of how best to balance the costs of overproduction with those of underproduction, and also to revise production schedules economically as sales actually materialize differently from the forecast. The author deals with these and other problems under the subtitle, "anticipating future needs".

Professionalism in business means a more analytical, objective approach to management problems. A manager may pour his blood and sweat into a company as much as ever before; he may become emotionally involved in his work. But if he is a professional, he will try to keep his judgments from being confused by his emotions and personal prejudices.

He will have an open mind about company policies, and one of his most important jobs will be to keep the management team asking questions: "What are we trying to do? What *should* we be doing? Is there a better way?" This is the spirit of enquiry which underlies the article.

Reprints of these articles are available at $1.00 each or $0.40 each, for 4 to 99, from *Harvard Business Review*, Soldiers Field, Boston 63, Mass.

HOW TO HELP PRODUCE THE ENGINEERS AND SCIENTISTS YOU NEED

L. R. Boulware, vice-president, General Electric Company
Edison Electrical Institute Bulletin, June 1956

Brain power may be the only limiting factor on how much energy we can produce. It may also be the determining factor in whether we can survive at all. The Soviet Union produced 682,000 specialists and technicians in the period 1928-1954, compared with 480,000 for the United States, is now training twice as many science and engineering graduates as the 45,000 the U.S. is producing yearly today.

General Electric has been looking at the problem more and more in terms of something for everybody to do everywhere, and this is primarily in terms of our individual communities. A plan to produce more scientists and engineers is by its very nature a long-range plan. It takes 30 years to make a professional engineer or scientist. Even after the 8th or 9th grade it still takes 9 to 12 years or more. The nation would be better served by augmenting the total pool of exceptional talent so all professions benefit rather than by giving exclusive attention to getting more talent into science and engineering.

General Electric's program is based on solving the problem at the local level in communities. It includes mailing G.E.s' series of "Adventure in Science" comic books to teachers for use in high schools and junior high schools, to glamorize the role of science and engineering. "Progress posters" are offered to classes by mail. G.E. today is telling a technical career story to 3½ million boys and an equal number of girls by these methods; their advertisements and motion pictures alert people to the problem and stimulate an interest in science. The company helps local high schools to obtain modern equipment for their laboratories. Local high school science fairs and engineering clubs are encouraged. Plant visits for teachers and students are organized.

G.E.'s apprentice program has 8700 graduates, and opens the way to a science career for the specially gifted or ambitious by providing college credit for some of the basic courses. Six-week summer fellowship programs for high school teachers were inaugurated in 1945, with G.E. underwriting the costs. Company officers, managers, and specialists address the teachers on various aspects of doing business and provide field trips to plants and laboratories. Graduates have already accumulated some 6000 teacher-years and have thus had some effect on the teaching of science and math to some 500,000 students.

RAPID READING

The Manager, May 1956

All managers complain that they have too much to read. In recent months a number of British firms have been experimenting with methods whereby individual managers can be trained to read faster, and hence to cope with their paper work more efficiently. In this article, a *Manager* staff writer describes how leading firms are tackling the problems and the results that they have achieved.

The present clamour for ways and means of speeding up the pace at which the executive may read and digest the mountain of printed matter which awaits him each morning undoubtedly has its roots in loose and verbose writing.

It would seem, therefore, that the basic solution of the problem lies in teaching people to write more concisely, rather than to read more quickly. Solve the writing problem and the reading problem disappears.

H. A. Robinson, clinical psychologist, division of student mental hygiene, department of university health, Yale University, wrote: "It is the usual experience in group reading instruction that marked and statistically significant gains in reading speed do occur, whatever methods or techniques are applied."

The first companies in this country to investigate the possibilities of efficient reading courses were Joseph Lucas Ltd. and Imperial Chemical Industries Ltd. Both used, as a basis for their work, the course developed at Harvard University by William G. Perry, Jr., and Charles P. Whitlock.

Commenting on the first course, Rex Strayton, assistant education officer, metals division, Imperial Chemical Industries, Ltd., wrote: "On the basis of initial and final tests only, the average reading of the group rose from just under 200 w.p.m. to about 355 w.p.m. — an increase of 80.6 per cent. For those who, like the instructor, feel diffident about basing net improvement figures on initial and final tests, a second set of figures revealed that, judged on an average of sessions 2 and 3 and sessions 12 to 15, the net improvement registered by the group was 40.7 per cent.

In order to read his minimum 250,000 words a week the businessman must read 50,000 words per working day — the equivalent of one novel or Sunday newspaper from cover to cover.

Most people would agree that this is perhaps a conservative estimate of what we have to read if we are to keep abreast of what is happening in the world in general and in our own line of business particularly.

More efficient reading is not likely to solve any of the major problems of management, but until more concise writing becomes universal it would appear that it can play a useful part in relieving the burden of the executive. As, in the light of experience and research, the courses are improved, they should prove more and more useful.

AUTOMATION: AN ADVANCE ON MECHANIZATION

Mass Production, 1956, v. 32, n. 6, June

Discussing the evolution of automation and the first techniques developed by Morris Motors in 1927 and by the Ford Motor Co. in Detroit twenty years later, the author (the Rt. Hon. The Earl of Halsbury, addressing the Royal Society of Arts) presents four techniques properly denotable as 'automation'; transfer machining, automatic assembly, control engineering, and information processing techniques. He warns that because they are technically independent of one another they do not, in their applications, interact.

Having thus described the four components of automation, their community of function, their technical independence, and their interaction in application, he concludes with the definition to which the foregoing will serve as a preamble, a preamble which will serve to make the definition both necessary and sufficient·

"Automation refers to a contemporary group of independent advances in the field of mechanisation. These advances characteristically employ discriminatory devices and automatic controls. Typical subjects classified as automative include transfer machining, automatic assembly, the whole field of control engineering and that part of communication engineering concerned with data processing, accountancy and calculation involving the use of electronic digital computers."

NEW YORK SCHOOL OF PRINTING

Green-tinted glass blocks will sheathe the facade of the 6-million dollar New York School of Printing in New York City. The building, designed by Kelly and Gruzen of New York City, will house the school which the New York Board of Education operates in conjunction with the printing industry. The glass blocks, a development of the Pittsburgh Corning Corporation, incorporate a blue-green diffusing screen to soften and diffuse the light, as well as cut down brightness and instantaneous heat gain.

KARIBA HYDRO-ELECTRIC POWER SCHEME

The World Bank has made a loan of $80 million in various currencies for the first stage of the Kariba hydro-electric power scheme in the Federation of Rhodesia and Nyasaland. The loan will help to finance the building of a dam and power plant with 500,000 kw. generating capacity at Kariba Gorge on the Zambesi River, and nearly 1000 miles of transmission lines to the copper belt in Northern Rhodesia and the principal cities of Southern Rhodesia.

The first stage of the Kariba development is expected to cost about $225 million. The Bank's loan will finance $80 million of this amount; the Federal Power Board will finance the remainder through long-term borrowings in the United Kingdom and from the Government of the Federation.

The full installation will generate and transmit 1.2 million kw. of power. In the first stage, now under way, a 400-foot high dam will be built

(*Continued on page 1384*)

Canadian Developments

NEWS OF MAJOR ENGINEERING DEVELOPMENTS IN CANADA

St. Lawrence Seaway and Power Project

Progress by Ontario Hydro

New production records were established in August in dike building operations for Cornwall dike. A total of more than 425,000 cubic yards of fill material was moved and placed in the dike during the month, principally in sections 2 and 3. Dike building was accelerated by the addition of five more 18 cubic yard diesel scrapers, bringing the total number of these units to nineteen. An average of 20,000 cubic yards of material daily was being placed in the dike sections.

One part of section 3 approximately ¼ mile in length had reached maximum height. The only remaining work in that stretch was to top the dike with eighteen inches of gravel and to slope the face on the water side with one foot of gravel and three feet of riprap. Dike was 27 per cent completed.

Placing of concrete for the power-house structure in draught tubes 2, 3, 4 and 5 numbered from north end, continued at a steady pace during August. Approximately 215,000 cubic yards of concrete had been placed in this structure at month's end, which had then reached 28 per cent of completion.

Excavation of rock on the power-house site was well advanced. A total of 150,000 cubic yards of rock had been removed to date. Earth excavation had been completed on the power-house site, with 1,502,000 cubic yards having been removed.

Behind the "U" abutment at the north end of the power-house main dam, placing and compacting of fill continued during the month for the power-house end of the Cornwall dike. Approximately 190,000 cubic yards had been placed in that area for dike building and backfilling.

Concrete placing in the closure for Cornwall dike continued ahead of schedule. A total of 81,000 cubic yards of concrete had been placed in the wing walls and floor. Erection of the 48-inch diameter pipe, for the City of Cornwall water supply, in the closure structure was completed. At the same time, progress was being made on the earth excavation for the diversion canal, now 30 per cent complete, and work was started for the embankment construcion in the Robertson Creek area.

Dredging continued south of Spencer Island pier and west of Chimney Island, with three dredges operating. Some 630,000 cubic yards had been excavated in this area to August 31. Crib placing in the Spencer Island pier had been completed and placing of rock fill for the pier continued beyond the cribs. At the end of August the pier construction was about 60 per cent completed.

Favourable weather aided railway and highway work throughout the month. The four railway contractors made excellent progress in their various sections, and some 20 miles of double track had been laid, with rock ballast spread for approximately 16 miles. Railway relocation was 85 per cent complete. The highway contractor's work for relocation of No. 2 highway was accelerated during the month and an all out effort was being made to bring the highway into service by the end of 1956.

Moving of houses into new town No. 2 proceeded well during the month of August. Construction of basements was well ahead of the house moving program. Work had commenced on the extension of services to the additional 50 lots on Saunders Avenue. The original sewer and water main contract for the town had been completed. The sewage pumping station was in operation. Considerable activity was taking place in the townsite on the construction of new houses by private contractors.

Preparations were being made at new town No. 1 for moving houses now located in the Dickinson's Landing area. Construction of basements and preparation of access roads were underway. The contract was awarded for the construction of the public school and work commenced during the month.

At Morrisburg, excellent progress had been made on the sewer and water mains in the new subdivision. Construction of the sewage treatment plant and the water pumping station continued. In Iroquois, contracts were awarded and construction was underway for one high school, and two churches. Rehabilitation work was about 30 per cent completed.

The total work force employed by Ontario Hydro and the various contractors during August averaged approximately 4,450 persons.

Progress by NYSPA

August construction continued at a fast pace as working conditions remained favourable. Concrete placement to end of August in all project structures exceeded 690,000 cubic yards, excavation for all features exceeded 24 million cubic yards and employment averaged 5,650 for the month.

All gate guides and sills were in place for first stage of Long Sault dam, concrete was being placed in the spillway bridge beams and had been completed for the spillway apron. Concrete in the structure totalled 220,000 cubic yards, bringing the structure to 48 per cent of completion. Excavation continued for cut F, and piling from cofferdams A and B was being removed and driven in the cells of cofferdams DU and DD. Excavation and grading work has started for the access road on Barnhart Island to the north abutment of Long Sault dam. The cofferdam E cable was load-tested.

Concrete placement in Barnhart power-house continued, with a total of 238,000 cubic yards placed to the end of August in draught tube piers for 12 units and in draught tube floors of remaining 4 units, in ice sluices, as well as in training walls and intake structure. This brought the structure to 27 per cent of completion with mechanical equipment 30 per cent installed. Excavation for the switchyard and placement of embankment in the south forebay dike progressed.

At Iroquois dam, steel piling continued to be threaded for the stage 11 cofferdam concurrently with the extraction of piling from Stage I cofferdam cells. Excavation within the cofferdam area continued. Painting of gates and guides and the erection of the gantry crane progressed. Concrete placement to month end totalled 91,000 cubic yards, with the first stage of the dam some 60 per cent completed.

At Massena intake, now nearing 54 per cent of completion, concrete operations were continued with 111,000 cubic yards placed to end of August. Back-filling the downstream wing wall was in progress and dike construction continued. Construction of the Massena-Alcoa water facilities was on schedule and all pipe for both lines had been installed.

Excavation under the five channel improvement contracts was 37 per cent completed as work at the Galop Island south channel progressed to 91 per cent of completion. Excavation at Sparrowhawk Point, Toussaints Island, Chimney Island, Point Three Points and Leishman's Point was in progress. Clearing of Long Sault and Delaney Islands and adjacent mainland areas was essentially for 135 acres of reservoir clearing between Point Three Points and Red Mills Point. Land acquisition was about 13 per cent complete.

Approximately 80 per cent of the survey work for the Barnhart-Plattsburgh transmission line had been completed. Specifications were issued during the month for elevators in both power-house and Long Sault dam and moving stairs in the powerhouse visitor's area and relocation of highways 37 and 37b. Work on the engineering drawings continued on schedule. The contract for clearing Point Three Points and Red Mills Point was awarded.

Progress By SLSA

On the St. Lambert Lock, contract No. 24, at south end of Victoria bridge, the first concrete had been placed in May. This was ready-mix, but the concrete plant was put into operation on June 11, and thereafter all concrete was mixed there. A stacker with "elephant's trunk" is used *at the lock,* the concrete being carried from mixer to stacker by conveyor belt. For the approach wall, the concrete is brought in by dumpcrete trucks.

By the end of August the lower approach wall footings and various lifts had been poured in a dozen monoliths. The river side of the structure was beginning to take definite shape. At the lock itself, footings at various lifts had been poured in about half the monoliths on the land side. Ports for the filling and emptying culvert were already in place in these monoliths. Excavation was progressing well and was ahead of schedule.

Relationship between the Iroquois control dam and the Iroquois lock is shown here. The channel, still open over to Iroquois Point, soon will be cofferdammed and the water allowed to run through the sluices. The wall of the approach from upstream to the Iroquois lock, being built in Canada, is at upper left. Navigation uses the Galop Canal, which may be seen behind the lock.

On the Cote St. Catherine lock, contract No. 20, excavation of the upstream approach was proceeding well. Downstream, the turning basin cofferdam had been completed and the area pumped dry.

The concrete batching plant had been operating since July. Three high gantries on rails were operating, placing concrete with 3-cubic-yard buckets. Concrete is brought under the gantries from the batching plant in trucks and dumped into the buckets. Footings and various lifts on the river side of the lock had been poured. The filling and emptying ports had taken form here, also.

On the two Beauharnois locks, the contractor for the first stage had cut some 1800 feet length of one tunnel approach to the tunnel under the lower lock, through tough and abrasive sandstone, and had made a start on excavation for the lock proper. On the two contracts for construction of the upper and lower locks, both contractors were still setting up their plant, preparing and commencing excavation. Crib work for the approach from Lake St. Louis was making good progress.

On the Iroquois lock site, contract No. 6, over half the excavation had been completed. The upstream approach wall, which will extend some 3,300 feet, was over half completed. This wall is 47 feet high, 34 feet broad at the base.

Two high gantry cranes, one on rails, are used here to place the concrete in the forms directly from buckets of two and four cubic yard capacity, which are brought individually by trucks from the batching plant. Structural steel and plywood forms, 50 feet in height, are used here. The entire concrete structure here will be 6000 feet long and will require some 300,000 cubic yards of concrete.

On the nine contracts for channel excavation between Montreal harbour and Lake St. Louis, as well as on the various dredging contracts, work was generally well on schedule at end of August, with two contracts completed.

A contract for supply and erection of wire rope fenders at the Authority's five locks was awarded July 30 to Maritime Steel and Foundries Ltd., New Glasgow, N.S. at a value of $2,289,460. Fenders are required to protect lock gates and bridges if ships get out of control or are improperly handled. Each will stop a ship weighing 40,000 long tons moving at 3 miles per hour, in a distance of 68 feet. Installation must be complete by August 1, 1958.

A contract for collector sewer construction was awarded July 30 to S. D. Miller and Sons at a price of $1,836,424. Sometimes referred to as the Seaway Collector, it is a reinforced concrete storm water and sewage collector along the south shore between Anjou Street in Preville and a point 250 feet upstream from the Jacques Cartier bridge. Completion is called for by August 31, 1957.

A contract for supply and installation of operating machines for lock gates at the 5 SLSA locks was awarded August 17 to Canadian Vickers Ltd. at a price of $1,508,520. Supply and erection of sector gates at the Cote St. Catherine, Upper Beauharnois and Iroquois locks was awarded the same day to Dominion Bridge Co. Ltd. at a price of $2,589,477.

A contract for construction and maintenance for two years of a temporary approach to Honoré Mercier Bridge was awarded August 23 to Atlas Construction Co. at $864,908. This approach leads to the steel structure at the south end. Demolition of piers and deck of the existing south approach is also called for. Work must be completed within 90 days of the time traffic is definitely transferred to the proposed permanent approach, which will be built to provide 120 feet overhead clearance for vessels.

Award of these contracts brought to some $150 million the total value of contracts awarded by SLSA to date, divided as follows:
Lachine section, 25 contracts, $74 million; Soulanges section, four contracts, $32 million; Lake St. Francis section, three contracts, $6 million; International section, two contracts, $8 million; Welland Canal section, 4 contracts, $12.8 million; lock bridges, sector gates, lock operating machinery, pumps, electrical equipment, etc., $8.4 million; and various miscellaneous contracts in all sections, $7.6 million.

The approach walls of the St. Lambert lock. Great steel and wood forms are used to contain the concrete for each lift until it hardens, and then the forms are raised to the height of the next lift.

Other Seaway News

A United States steel company, believed to be the U.S. Steel Corporation, has optioned 400 acres of land, with 3,000 feet of water front, on the south shore of the St. Lawrence adjacent to the Iron Ore Co. of Canada transhipment pier at Contrecoeur.

Initial reports suggest the company will build a concentration plant for upgrading ore before shipping it on to its plants in the U.S. Great Lakes states. The ore might come from Venezuela or from Sept Isles. Cost of the plant would be $5 million or more. Primary production of steel in the area is believed to be only a matter of time.

With such a plant in operation the tonnage of Ungava ore concentrates passing through the seaway would probably be much smaller than the expected tonnage of untreated Ungava ore. Yet treatment of Venezuela ore as well at such a plant might sharply increase the total upbound seaway tonnage if this movement proved a cheaper alternative to the downbound movement of Mesabi ores or taconite from Michigan and Minnesota to Lake Erie ports.

Four new industries now building or recently completed in the area have a total value of some $35 million. Six other firms have purchased land and are planning to build. These include a French cement company, an oil company which plans a fuel oil terminal, an American oil company which plans a tank farm for storage of crude, a Swiss-American sponsored brick plant and a company to produce carbide.

Lake Michigan Level

President Eisenhower on August 15 vetoed a bill passed by Congress and Senate, to divert an additional 1000 cubic feet per second of water from Lake Michigan to better the flushing of sewage into the Illinois river. A similar bill had once before been vetoed by the President.

Approval would have cost Canada tens of millions of dollars, through lowering levels in the Great Lakes and the seaway. The power potentials at Niagara and at Cornwall would have been reduced. Canada's Ambassador Arnold Heeney had entered a protest with the State Department. NYSPA Chairman Robert Moses had predicted the U.S. alone would lose $78 million in the next 50 years due to reduced output of electric power, with Canada suffering similar losses.

Setting Seaway Tolls Difficult Problem

The pay-as-you-go principle, though a new one as far as Canada is concerned, was accepted before the St. Lawrence Seaway Authority was established by Act of Parliament. The Wiley Act, passed by the U.S. Congress, also recognized the toll principle.

After a careful survey of major industries that would use the seaway, Canada's Department of Trade and Commerce assessed the traffic potential at 31 million tons a year for the first few years of operation. The U.S. Toll Committee made a similar survey, and predicted traffic of 36½ million tons yearly.

The purpose of tolls is to recover capital and operating costs of the seaway. Legislation calls for construction cost to be recovered within 50 years, though not necessarily spread evenly over each year.

The task facing the Canadian and United States toll committees is to agree on the type and amount of traffic through the seaway over the next half century and then agree on a system of tolls high enough to recover the cost of building and operating the canals and low enough to attract the traffic. The committees have been meeting regularly. By 1958 they will have to reach a joint conclusion.

Questions they must settle include: will there be different rates for different commodities? Will tolls be based on tonnage or commodity, or on a combination of the two? What will be the division of toll receipts between the two countries, will it be based on each country's contribution to the cost of construction or will it be divided according to use? If according to cost, which projects, completed years ago, should be included in costs? If, however, agreement cannot be reached, each country will still be free to follow the path of its own self interest and set its own toll schedule.

Canada's Great Lakes-St. Lawrence Ports

Lakehead Ports

The twin Lakehead ports of Fort William and Port Arthur, with a combined population of 80,000, have a waterfront area of 34 miles, with authorized depth of 25 feet, 40 per cent of it available for additional harbour use. About $50 million has been spent over the years in dredging and breakwater construction.

There are 25 terminal grain elevators with capacity of 93 million bushels. Twelve railway freight and transfer sheds accommodate 70,000 tons. Currently these ports handle over 11 million tons yearly. Over 1,600 cargoes are cleared in a navigation season. A dozen or more 2,000 ton ocean vessels load grain yearly. The present ore dock is 1,200 feet long. Last year it handled 2,265,000 tons of Steeprock ore.

$250 millions will be spent over the next few years for expanding industry in the surrounding area. Plans are already afoot for increasing iron ore shipping facilities fourfold. There will be greatly increased shipments of pulp and paper. Port Arthur has one of the best equipped shipbuilding plants on the Great Lakes, with a drydock 750 ft. long and 78 ft. wide.

Harold M. Mayer of Chicago, in an economic report for the government of Manitoba on the effects of the seaway, observed that while elevators were reasonably adequate and could serve ocean vessels with little change in facilities except for deepening channels, the general cargo terminals were already obsolete. Sheds are designed for side-port loading and discharging from lake package freighters. Modern ocean vessels discharge through vertical hatches, while most port traffic will be handled shoreward by highway carriers.

Sault St. Marie.

Sault St. Marie sees a promising future ahead for itself as a transhipment point on the seaway. With Chicago destined to become a major port of call for foreign ships, goods for Western Canada would be carried on Chicago-bound vessels. Such cargoes would be too small to make the run across Lake Superior economically sound, thus transhipment at the "Soo" would be the logical result.

To take advantage of this situation however, the city needs greatly expanded facilities. Dockage and wharfage facilities are inadequate. At least two 800-ft. wharves with sheds to accommodate 8 000 ton cargoes would be needed, with necessary trackage, scales and bonding facilities, as well as refrigerated sheds for cold storage.

The major resources of the region are lumber and minerals. The city feels it needs a sugar refinery, an oil tank farm, and a big grain terminal. Planning for the seaway era is in a preliminary stage, much depending on financial help from senior governments.

Sarnia

Mainly due to its petro-chemical industries, Sarnia is already Ontario's second ranking port in seaway export trade. It may become an important transhipment port as well. With two railways serving it Sarnia has a five day advantage over Chicago, Duluth and other Upper Lake ports.

Overall existing dock area is more than 11,000 feet, and dockage can accommodate 31 ships of the 350 foot class at one time. There is little or no waterfront property available for additional dockage facilities. There are, however, several thousand feet of Indian Reserve river frontage within the city, the choicest potential industrial land available.

In 1953 the Government authorized a 300-ft. extension to its dock, and a 100-ft. extension to the warehouse, dredging of an elevator slip and improvements in loading facilities. Up to 1954, $400,000 had been appropriated for improvements. Dredging and two steel pile cellular dolphins were completed in 1955.

Windsor

Windsor, with a population of 189,000 and many large industries, is fifth in Canada in volume of capital investment for new industrial construction and equipment according to official estimates for 1956. Its growth has been steady. No longer has it an economy of 'boom and bust', according to the demand for automobiles.

A civic harbour committee is working on behalf of the Chamber of Commerce for establishment of a harbour commission. Once legislation has passed parliament, Windsor's present 6,400 feet of dockage will be expanded, with cranes and warehouses to handle ocean going vessels. Dredging at the docks will be simple, as most docks have a depth of over 19 feet, on a mud-clay bottom. The city is better off than Detroit for space and availability of land for dock expansion. Three miles downstream, at Ojibway, locations are available for slips and modern docks. In Detroit nearest available land for dock construction is 20 miles south on the Huron river.

The full benefits of the Seaway will not reach Windsor until the 21-ft-deep bottleneck in the Detroit river at Amherstburg is dredged. This work will be started by the United States this year, with completion called for by 1963. But ocean commerce on the Detroit river, according to U.S. Army engineers, will increase tenfold in the next 10 years. Windsor's share should be 120 ocean ships or more yearly.

One problem in the past has been quantities too small to warrant ships stopping at Windsor, thus most goods have been handled through the Detroit terminal. An idea which is gaining support is provision of bonded warehouses in Windsor to break down and tranship cargoes to various locations in the mid-west.

Hamilton

Hamilton handles more tonnage than any other Canadian port except Montreal and Vancouver. The harbour commission controls 14,600 ft. of docks, most of it suitable for cargo ship use. Private docks owned by industries total 21,000 feet. The Federal Government is spending $2 million for extending the Wellington Street dock area. Other proposals are for a new terminal and docks at Ship Street and a new slip and dock at Strathearne Avenue at the east end of the harbour. Longer range plans call for filling in the bay side of Burlington beach.

Fifty one shipping lines now use the port, of which 19 are foreign. 1566 vessels entered or left the port in 1955, while an all time record for tonnage of 7½ million tons was recorded. Outward commodity shipments of package freight totalled 312,000 tons. The port aspires to become the leading trading and industrial centre on the Great Lakes, with the aid of the seaway.

Toronto

The port of Toronto, with a metroplitan market of some 1½ million people and a prosperous hinterland, has ample accommodation for all classes of shipping. Piers have been built for possible dredging to 30-ft, depth without endangering foundations. The new terminal on Pier II was opened in the spring of 1955, adding berths for four ships and close to two million cubic feet of covered cargo stocking space.

The harbour commission is keeping its planning three years ahead, its financing two years ahead and its building one year ahead of needs. The central portion of the harbour has been set aside for package freight terminals. The Federal Government has just added 26 acres to the harbour between Pier 12 and Parliament St. Some five city blocks in length, the 3,300-foot retaining wall was built at a cost of $1½ million. The dock was created by dumped fill from city projects including the subway. Dredging has also been completed.

Waterborne trade has expanded year after year to 4½ million tons in 1955, a nineteen-fold increase in 35 years. 792 entrances and clearances of foreign ships were recorded last year. Commissioners have recently established a Trade Development Department to encourage the movement of merchandise both inward and outward through the port. They also look for increasing development of transhipment to lake carriers, rails or trucks, to save uneconomical runs of large vessels further up lake with small tonnages.

Port Credit

Fifteen miles west of Toronto the government is building a million dollar 850-ft.-long dock to handle overflow business of Toronto's port. Completion is expected early in 1957.

Kingston

Kingston is spending $4 million on dredging and other construction. The port does not come under the jurisdiction of the National Harbours Board.

Brockville

Brockville has in hand two possible docking sites. The first would cover an area of ½ square mile with three piers jutting out 600 ft. east of Brockville Island Park. Each pier would accommodate two freighters. Construction would be off rail facilities and coal terminals lining the shore off Water Street. A more logical alternative plan calls for three piers of similar dimensions to the first plan situated west of the blockhouse. No estimates are available of the amount of dredging needed for larger vessels. The town has arranged to have itself declared a port and a port authority has already been established.

Existing facilities for shipping consist of privately owned docks. The C.P.R. wharf is the largest, but is not extensively used. Warehousing is very limited.

Cornwall

Cornwall, at the lower end of the huge lake to be created above the seaway power development, is strategically located to derive maximum benefit from the seaway. With an eye to greater industrial activity the city plans to purchase or expropriate 200 to 300 waterfront acres for lease at reasonable prices. Its planning commission has made provision for a considerable length of waterfront east of the city with docks and warehouses on the shoreline. Served by both Canada's rail systems, the city provides excellent freight service through the Cornwall street railway and trucking services.

Government docking facilities are provided by docks 1,450 feet in length along the 14-foot canal, while one industry, two oil companies and a coal company have their own docks.

Cornwall has never developed as a large port owing to its proximity to Montreal and because vessels exceeding 14-ft. draught cannot proceed upstream beyond Montreal. Opening of the 27-ft. seaway channel will open up new opportunities.

Montreal

Montreal's earlier fears that the seaway would adversely affect its port activities and retard the growth and development of the surrounding region have long since subsided. Today there is optimism and confidence that the seaway will benefit and enhance economic activity and maintain its traditional role and status as Canada's chief Atlantic port and transportation centre.

Present facilities include ten miles of wharves, piers and jetties which provide berths for 142 vessels of deep ocean draught. 32 of the berths are equipped with transit sheds, providing more than 2.3 million square feet of floor space. Cargoes are handled by trucking and a 62-mile terminal railway connected with two great rail systems.

While all types of cargo and commodity shipments move through the port, grain is by far the largest. Montreal's position as world leader in grain shipments was established in the "twenties" and is likely to be enhanced by the seaway. In the three year period 1953-55 grain accounted for 65% of total outbound cargo tonnage, flour 8%, and grain products 2%. Other bulk commodities and general cargo accounted for the balance.

Over the same period petroleum and its products accounted for 40% of incoming shipments, with coal 9%, sugar 8%, cement 6%, and iron and steel 4%. General cargo accounted for the balance.

In recent years some 1,700 ocean going vessels pick up and discharge cargo yearly. Foreign cargoes average 9 million tons annually — 4.1 million tons inbound and 4.8 million tons outbound.

Two new wharves each 1,500 ft. long are under construction, with provision for unloading berths for large 'lakers'. New transit sheds and improvements to grain conveyor galleries are also underway. Of a $7 million program planned in 1955 to improve Montreal's port facilities, $2 million was spent in 1955. Dredging to connect the seaway channel with the St. Lawrence ship channel, together with a turning basin, is presently being carried out. One of the factors underlying the sharp increase in land values along the south shore of the river is that the 16 miles between Contrecoeur and Laprairie offer great possibilities for future extension of the port. Here many large industries have purchased sites and are already planning plant expansion facilities in the area.

Trois Rivières

With approach channels dredged to 35 feet, Trois Rivières is an important port for shipment of pulp. It has 5 miles of railway, three wharves with berthing space of 8700 feet in length, 193,000 square feet of transit shed space, 500 cubic feet of cold storage and 2 million bushel elevator capacity. It is operated under the National Harbours Board and addition of more wharfage space, sidings and sheds is contemplated. Tonnage handled yearly averages 2½ million tons inbound and one million tons outbound, mostly pulp, coal, and grain.

Quebec

The Port of Quebec, like Montreal and Trois Rivières, is under National Harbours Board jurisdiction. With 35 feet depth for its approach channels, it has 23 miles of harbour railway, 36 wharves, piers and jetties containing total berthing space of 743,600 square feet. There are 528,000 cubic feet of cold storage space and elevator space for 4 million bushels. Coal storage capacity is 215,000 tons, oil tank storage capacity 54 million gallons. In preparation for the anticipated increase in shipping due to the seaway, improvement is being made to the elevators and cold storage sheds. The St. Charles Estuary, on which is situated the Davie Shipbuilding plant, is due for further dredging. Inbound freight yearly averages close to two million tons, outbound one million tons, mostly pulpwood, coal and petroleum products.

Canadian Pipeline Projects

During August construction on the two natural gas pipelines to carry Peace River gas to the Pacific Northwest and Alberta gas eastward as far as Winnipeg, was well under way. Westcoast was approaching 25 per cent of completion, with no foreseeable hold-ups threatening. Trans Canada, delayed by retarded pipe deliveries due to the steel strike, was forging ahead on two 110-mile spreads, covering the western third of the line from Alberta to Winnipeg.

Each "spread", fully manned, employs 200 men more or less. After the clearing comes the ditching crew, equipped with a large ditcher; the bending crew follows with a giant pipe bender to fit the pipe to the overbends, sags and lateral curves in the line. Next comes the welding crew, making four welds per joint. Each welder is tested for proficiency. Welders are scarce and high priced, earning up to $50 per day each with overtime.

A ditch is cut through the Saskatchewan prairies by a huge ditching machine operating on the Trans-Canada Pipe Lines project.

The doping crew follows the welding crew, cleaning the pipe and removing rust and scale. The pipe gets a priming coat of enamel and then a coat of bitumastic. It is then wrapped by machine with spiral sheets of wrapping. The lowering-in crew then hoists the pipe with a tractor-mounted derrick and special slings, and lowers it into the trench, after which the trench is backfilled with bulldozers. Four or five inspections of the pipe are made at various stages.

Westcoast Transmission

Westcoast construction crews had caught up with their progress schedules by mid-August, and spreads 1, 2, and 3 were each laying pipe at the rate of one mile a day on the south central portion of the line. 400 miles of line had been cleared. Pipe for a total of 404 miles had been delivered, 184 miles had been ditched, 143 miles were welded, 134 miles doped and wrapped, and 120 miles laid. Officials were confident no delays would be caused by the U.S. steel strike.

On the six suspended crossings, work had been about 20 per cent completed over the Peace River; foundations were completed for a crossing over the Fraser River at Shelley; excavation had been started at Quesnel, at one crossing over the Thomson River and two other Fraser crossings. Compressor sites had been started at Fort McLeod and at a point 20 miles south of Quesnel. Crews were laying steel for two gas processing plants in the Peace River area.

It is estimated the pipeline will be in service about September, 1957. In preparation, Pacific Petroleums had already drilled some 70 wells in the Fort St. John area where 10 drilling rigs were in action. Only 10 of these were dry wells. Thus with 10 indicated producers the company was more than half way to the objective of 120 producers by the fall of 1957. It was reported two major chemical plants were planning to establish plants at Taylor Flats.

Meantime from south of the border comes word that the first gas was turned in to the Pacific Northwest Pipeline system, with which Westcoast connects, on August 11. The gas came from the "Big Piney" field in Wyoming which has a 750 million cubic feet reserve. First sale of the gas was made to customers in Monticello, Utah, at 41 cents per 1000 cubic feet The wellhead price is 15 cents per thousand over the first five years, one cent being added each five year period.

At the end of August, some 83 miles of pipe had been placed in the ground by the two contractors working on the western section between Burstall, Sask., and Winnipeg. Working on the project are Majestic Contractors Limited, from Burstall, to Leinan, north of Swift Current, and Canadian Bechtel Limited, from Leinan to Pense, east of Moose Jaw. Each contractor has a spread of about 110 miles.

Right of way had been cleared and graded for 186 miles, pipe had been strung 109 miles, 110 miles of ditching had been completed, 91 miles of bending, 88 miles of pipe had been welded, 86 miles of pipe had been cleaned, primed, coated and wrapped, 83 miles had been lowered in the ditch, 73 miles of ditch had been backfilled, and 74.5 miles of right-of-way had been cleaned up, terraced, tilled and had fences restored.

Majestic had almost completed its construction through the Great Sand Hills, south of Leader, Sask. Operations in this area were not as difficult as had been anticipated. There were few cave-ins of the ditch and the coating and wrapping operations, preceded by a clamshell ditcher, were not delayed.

Majestic had moved its base of operations from Leader to Cabri, and Canadian Bechtel had moved from Swift Current to Moose Jaw. Trans-Canada's western division construction office is at Regina and the district office remains at Swift Current.

Canadian Bechtel Ltd., had set up a double-jointing yard at Morse, 40 miles east of Swift Current, and planned to move the yard to Archydal, northeast of Moose Jaw, as the construction progressed. The yard was set up so that less field welding and pipe handling would be necessary on the right-of-way, special equipment could handle the pipe more efficiently, automatic welding could be more closely controlled and shelter would enable work to continue despite weather conditions and working schedules of the line crews.

Double jointing of line pipe in central yards is paying off handsomely on Ohio pipelines. By doubling 30-ft. joints into 60-foot lengths, spreads have increased their daily pipeline laying there by 20 per cent. Even in hilly country the normal spread output using double joints has been raised to 8,500 feet per day. Cost per mile is also cut but not so sharply as output.

Trans Canada Pipelines

The western leg of the pipeline from the Alberta-Saskatchewan border to Winnipeg will have six compressor stations, one of 17,500 horse power at Burstall, Sask; one of 10,500 horse power at Swift Current, Sask.; while the remaining four at Moose Jaw and Deveron, Sask., and McCauley and Bagot in Manitoba will have initial capacities of 10,500 horse power each. These stations are not needed to operate the line in 1957 since first year's gas from the Bindloss field has enough field pressure to push it to Winnipeg.

Late in August it was reported by a representative of the U.S. Steel Corporation, which is supplying 34-inch pipe for the entire 574 miles of the western portion to Winnipeg, that mills should be able to resume shipments about September first. Together, the two suppliers could produce about 10 miles of pipe daily, and might be able to complete the order by mid-October.

The cleaning and priming machine rides the pipe under its own power. At the front revolving knives scrape dirt and rust from the pipe, after which revolving brushes coat the pipe with a priming base for the coal tar coating.

Bannister Construction Ltd. had moved equipment into Brandon early in August. They started on the distribution system for Great Northern Utilities, including 15 miles of 8-inch pipe from the main pipeline.

Dutton-Williams Ltd., was awarded a contract in mid-August for seven miles of pipeline by B.A. Oil, in connection with their gas recycling plant at the Pincher Creek gas field. Completion is called for by late fall, 1956.

While Trans Canada officials stated late in August that reports of financing for September were premature, it appeared possible the marketing might take place by November. It is already clear that FPC approval for export to United States is not now needed to satisfy potential investors of sufficient income under firm contract to service debt and provide reasonable profit. The company had signed up Canadian sales contracts in excess of 250 million cubic feet daily under 20 year contracts in the early summer and the total is fast approaching 400 million.

Bridge at Trois Rivières

Royal assent was given on June 7 to legislation authorizing construction of a $12 million toll bridge across the St. Lawrence River near Trois Rivières, Quebec. The federal legislation, necessary because the bridge crosses a navigable international waterway, will permit construction of the span by a six-man corporation which has already been set up by an act of the Quebec Legislature. The bridge was first proposed some ten years ago.

Tunnel under Fraser River

Construction of a tunnel under the Fraser River at a cost of some $16 to $17 million was given final approval by the B.C. Cabinet on June 26. The tunnel, which will carry highway traffic under the river near its mouth at Deas Island, will be completed within two years. It will eliminate a bottleneck caused by cars from the Pacific highway now using Pattullo bridge on the main highway to and from the United States.

(Canadian Developments section continued on page 1424)

KARIBA HYDRO-ELECTRIC POWER SCHEME

(Continued from page 1376)

across the Zambesi River at Kariba Gorge, about 170 miles from Salisbury. The dam will be about 1800 feet long at the crest; hydraulic head will be 300 feet. The reservoir will be 190 miles long and a maximum 40 miles wide.

Two underground stations will ultimately be built, one on either side of the dam, each equipped with six 100,000 kw. units. First stage will comprise one station with five units and also construction of a grid to interconnect the major load centres in the Federation. A high-voltage transmission line will run northward from Kariba to Kitwe, the main power switchyard in the copper belt; southward to switchyards at Norton and Umniati, and thence to Bulawayo and Salisbury, the two largest cities in the Federation. Combined length of lines to the south will be 650 miles.

The Federal Power Board has retained an international group of engineers to plan and supervise construction of the project. Preliminary works are under construction and power production is expected by 1960. The first stage is expected to reach its full potential of nearly 4000 million kwh/year by 1963. The second stage of the Kariba scheme will be carried out as the growth in power demand justifies it.

The Metal Bonding of Aircraft Assemblies (Discussion)

(Continued from page 1373)

able solvent-free adhesives based on epoxy resins which require neither the high-temperature cure nor the solvent-drying and pre-cure procedures necessary with the vinyl-phenolic types.

The Author

In regard to Mr. Diggle's comments, I have nothing further to state. However, in regard to Mr. Gray's discussion, I would like to submit the following.

The epoxy adhesives by themselves would be unsuitable for structural applications where there must be a close relationship in shear modulus between that of the adhesive and that of the adherents. The problem associated with the use of a brittle adhesive (such as an epoxy) with a ductile metal (such as aluminum) is obvious from the point of view of the transfer of load from one element to another.

The epoxy adhesive could be plasticized with a rubber or another resin such as polyvinyl butyral but this would introduce the solvent problem which Mr. Gray mentions that epoxy adhesives avoid.

The strength of a bonded joint is line thickness. Unfortunately, the epoxy adhesives which, at least, are known to the writer at the present time, are not only very viscous and difficult to apply uniformly but also cannot be appplied to any desired thickness as is the case with the fiberglas cloth-supported phenolic adhesives mentioned in my paper.

Application of Welded Design to Hydraulic Turbine and Valve Manufacture (Discussion)

J. G. Warnock, *English Electric Company of Canada Limited*

The Engineering Journal, 1956, *Oct.*, *p.* 1350

H. M. Viberg [1]

Our organization would like to take this opportunity to present some pertinent data on steel castings to alleviate any doubts as to their industrial value.

The industry as a whole spends large sums of money for technical research in plants, universities and associations; it is ever searching for ways to improve design and pattern equipment, production processes, and inspection in the foundry. Great advances have been made in metallurgical control and heat treatment. Melting and pouring temperatures are constantly checked by pyrometers and improvements of pouring practice, heading and gating are going on all the time; even the selection of scrap is under laboratory control. Improvements have been made in furnace controls and operation. The modern foundry today is equipped with modern sand preparation equipment, new moulding machines and improved cleaning machines. Foundry engineers are co-operating with the customer to improve designs. Many intricate designs may be cast in order to distribute loads properly with specifications laid down to make use of cast steel's high impact values obtained through the addition of alloys and subsequent heat treatment.

Product development has done much to reduce weight, improve appearance and reduce costs. Today's requirements for new equipment operating under higher pressures and at higher temperatures are calling for new designs.

These castings must be homogeneous and the design must be such as to facilitate foundry practice to produce a good dependable sound casting. These castings are further subjected to "Magnaflux" and radiograph inspection which ensures the internal integrity of the casting to both the producer and consumer.

[1] Chief Mechanical Engineer, Steel Foundry Division, Canadian Car & Foundry Company Ltd., Montreal.

Report on Investigation into the Failure of Two 100-Mw. Turbo-Generators

Sir Claude D. Gibb, C.B.E., D.SC., M.E., F.R.S.

The Engineering Journal, 1955, March, p. 213.

V. S. Thompson, M.E.I.C., Ottawa.

I was once again impressed by the honesty of the C. A. Parsons and Company Limited in making public the findings into the failure of two generators at Toronto.

A similar illustration of such an attitude was the investigation into the Comet disasters. Both of these reports must increase the respect of all engineers for the manufacturers who have not tried to conceal any weakness in their products when general benefit may accrue from publicity.

In comparison, it would seem a great pity that the investigations into a recent failure of an important Canadian bridge have not been made public for the benefit of all structural engineers.

I suggest that the Engineering Institute should endeavour to obtain this information "to facilitate the acquirement and interchange of professional knowledge among its members".

Month to Month

News of the Institute and the Profession

COMMENT AND
CORRESPONDENCE
ELECTIONS
AND TRANSFERS

Atlantic Provinces Professional Engineers

1956 Biennial Meeting

As most readers are aware, every second year the Atlantic Provinces Branches of the E.I.C., together with the Associations of Professional Engineers in those provinces, hold a regional meeting. It has become the custom for these gatherings to alternate in locale between Digby, Nova Scotia and St. Andrews, New Brunswick. This year, during the three days of September 5, 6, 7, the meeting centred around and in the Algonquin Hotel at St. Andrews.

If it is reasonable to judge by numbers of those attending, and by genuine enthusiasm, the 1956 meeting was the one to eclipse all previous occasions. Probably the best way to describe the event, and this is from the point of view of one of the ordinary participants, would be to say that it was an example of well organized informality. The committee in charge obviously had as their objective a program designed to develop friendship, in keeping with their ideas of professional dignity and technical advancement, and they succeeded — most admirably.

Two council meetings occupied the afternoon the opening day, providing an opportunity for regular deliberations by the councils of the E.I.C. and of the New Brunswick Professional Engineers Association. These were followed by an informal dinner, and later the evening was spent in get-together manner at the E.I.C. president's reception. Old friends renewed acquaintance, and newcomers were welcomed.

The morning periods on Thursday and Friday were devoted to the

A council meeting was held at St. Andrews during the Atlantic Provinces meeting. President V. A. McKillop presided. Above, R. E. Heartz, vice-presidents R. L. Dunsmore and H. W. Doane, Mr. McKillop and the general secretary, L. Austin Wright; below, the councillors.

Cover Picture

The cover picture shows a new terminal station which went into operation recently at Chaudiere, just south of the Quebec Bridge. It is one of a series of new Shawinigan installations nearing completion.

"The Growth and Development of Large Electric Power Systems" is treated by W. R. Way of Shawinigan Water and Power Company in a paper on page 1329 of this issue.

presentation of the technical papers. It was to be expected that the authors would deliver talks of particular interest to Maritime audiences, and these were as follows:—

An Appraisal of the Potentiality of High Voltage Direct Current Transmission, by E. V. Leipoldt, vice-president, Shawinigan Engineering Limited.

Sub-Surface Foundation Exploration by the Seismic Method, by Emery Holzl, chief engineer, S.E.M. Prospecting Limited.

Smelting of New Brunswick Manganese Ores, by Dr. Marvin Udy, Consulting Engineer.

Canada's Approach to the Economic Fuelling of Nuclear Power Reactors, by Dr. A. V. Mooradian, superintendent of engineering development, Atomic Energy of Canada Limited.

In addition to the technical sessions, the program included guest speakers at two luncheons, and at the banquets which were held on the evenings of the second and third days. In the order of their appearance, we heard from V. A. McKillop, E.I.C. president, who spoke of the very important relationship of the engineer and his community, then at dinner the same day Brian H. Colquhoun, M.E.I.C., engineering advisor to the International Bank for Reconstruction and Development gave some interesting and important details of the workings of that organization.

At noon on Friday the 7th, a popular speaker was Mrs. T. P. Lusby of Halifax, the president of the Professional Engineers Wives Association of that city. She covered some amusing, yet fundamental, aspects of the wife's place in an engineer's life. The guest of honour at the final banquet was the Right Honourable C. D. Howe, Hon.M.E.I.C., who gave the meeting his views, both personal and as a cabinet minister, on the question of shortage of Canadian engineers and technical personnel.

On Thursday afternoon, the second day, we enjoyed one of the highlights of the convention. In fine clear crisp weather the MV. "Grand Manan" took a large party of engineers and ladies for a three-hour cruise through the bays and channels which may some day form the workings of the long discussed Passamoquoddy Power Project. The size and importance of this vast proposal were made evident to the passengers, and the cruise itself was a pleasant diversion.

The social side of the meeting was carefully organized and well carried out — probably deserving of more prominent mention than at the end of this account. We had an evening cabaret show, well attended and very amusing, a golf tournament on the fine St. Andrews Course, and the wind-up event was the grand ball on Friday night, one of the nicest dancing parties it has been our pleasure to attend in recent years.

It is possible to see, in these regional meetings, the pattern of our Canadian engineering conventions of the future. As the nation and the profession grow, the time will undoubtedly come when the great all-provinces annual meeting must give way, from sheer difficulty of size, to other gatherings of more local interest and colour, such as this one recently concluded at St. Andrews. We hope that they will be planned and carried through by such able and dynamic committees as the one headed by general chairman Joe Donahue, M.E.I.C. of St. John, N.B.

Mrs. T. P. Lusby

AT THE ATLANTIC PROVINCES MEETING

There were two banquets during the Atlantic Provinces meeting, at which the speakers were the Rt. Hon. C. D. Howe, HON. M.E.I.C., and Brian H. Colquhoun, M.E.I.C., of London, England. Mr. Howe is shown in the picture below left, with Mrs. Webb and D. R. Webb, president of the Association of Professional Engineers of New Brunswick. V. A. Ainsworth presided at the Thursday banquet. He is at right in the photograph below, with Mr. Colquhoun, and Mrs. Ainsworth. Others are Mr. and Mrs. Norman F. Stewart, and H. W. L. Doane.

Cruise on M. V. "Grand Manan" through the proposed Passamaquoddy power project area.

I.A.E.S.T.E.* Travelling Bursaries

As was explained in the September *Journal,* one of the chief obstacles in the way of full scale Canadian participation in the IAESTE student exchange has been the deficit incurred by our students in trying to meet their travelling expenses out of European summer earnings. The dollar equivalent of what they can clear above living expenses is just not sufficient.

In July we had with us for several weeks James Newby, IAESTE secretary for Great Britain, and formerly general secretary for the whole organization. He was equally disturbed about the very small numbers of Canadian undergraduates who are taking advantage of employment offers in the U.K., and he decided, with our consent and encouragement, to do something about it. Mr. Newby felt that if this situation was explained in a straightforward manner to some of our larger industries, they might be willing to contribute funds toward closing this gap in the exchange plan. He sounded out a few key personnel, and the response was almost immediate — they liked the idea.

It has been decided therefore to go ahead with this travelling bursary proposal, and the necessary machinery will be organized and set up through Institute headquarters in the next several months. Close touch will be maintained at all stages with the industries concerned and with the university authorities. The objective will be to see that simple but effective procedures are worked out to ensure that assistance, in proper amounts, reaches the hands of recommended Canadian engineering students on their way to IAESTE positions abroad.

It is not difficult to foresee the advantages, both direct and intangible, that will result to our industry, and to Canada, from participation in this bursary plan. Our first consideration should be the reward to the individual student, technical and cultural, from having spent a few very informative months working in a European community. As more and more take advantage, this will of course become cumulative, and the nation will benefit. At the same time, a Canadian industry looking for young engineers (and who isn't?) will quickly recognize how it may affect their chances of gaining a student's allegiance — or at least his friendship — when it is their money which is helping to make his trip overseas possible. It is intended that each of these bursaries will be named after the company contributing it.

Three generous donations from Canadian companies have already been received, and more are expected to come in during the next few weeks. The *Journal* suggests that others might well give this travelling bursary plan some serious study.

* International Association for the Exchange of Students for Technical Experience.

Service To Consultants

For several years the Institute has maintained a register of consulting engineers in Canada.

There are over 300 firms so registered.

The steadily increasing use of the register by industry and government and the rapid expansion of the fields or interest of most engineers, have emphasized the need of bringing the register up to date.

The latest additions to the experience records of the registrants were made for most firms in 1953. In the three intervening years many of them have entered new fields, and in many instances it is to these fields that the current inquiries apply.

In order to bring everything up to date the Institute recently has sent to every registrant the complete file that is with the Institute. The request is made that the record be reviewed, brought up to date, and returned to Headquarters with the least possible delay. Prompt action is requested so that the records will not be absent from the file when inquiries are received.

It is not possible to inform consultants of instances where the names and records have been submitted to inquirers, but it can be said that many millions of dollars' worth of work has been placed with firms whose names were supplied by the Institute register.

Naturally the Institute cannot recommend one firm in preference to another. On receipt of an inquiry the procedure is to examine the classification file to determine which firms have had experience of the kind requested. These names are submitted along with copies of the experience record of the firms, so that the prospective client may select for himself the firm or firms to which he may direct his further inquiries.

The service is free to the engineer and to the client and is not restricted to members of the Institute. One of the prime purposes for creating it was to meet at least partially the frequently offered defence for employing foreign consultants, "We did not know of any Canadian consultants who could do the work." With the Institute's register so well established there is no longer any excuse for lack of information.

Consultants! Be sure to return your records promptly. It is essential that we have them promptly to continue our service.

Elections and Transfers

At a meeting of Council held on September 5, at St. Andrews by the Sea, N.B., a number of applications were presented for consideration and on the recommendation of the Admissions Committee the following elections and transfers were effected:

For Admission as Member

H. M. Brownrigg, Joliette
I. T. Burke, Ottawa
G. B. Carter, Shawinigan Falls
G. H. Currie, Winnipeg
A. E. Fee, Ottawa
F. A. Fell, Balmertown, Ont.
T. C. Hirst, Montreal
J. F. Leaver-Power, Wythenshaw, U.K.
F. S. Maconachie, Ottawa
J. D. Mayo, Toronto
S. H. McClure, Montreal
W. F. McDougall, Montreal
E. S. Szekely, Arvida
B. S. Thornton, Montreal
H. F. Wooster, Vancouver
G. B. Wray, Cornwall

For Transfer from Junior to Member

D. B. G. Dutton, Waterloo, Ont.
R. L. Nordlund, Vancouver
J. D. Smith, Toronto

For Admission as Junior

J. A. Fordham, Toronto
W. E. Stone, Vancouver

For Transfer from Student to Junior

G. G. Hurlburt, Toronto

For Admission as Student

H. J. Coulombe, Laval University
D. C. Bouras, McGill University
B. de Cardaillac, McGill University
R. L. Hicks, Nova Scotia Technical College
A. T. Isaacs, Nova Scotia Technical College.
R. A. Morrow, Queen's University
D. M. Robertson, B.Eng. (Civil), 1956 N.S.T.C.
R. M. Watson, B.Sc (Elec), 1956 Univ. of Alta.
L. J. C. Almassy, Passed test at Sir Geo. Williams for entrance in Science in Mar./56

Applications through Associations

By virtue of the co-operative agreements between the Institute and the Association of Professional Engineers, the following elections and transfers have become effective:

ALBERTA

Members

H. L. Hogge
K. Kamra
L. Keet
J. W. Poole
E. M. Searcy

Junior to Member

B. Smolensky

SASKATCHEWAN

Members

A. R. Byers
J. K. Diebel
R. E. Harris
C. G. Holthouse
W. O. Kupsch
G. J. Sladek

Junior to Member

W. A. Byskal
R. B. Godwin
A. W. Holroyd
T. A. Kajewski

Student

G. T. Dewhurst

MANITOBA

Junior to Member

H. A. MacDiarmid

NOVA SCOTIA

Members

I. MacInnis
H. C. McGee

Junior to Member

H. C. Maitland
D. H. Waller

There Is Something New

At the last meeting of the Council of the Institute approval was given to the creation and distribution of a new insignia of the Institute. This is to be in the form of a miniature slide rule, made up as a tie clip. The initials "E.I.C." appear on the slide.

An experimental number were made in time for some distribution during the annual meeting but these disappeared very quickly and further orders have now been placed.

Council has ruled that a tie clip will be given to each new Student member as his application is approved by Council. Clips will be available to other student members at the price of $1.00 each and to Members and Juniors at the price of $2.00 each.

The clip is a first class piece of jewellery and will be an ornament to any engineer, either young or old. It is expected they will be popular with members in all parts of Canada.

The following experience is an illustration of how popular it is expected they will become.

At the Council meeting six clips were distributed so the councillors could see what was being discussed. When Council agreed that the clips would be sold at $2.00 each six separate payments of $2.00 reached the head of the table but not a single tie clip was returned.

The wearing of a tie clip would identify a person as an engineer just about as clearly as does the iron ring and it is hoped that eventually there may be as many tie clips in use as there are iron rings.

It is regretted that it isn't possible to present every student member with one of these useful articles. However, there are today over 3500 students on the membership list and when it is considered that the clips cost almost as much as the selling price it will be realized that the initial cost would be more than the Institute could bear. Council hoped that by offering them to the present student members at $1.00, they would meet the situation satisfactorily.

Members desiring clips may obtain them from headquarters, although at the moment the stock is very low. It is planned to have a supply at each university centre this fall.

Aid to Education in Canada

That industry should take its part in solving our educational problems is commendable, and the growing conviction is that it is a necessary trend.

There are many instances of co-operation between industry and the universities. One remarkably generous program of financial aid to education is supported by the International Nickel Company of Canada.

Recently it was announced that this company's contribution to higher education in Canada will be $2,500.000, to be paid over a five-year period in grants to 140 institutions in the ten provinces.

Approximately 80 per cent of the amount will be for use by the universities and colleges in their programs to provide for anticipated increase in requirements throughout the country in the next few years.

Two-Phase Program

The program has two major phases. One authorizes approximately $2,000,000 in grants to the 140 universities, liberal arts colleges and technical colleges for use in strengthening and expanding their educational programs.

The second phase covers the allocation of approximately $500,000 for scholarships, fellowships and special projects, including assistance to teachers of science and mathematics and guidance counsellors in preparatory and high schools. It will increase the company's present fellowship program and establish one fellowship in each of Canada's 13 major universities; it will establish 40 scholarships, half of which will be restricted to study in the fields of geology, geophysics, mining, metallurgy and engineering; it will include a fund of about $150,000 for special projects.

Of special interest in this program, is the fact that each fellowship and scholarship awarded to an individual is accompanied by a grant of $500 to the institution in which the student is placed. Thus, in these instances, the gap between tuition fees and the actual cost of education is bridged.

The policy of the company has been expressed as follows: "Financial aid by Canadian corporations to education in this country is sound business policy. It is an investment by these corporations in their own future."

The proposal to give such a substantial amount direct to the universities must greatly encourage the university officials. It helps them meet the burden of increased enrolment, and it shows the appreciation of the employer, who after all is the one who absorbs about 90 per cent of their end product.

Contribution to Education

Recently on the death of one of the members of the Institute, his family requested that persons who wished to pay respect to his memory send contributions to the Education Fund of The Engineering Institute of Canada rather than to send flowers.

This is the first time that this thoughtful action has been taken, and both the Council of the Institute and the trustees of the fund are extremely grateful for the kindness and the thoughtfulness of the family.

At the present time the amount of money contributd to the Education Fund is approximately $250.00, and information has reached the Institute that further amounts are forthcoming. This is a substantial assistance in the accomplishment of the objectives of the Fund.

Would it be improper to suggest that similar action might be taken by the next of kin of other members of the Institute? Certainly there are few ways which money can be used to better advantage than in education, and indeed within the field of engineering there are few funds that are more worthy than this one of the Engineering Institute.

Incidentally, contributions made to this fund are deductible from income for tax purposes.

The Covered Bridge

Everyone who does much commercial flying will have expeprienced the unpleasantness of having to embark or disembark in a pouring rain. Usually it is a long way from the plane to the terminal building and particularly so in a rainstorm. The Lockheed Company have come up with something that may be the answer. At least it works now for freight transportation and it should not be difficult to adapt it to passenger needs.

The device is simply a long covered platform that can be wheeled up to the door of a plane at one end and to the passenger or freight terminal at the other.

This telescopic portable covered bridge has a maximum length of 84 feet. It is 10 feet wide inside with a height of 8 feet 6 inches. It is fitted with roller conveyors but tests are underway with powered rollers and powered belt. It is claimed that 18,000 pounds of cargo have been removed from a DC4 in less than 18 minutes, and the same amount loaded in 35 minutes. It is planned that the aerobridge will save at least one hour in turnaround time.

The bridge is being tested now at Travis Air Force Base in California, and a second unit is being installed at Tinker Air Force Base, Oklahoma where it will be tested and evaluated by the Air Materiel Command.

A view of the bridge may be seen in the photograph reproduced below.

The "covered bridge" developed by Lockheed Company for use at air terminal in bad weather.

THE CONTINUED EDUCATION OF THE GRADUATE ENGINEER

ASME-EIC Engineering Education Conference

UNIVERSITY OF WESTERN ONTARIO
LONDON, ONTARIO

OCTOBER 18-19, 1956

Session No. 1.	THE ENGINEERING TECHNICIAN
Moderator	DR. L. S. BEATTIE, Superintendent of Secondary Education, Province of Ontario.
Panel Members	KIMBALL C. CUMMINGS, Associate Director Aero Research, Minneapolis-Honeywell Co., Minneapolis. DR. H. H. KERR, Principal, Ryerson Institute of Technology, Toronto. KARL O. WERWATH, President, Milwaukee School of Engineering, Milwaukee. R. S. EADIE, Vice-President and General Manager, Eastern Division, Dominion Bridge Company Limited, Montreal.
Session No. 2.	THE PRODUCT OF THE ENGINEERING BACCALAUREATE CURRICULUM
Moderator	G. ROSS LORD, Head, Department of Mechanical Engineering, University of Toronto.
Panel Members	JOHN T. RETTALIATA, President, Illinois Institute of Technology Chicago. PROF. STUART LAUCHLAND, Head, Department of Engineering Science, University of Western Ontario. A. M. ANDERSON, Manager of Technical Education, General Electric Company, Schenectady. E. T. W. BAILEY, Combustion Engineer, Steel Company of Canada, Hamilton.
Dinner address	FUNDAMENTAL CONCEPT OF EDUCATION
Chairman	C. J. FREUND, Dean of Engineering, University of Detroit.
Address by	DR. G. E. HALL, President, University of Western Ontario.
Session No. 3.	TRAINING AND ORIENTATION OF THE GRADUATE ENGINEER ON THE JOB
Moderator	A. C. MONTEITH, Vice-President, Westinghouse Electric Corporation, Pittsburgh.,
Panel Members	C. A. PEACHEY, General Manager, Communications Equipment Division, Northern Electric Company, Montreal. JOHN GAMMELL, Director, Graduate Training, Allis Chalmers Mfg. Company Milwaukee, (General Machinery Divn.). M. J. J. MCAULIFFE, Superintendent of Graduate Training, Canadian Westinghouse Company, Hamilton. LEO. L. CASE, Chicago Blower Corporation, Detroit.
Session No. 4	AMPLIFYING THE BACCALAUREATE EDUCATION
Moderator	H. G. CONN, Dean of Engineering, Queen's University.
Panel Members	CORNELIUS WANDMACHER, Head, Department of Civil Engineering, University of Cincinnati. DR. B. B. HILLARY, Research Co-ordinator, Dow Chemical Company, Sarnia. R. E. JAMIESON, Dean of Engineering, McGill University. F. E. VERDIN, Management Consultant, Cleveland.
Session No. 5.	FORMAL GRADUATE STUDY
Moderator	NEWMAN A. HALL, Professor of Mechanical Engineering, Yale University, New Haven.
Panel Members	DR. MORRIS KATZ, Occupational Health Division, Department of Health and Welfare, Ottawa. WARREN C. STOKER, Director, Graduate Centre, Rensselaer Polytechnic Institute, Hartford. D. S. SIMMONS, General Manager, Manufacturing, (Refining and Engineering), Imperial Oil, Toronto. SYDNEY B. INGRAM, Director, Education and Training, Bell Laboratories, New York.
Dinner address	MEETING THE SHORTAGE OF ENGINEERS AND SCIENTISTS
Chairman	VERNON A. MCKILLOP, President, The Engineering Institute of Canada, General Manager, London Public Utilities Commission.
Speaker	DR. JOSEPH W. BARKER, President, American Society of Mechanical Engineers, President, Research Corporation, New York.

New Trustee for the Education Fund

Dr. Otto Holden, M.E.I.C. assistant general manager of the Hydro-Electric Power Commission of Ontario recently has been appointed by Council as a trustee administering the Harry F. Bennett Education Fund of the Engineering Institute of Canada.

Dr. Holden is replacing V. A. McKillop, M.E.I.C., the president of the Institute, who for many years has acted on the board. It is the policy of Council to change the trustees from time to time on the basis of a three-year term of service for each.

The Education Fund was established in 1946 by the Institute in memory of the late Harry F. Bennett, former chairman of the Committee on the Training and Welfare of the Young Engineer, and past-chairman of three different branches of the Institute. It is administered by three trustees who have full control as to the disposition of the monies.

The other trustees who will act with Dr. Holden are Dr. I. R. Tait, M.E.I.C., of the Canadian Industries Limited, Montreal, and Mr. Hugh C. Nourse, M.E.I.C., of the Bell Telephone Company, Montreal.

At the end of 1955 the fund totalled $33,000.00. Within the last year the activities have increased greatly, in the form of loans to worthy engineering students. In 1955 loans amounted to $6,400.00 and at the end of that year there were seventy-nine loans outstanding.

The fund was quite active early in 1956 but in view of the fact that the greatest number of requests for assistance come in the fall of the year, there are no significant figures to present for this year so far.

The increasing use of the fund is proving the wisdom of having established it many years ago. Seventy-nine students are today benefiting from the fact that money can be secured from the Institute in this way. It is expected that the number will increase substantially within another year's time.

Donations to the fund are deductible from income for tax purposes and members are asked to keep this worthy cause in mind when they wish to do something helpful for the young engineer and for education.

ASME-EIC Engineering Education Conference

The Engineering Institute is taking part, with the American Society of Mechanical Engineers in a second Engineering Education Conference, this time at the University of Western Ontario, London, Ontario, October 18-19, 1956.

The first such meeting was two years ago at Clarkson College of Technology, Potsdam, N.Y., and our members will recall that then the matter under discussion was "Trends in Mechanical Engineering Education".

This year the theme is "The Continuing Education of the Graduate Engineer". The general purpose of the conference is to dramatize the vital importance of the continuing education of the graduate engineer in its various phases, to clarify the responsibility of the engineer, the employer, and the engineering school and to report successful methods.

Because of the importance of the engineering technician in amplifying the usefulness of the graduate engineer and the need for developing this usefulness, the opening panel session is devoted to this subject.

Because of limited accommodation, attendance at these meetings must be by invitation, only. However it is planned that there will be a full report in *The Engineering Journal* for the benefit of our members who are unable to participate.

The program of the meeting appearing on the opposite page will demonstrate the importance of this meeting.

Nominees for Office

The report of the Nominating Committee, as accepted by Council at the meeting held on September 5th, 1956, is published for the information of all corporate members as required by Sections 19 and 40 of the by-laws:

President	C. M. Anson	Sydney, N.S.
Vice-Presidents		
*Zone A (Western Provinces)	S. C. Montgomery	Trail, B.C.
*Zone B (Province of Ontario)	W. J. Ripley	Copper Cliff, Ont.
*Zone C (Province of Quebec)	Albert Deschamps	Montreal, Que.
Councillors		
†Yukon Branch	John L. Phelps	Whitehorse, Y.T.
†Vancouver Island Branch	P. F. Fairfull	Victoria
†Vancouver	W. O. Richmond	Vancouver
†Central British Columbia	M. L. Wade	Kamloops
†Kootenay	W. K. Gwyer	Trail
†Edmonton	R. N. McManus	Edmonton
†Saskatchewan	W. L. Sharpe	Weyburn
†Winnipeg	W. D. Hurst	Winnipeg
†Lakehead	E. T. Charnock	Fort William
†Sudbury	F. A. Orange	Sudbury
†Nipissing & Upper Ottawa	R. R. Prescott	Temiskaming
†Border Cities	P. S. Dewar	Windsor
	R. J. Trinder	Windsor
†London	G. E. Humphries	London
†Port Hope	R. C. Wilson	Port Hope
†Belleville	S. Sillitoe	Belleville
†Kingston	C. H. R. Campling	Kingston
†Brockville	J. S. Waddington	Brockville
†Ottawa	W. B. Pennock	Ottawa
‡Toronto	K. F. Tupper	Toronto
§Montreal	E. D. Gray-Donald	Montreal
	J. H. Budden	Montreal
	R. B. Winsor	Montreal
†Saguenay	A. B. Sinclair	Kenogami
†Lower St. Lawrence	L. P. Dancose	Mont Joli
†St. Maurice Valley	W. G. Seline	Three Rivers
†Eastern Townships	G. J. Cote	Sherbrooke
†Corner Brook	Ernest Leja	Corner Brook
†Newfoundland	William Watson	St. John's
†Prince Edward Island	W. S. Veale	Charlottetown
†Amherst	A. G. Baxter	Amherst
†Halifax	W. A. Devereaux	Halifax
†Fredericton	S. B. Cassidy	Fredericton
†Saint John	A. G. Watt	Saint John

* One vice-president to be elected for two years
† One councillor to be elected for two years.
‡ One councillor to be elected for three years
§ Three councillors to be elected for three years each.

THIRTY-FIVE YEARS AGO

Comment on the Journal of October 1921

A policeman's lot may not be a happy one, but neither is that of the editor of a society journal. Ideally, he should follow the policy of his directors to the line; publish only what his readers want and nothing else, turn down authors whose offerings are unacceptable so gracefully they will feel honoured by his rejection and keep the content of his magazine such that his advertising manager can fill the pages allotted to him without stirring from his chair. Moreover, such an editor must depend almost entirely for his material upon that submitted by the members of his society.

It goes without saying that this ideal editor never has existed and does not and never will exist. Judging by any standard, the best would not have a batting average of more than about five hundred, which may be high in the big leagues, but is not too good here.

One of the greatest difficulties in publishing a society journal is to get enough suitable material to give each issue that plump and satisfying look which betokens the prosperity of its sponsors. Of course, the larger the society, the easier this task becomes.

The Institute of 1921 had about 4,000 members, today it has some 17,000. The difference shows up in the *Journal*. That for October, 1921, contained three technical papers totalling sixteen pages; the July, 1955, issue, which happens to be lying before me, has six papers occupying forty-three pages. The 1921 *Journal* could say all it wanted to editorially in three and a half pages, but it took the editor of 1955 about twelve pages to unburden himself. Only twenty-one members received personal mention in 1921 as against about a hundred in 1955. The employment service had four *items* then; today it occupies half as many again *pages*.

The Engineering Index disappeared from the *Journal* long ago, but in its place it now carries regular features unknown in 1921—abstracts of current literature; Month to Month; news of the professional associations and of the Corporation; library notes; business and industrial briefs; and, of course, these recollections of thirty-five years ago! Some of these features would probably have been added to the *Journal* in any event, but it should not be overlooked that a large part of whatever improvement it has been possible to make in the *Journal* in recent years has been made possible by an increase in its income from advertising. Not only has the volume of advertising increased, but so have rates, and yet they are not excessive for a magazine of the *Journal's* character and coverage.

But I seem to have got somewhat off the track. I set out to see what the *Journal* of October, 1921, was saying and I find I have in effect been telling you that the good old times were not so good as the good new times.

Study of Corrosion

The intense interest in 1921 in the effect of alkali soils on concrete led to a parallel interest in their effect on metals. In Winnipeg the corrosion of cast iron pipe had led to the suspicion that electrolysis was at work. But much of the damage had occurred in areas where there was no possibility of electrolysis.

W. Nelson Smith, M.E.I.C., and Dr. J. W. Shipley had conducted a long series of experiements to determine the effect of various metallic salts on cast iron and reported their results in this *Journal*. They arrived at certain conclusions:

"The corrosion of cast iron by salt solutions . . . in natural soils is readily accomplished . . . without access of stray current . . . Magnesium salts are the most corrosive . . . and magnesium sulphate . . . is the most . . . (active)."

They had a low opinion of the protective coatings then in use . . . "The treatments with tar, dips and paints have generally . . . proved futile . . . The life of cast iron pipe in a wet, salty soil could (probably) be lengthened . . . by backfilling the trench with quartz sand or washed gravel . . ."

While there is no absolutely certain method even yet for protecting buried cast iron or steel pipe from corrosion, coatings have been developed by the designers and builders of our long gas and oil pipe lines which are pretty efficient, so corrosion is no longer the great bugbear it once was.

Western Irrigation Schemes

In 1921, the west's eyes were on irrigation, so that a paper describing the various schemes then completed, under construction or contemplated, by G. M. Houston, M.E.I.C., was timely. Sixteen of the principal schemes in Alberta and Saskatchewan were shown on a map accompanying the paper. They ranged from the Lethbridge Southeastern Project of half a million acres, down to the Little Bow Project of a mere 3,000, and totalled 1,760,000 acres, not including one which had not yet been surveyed. Mr. Houston had no doubts of the results of irrigation: "Irrigation has only just started in the prairie provinces and if the schemes now projected proceed to completion and are operated successfully, southern Alberta and Saskatchewan will be the garden spot of the Dominion."

Roads Committee

The October, 1921, *Journal* announced the appointment by Council of a "Roads and Pavements Committee" of nineteen members, most of them connected with the provincial highway departments or with the larger cities. There was no hint as to what the committee was supposed to do, but it "has its work well in hand so that definite results may be expected in the near future."

Employment

Unemployment among engineers was becoming a problem, which moved the editor to say: "To those who are fortunate enough to be . . . secured in their positions an opportunity is presented to demonstrate that there is a faternal spirit . . . among members of the profession . . . Letting a man out (now) is almost equivalent to condemning him to unemployment . . . for . . . months; . . . it is practically impossible for an engineer . . . to secure a position. Would it not be well for those who influence engineering positions to make a special effort to hold their men . . . even though it (means) a temporary reduction in pay?"

I suppose the fact that there was nothing to excite one in this issue of the *Journal* is evidence that the Institute's affairs were running smoothly, but such placidity does not make for the interest one finds in other *Journals* where there were sometimes rather hot arguments to report.

R. DeL. F.

Professional Standards and Employment

A report recently issued by the Engineers Joint Council entitled "Professional Standards and Employment Conditions", was finally adopted only after review by the E.J.C. executive committee and a special task committee, and after approval by the board of directors.

It was, therefore, not the work or view of one individual and perhaps everyone will find some part of it with which he does not fully agree. It does, however, represent a significant appraisal of employment factors which deserve attention.

Emphasizing that "there is no simple solution" toward raising professional standards or improving employment conditions of engineers, the report makes seven recommendations (that):

1. Management utilize the services of engineers more effectively and thereby afford them the opportunity for advancement and economic improvement.
2. Management recognize its responsibility to make engineers feel that they are a part of management.
3. Management survey areas of communication, recognition, and salaries and, where found wanting, correct to conform with standards of professional practice.
4. The engineer takes inventory of his services and his actions to make sure that he has a professional attitude toward his work.
5. Engineering societies establish and employ appropriate means to maintain high standards of ethical conduct for professional achievement.
6. Engineering societies encourage the professional development of their members and promote proper recognition of the profession.
7. Engineering educators emphasize the characteristics of the profession.

The E.J.C. board of directors endorsed these recommendations and strongly urged the constituent societies to examine the entire study carefully. Copies of the report may be obtained without charge from: The Engineers Joint Council, 29 West 39th St., New York 18, N.Y.

OBITUARIES

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Major W. E. Blue, M.E.I.C., retired Gatineau Power official, of Ottawa, died in that city during August, 1956.

Born in Toronto on February 27, 1889, he followed his engineering studies at the Royal Military College, Kingston, Ont., and graduated with a diploma in 1910. Before the beginning of World War I, he had three years' experience as an engineer in charge of various surveys and river metering for the Department of Public Works, mainly on the Ottawa and St. Lawrence rivers.

A concrete inspector on the Chaudiere dam, Ottawa, while a student in 1908, he was resident engineer for the Department of Public Works on the Chaudiere dam at Lake Nipissing, late in 1913 and until the early part of 1914.

At this point in his career he joined the Canadian Expeditionary Force, Canadian Field Artillery, commanding a field battery overseas, and was for a time adjutant of the brigade. For his service he was awarded a D.S.O.

By June 1919 he had once again taken up duties with the Department of Public Works, Ottawa, as an assistant engineer. In 1922 he was associated with the Riordin Pulp Corporation Limited. Within the next few years, in 1926, he joined the Gatineau Power Company in Ottawa, where he became manager of the development department, a position he retained for many years. He retired in 1954.

Long associated with the Institute, Major Blue was granted Life Membership in 1955. He was a Student Member in 1910, a Junior in 1913, transferred to Associate Member in 1919 and to Member in 1940.

H. G. Bertram, M.E.I.C., for many years president and general manager of John Bertram and Sons Company Limited, Dundas, Ont, died suddenly on June 16, 1956, in Dundas.

Born there on May 9, 1886, he was educated in Dundas public and high schools and in 1910 graduated with a bachelor of science degree from Queen's University.

Mr. Bertram's professional career began in Costa Rica and Mexico, where he did construction work and was assistant engineer with the Mexican N.W. Railway, shortly after graduation. In 1913, once again in Canada, he joined the firm of John Bertram and Sons Company Limited as a shop engineer. Five years later he was plant engineer and superintendent of the shell shop, concerned with the design of machine tools. He progressed to executive posts, becoming general manager in 1926.

He was named secretary and treasurer of Pratt and Whitney Company of Canada Limited in 1928 and 1931 was vice-president and general manager of his firm, John Bertram and Sons and of Pratt and Whitney. He received his appointment of president of the latter organization in 1943, and retired from business in 1951.

Enjoying a far-reaching career in matters relating to engineering, Mr. Bertram had been a member of the executive of the Canadian Manufacturers' Association. In 1939 he assured the British premier, along with J. G. Morrow of Hamilton, in a conference, of Canada's industrial co-operation in the event of hostilities. During his stay in England, at the time, he interviewed the authorities in the war office and had the foresight to bring considerable technical information regarding the manufacture of guns which previously had never been made in Canada. He secured designs for gun boring and rifling machines which speeded production at the local plant in Dundas.

He was also on the advisory board of the Royal Trust Company and retired last December as a director of the Equitable Life Insurance Company. For many years he served on the University Council and Trustee Board of Queen's University, and it was there that he was awarded an honorary LL.D. degree in 1947. At the time of his death he was a member of the Board of Governors of Hamilton College.

Members of the Institute may recall the late Sir Alex Bertram, treasurer of the Institute from 1919 to 1926, whose nephew Mr. H. G. Bertram was.

Mr. Bertram joined the Institute in 1920 as a Member, and was granted Life Membership on Jan. 1, 1956.

William John Dyne, M.E.I.C., of Deep River, Ont., died on May 2, 1955.

Born at Maesteg, Glamorganshire, South Wales, on April 6, 1926, he studied engineering at Loughborough College., Leicestershire, Eng., and was graduated in 1946 with a diploma in mechanical engineering.

He served a two year period with the Royal Engineers, work services branch, from 1947 to 1948, as a second lieutenant. Employed with a power station in Surrey, Eng., from 1948 to 1950, he later gained experience with the British Coal Utilization Research Association as an assistant research engineer, and with the British Oxygen Company.

Resident in Canada in 1952, he became an assistant engineer with the Canadian Western Natural Gas Company at Calgary. Most recently Mr. Dyne was an assistant research officer with Atomic Energy of Canada Limited, at Chalk River, Ont.

He joined the Institute in 1953 as a Member.

NEWS OF THE

Associations and Corporation

Information received through co-operation of the provincial organizations.

ONTARIO

Instructor Teacher Shortage
An editorial reprinted from the Bulletin of the Association of Professional Engineers of Ontario.

We read and hear much about shortages of various kinds — shortages of basic commodities, shortages of engineers, and anticipated shortages of facilities for educating engineers and technicians during the next decade or longer.

All are of concern to our profession, but one which merits particular consideration is the existing and continuing shortage of teachers and instructors in the field of engineering. For many months we have been facing what President Sidney Smith of the University of Toronto calls the "crisis of numbers". He and many other educators qualified to know point to the rapid and unprecedented increase in Canadian youth reaching the age of eighteen in the years just ahead of us. This situation needs no detailed blueprint to make us appreciate the problem of the engineering faculties and technical institutes. Even with today's enrolment the scarcity of instructors is all around us. Tomorrow's problems will be many times greater and more urgent.

The role of the teacher is an old and honourable one and if service is one of the distinguishing badges of a profession, teaching is indeed a profession of a high order. It is more than gratifying to see the grass roots growth of educational programs within industry. It is a pleasing indication of awareness of the problem we are facing and practical evidence of a willingness to come to grips with the problem.

A number of our profession have directed their life work to teaching in our secondary schools, in our technical institutes and in our universities. Others are contributing of their spare time to the same work in their plant or in more formal places of learning. It is hoped that others of our members will sense the need and be guided by the direction of their conscience. We all are not blessed with those special gifts that make an outstanding instructor but in the emergency many of us may acquire some of the teaching technique which will help. Age, too, need be no barrier in making a needed and worthwhile contribution.

BRITISH COLUMBIA

Engineers in the News

J. P. Hague, has been appointed senior location engineer with the Department of Highways in Victoria. He had previously held the position of maintenance engineer in the Department.

S. K. Thorneycroft, of Crown Zellerbach (Canada) Limited, was recently transferred from Ocean Falls to the Company's central engineering office in Vancouver as paper mill engineer.

G. D. Trethewey, research chemical engineer with Alaska Pine and Cellulose Limited, has been transferred from woodfibre to the research division in Vancouver.

E. E. Olson, a 1952 civil graduate of U.B.C., has returned from California to accept an engineering position with the City of Nelson.

P. S. Herring, city engineer of Kamloops, recently accepted a position with the engineering department, city of Vancouver. He will be assistant to the engineer in charge of operations.

W. G. Edward, a 1949 mechanical graduate of U.B.C. is now assistant chief engineer, Lumber Division, Potlatch Forest Inc., Lewiston, Idaho.

R. A. De Bou, formerly with the Shell Oil Company has joined the staff of H. H. Minshall and Associates.

I. R. Corey, of the Consolidated Mining and Smelting Company at Tulsequah, B.C. has sent word that he is leaving for Ireland where he will be with the St. Patrick's Copper Mines Limited, Avoca, County Wicklow.

H. M. Matson, is now in Lima, Peru, as chief construction engineer for the Utah Construction Company and Morrison-Knudsen Joint Venture and engaged on the Toquepala Development for the Southern Peru Copper Company.

Municipal Engineers' Convention

The annual convention of the Municipal Engineers' Division of the Association of Professional Engineers of B.C. took place in Penticton from September 20 to 22.

The program included a pre-convention annual meeting of the Municipal Supplier's Association.

The main topics of technical discussion were:

Frost Damage, treated by a panel of speakers consisting of C. P. Harford, city engineer, Prince George; R. C. Thurber, materials engineer, Department of Highways, Victoria; and D. McMullen, Meteorological Services, Department of Transport, Vancouver.

Services of the Provincial Water Rights Branch, discussed by W. A. Ker, Deputy Comptroller of Chief Operations Division, Water Rights Branch, Victoria.

Foundations and Soil Mechanics, a paper by R. M. Hardy, Dean of Engineering, University of Alberta, Edmonton.

Traffic Problems, a paper presented by F. R. Hole, of the City of Vancouver.

R. P. Walrod, of B.C. Tree Fruits Ltd., was the guest speaker at the annual banquet

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There is a report in this issue
of the

ATLANTIC PROFESSIONAL ENGINEERS' BIENNIAL MEETING

This meeting is sponsored by
the E.I.C. Atlantic Provinces branches
and the Associations of Professional Engineers
of New Brunswick, Nova Scotia, Prince Edward Island
and Newfoundland

Personals

News of the Personal Activities of Members of the Institute.

Prof. E. A. Allcut, M.E.I.C., head of the department of mechanical engineering at the University of Toronto retired recently with the title of professor emeritus.

Prof. E. A. Allcut, M.E.I.C.

Named to the staff of the university in 1921 as an associate professor of mechanical engineering, he has served in the capacity of professor since 1931.

Originally from England, Prof. Allcut graduated from the University of Birmingham with an M.Sc. degree in engineering in 1909 and gained eleven years industrial experience in Great Britain.

Prof. Allcut has been associated with a number of professional groups in whose interests he has served widely. He became a member of the Royal Aeronautical Society in 1939, and was named president of the Affiliated Engineering Societies of Ontario in 1946.

He is a Fellow of the American Society of Mechanical Engineers, a member of the A.S.M.E. Power Test Codes Committee, and a member and past chairman of the Ontario Section of the Society. He is a chairman of the Canadian Advisory Committee of the Institute of Mechanical Engineers.

He has also served the National Research Council on various committees.

In 1955 Professor Allcut became chairman of the newly formed Canadian Standards Association committee, on Air Pollution Control. He is chairman of the Air Pollution Board of Toronto, has served as chairman of the E.I.C. Committee on Air Pollution Control and as a member of the committee on Air Pollution Control of the American Society of Mechanical Engineers. Last year he was appointed a member of the Industrial Design Council for a two-year period.

Winner of a number of awards during thirty-five years work in the profession in Canada, Dr. Allcut received the Duggan Medal and Prize of the E.I.C. in 1952; the Plumber and Gzowski Medals of the Engineering Institute in 1943 and 1947 respectively; and the Herbert Akroyd Stuart prize of the Institution of Mechanical Engineers in 1930.

Professor Allcut is the author of the following books; Materials and Their Application to Engineering Design; Engineering Inspection; An Introduction to Heat Engines, Principles of Industrial Management, and many technical articles and papers.

John C. Hamilton, M.E.I.C., has been named vice-president, manufacturing, of Canadian Resins and Chemicals Limited, Montreal.

Works manager of the company's plants at Shawinigan Falls and Ste. Therese, Que., since last October, he was previously general superintendent of plants. Mr. Hamilton joined Canadian Resins in 1943 and, prior to becoming general superintendent in 1953, was successively plant production supervisor and production superintendent.

Douglas G. Darling, M.E.I.C., has been appointed president and general manager of the Wayne Forge and Machine Company Limited, Toronto

A graduate in mechanical engineering with an M.A.Sc. degree from the University of Toronto, Mr. Darling was, until his new appointment, chief engineer of the Toronto Brick Company Limited.

He is a past chairman of the Ontario Section of the American Society of Mechanical Engineers, and a member of the Association of Professional Engineers of Ontario.

D. G. Darling, M.E.I.C.

Dr. George Sinclair, M.E.I.C., associate professor of electrical engineering at the University of Toronto has been promoted to the rank of professor.

Dr. Sinclair received his Ph.D. degree from Ohio State University in 1946, following the degree of M.Sc., in electrical engineering, obtained at the University of Alberta, during the thirties.

In 1954 he was named a Fellow of the Institute of Radio Engineers, following extensive work in that field. During World War II Dr. Sinclair had been director of the antenna laboratory of Ohio State University and was consequently awarded a certificate of appreciation by the United States War Department. Later he became president of Sinclair Radio Laboratories Limited while carrying on the duties of associate professor.

J. A. Stewart, M.E.I.C., has been appointed general manager and a director of Creswell Pomeroy Limited. Mr. Stewart served seven years with Cresswell Pomeroy Limited, from 1946 to 1953, as contracts manager and subsequently as plant manager. During the last three years he was manager, sales and engineering, with Walter Kidde Company Limited.

A graduate of Queen's University, Mr.

J. A. Stewart, M.E.I.C.

Stewart's early affiliations were with Ford Motor Company of Canada and the International Nickel Company of Canada Limited. He also served with the R.C.E.M.E. overseas during World War II.

W. A. MacDonald, M.E.I.C., of Sydney, N.S., has been appointed manager of the Seaboard Power Corporation Limited.

Mr. MacDonald began his career in 1929 with the Northern Electric Company in Montreal, and went later to the Provincial Highways Department of Nova Scotia. In 1934 he joined Dominion Steel and Coal Corporation, Sydney, as an assistant to the chief electrical engineer, carrying out field and construction work. He was appointed field engineer in 1942 and was associated with engineering and construction of the more recent units added Seaboard's expanding facilities. The company supplies electrical energy for industrial and domestic purposes in Cape Breton.

Leon R. Marsh, M.E.I.C., formerly sales manager with Lion Equipment and Supplies Company Limited in Montreal holds the position of regional export manager (Canada), for Stork Werkspoor, the Dutch V.M.F. group of companies, engaged in the manufacture of heavy industrial and marine equipment.

Mr. Marsh received an M.A. degree from Cambridge University in 1952.

Jacques Gariepy, M.E.I.C., has recently been appointed chief engineer, Marine Industries Limited, heating division, at Montreal.

Mr. Gariepy graduated as a civil engineer at the Ecole Polytechnique, in 1946. The same year he was awarded the degree of bachelor of applied science from the University of Montreal.

Formerly a field engineer and assistant superintendent of construction, with Canadian Celanese, he has also served as supervisor of the construction of French trawlers and cargo ships for Marine Industries Limited. In 1948 he joined the heating division of the organization and since that time has taken on the responsibilities of selling, supervision and installation. His present promotion will put Mr. Gariepy in charge of all engineering requirements for the heating division.

Fernand Dugal, M.E.I.C., has been appointed chief engineer of the shops and transportation department of the Quebec Hydro-Electric Commission.

Educated at McGill University he received a degree in mechanical engineering in 1939. Prior to joining Hydro-Quebec in 1949 as assistant chief engineer of the department he now heads, he was associated with Canadian Car and Foundry. He has served as technical adviser and field engineer with Canadian Associated Aircraft, as technical officer of the Royal Air Force Transport Command at Dorval, Que., and as consulting engineer and works manager of Cartier Industries Limited. He has also worked with Montreal Locomotive Works and American Locomotive at Schenectady, N.Y.

M. M. Davis, M.E.I.C., a member of the staff of the Department of Highways, Province of Ontario, until recently, has received the appointment of assistant professor of civil engineering at the University of Toronto.

A Queen's University graduate, class of 1945, Mr. Davis has been with the Department of Highways since 1947, apart from a year devoted to further study. He obtained an M.Sc. degree in civil engineering from Purdue University in 1949.

P. A. Soicher, M.E.I.C., associated with Dominion Engineering Company Limited, Montreal, since 1946, and at the time of his present appointment serving as project engineer for propellor turbines and pumps, has been named sales manager for the hydraulic division of the firm.

Mr. Soicher received a B.Eng. degree

F. Dugal, M.E.I.C.

from McGill University in 1940 and the following year was awarded an M.Sc. degree from the University of Michigan.

H. Lillie, M.E.I.C., of Vancouver, has joined the J. Muirhead Association in that city, and will eventually take over the firm when the founder, J. Muirhead, consulting engineer, goes into his announced retirement.

Previously managing director of the Alliance Engineering Company Limited in Vancouver, Mr. Lillie has also been associated with the Ford Motor Company Limited in Windsor, Ont., as an electrical engineer and with Bepco Canada Limited, in Montreal. Mr. Lillie came to this country from Great Britain as representative to the latter concern for Bruce Peebles and Company Limited of Edinburgh.

Mr. Lillie had his education in Scotland, graduating from the Royal Technical College, Glasgow.

James W. Kerr, M.E.I.C., has been elected a vice-president of the Canadian Westinghouse Company Limited.

With the firm since the outset of his career, Mr. Kerr, a graduate of the Uni-

J. Gariepy, M.E.I.C.

P. A. Soicher, M.E.I.C.

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

versity of Toronto, class of 1937, enrolled in the Canadian Westinghouse graduate engineering course before starting on a career as a sales engineer in the Toronto district. Later he served overseas with the R.C.A.F. and at the close of World War II was discharged with the rank of squadron leader.

Again active in the company he was within a short time manager of transformer sales, assistant manager, central station sales, and then manager. In 1949 Mr. Kerr became manager of apparatus sales and, three years later, manager of power products division.

He is now in charge of the apparatus products group which includes the power products division, the defence apparatus division and the district apparatus division.

S. B. Moro, M.E.I.C., of the Shell Oil Company of Canada has been transferred from the Montreal refinery to Vancouver's Shellburn refinery. Now chief engineer, he moves up from the position of assistant chief engineer which he held at his eastern post.

Mr. Moro has been with the Shell Oil Company since his graduation from Queen's University in 1945, progressing from general engineering duties to the posts of preventive maintenance engineer, project engineer, plant engineer and chief inspector, all at Montreal.

A. Sandilands, M.E.I.C., western regional manager of Phillips Electrical Company Limited in Winnipeg, was recently named sales manager with the firm's head office at Brockville, Ont.

A 'Personal' on his appointment appeared in the September issue.

D. E. Haig, M.E.I.C., of Phillips Electrical Company Limited, formerly sales engineer for the West, has been named manager of the western region. He is responsible for sales in Saskatchewan, Manitoba and North western Ontario, with headquarters located in Winnipeg.

Earlier a power sales engineer with the City of Winnipeg hydro-electric system in Winnipeg, Mr. Haig is an electrical engineering graduate of the University of Manitoba, class of 1944.

P. E. Peele, M.E.I.C., of the Canadian General Electric Company, apparatus department in Toronto, has been transferred to Peterborough, Ont. where he will be concerned with the motor and generator department of the company.

His entire career spent with the General Electric Company, Mr. Peele gained his early experience at the Peterborough plant. Since then he has held a number of company positions which include those of sales engineer in Vancouver and Calgary which latter position he held for many years. He was manager of the apparatus division of the firm in Calgary in 1947 and by 1953 was locomotive and car equipment sales manager in Toronto.

Mr. Peele was chairman of the Calgary Branch of the Institute in 1945, secretary-treasurer in 1940 and 1941.

Brig. **Murray Dillon**, M.E.I.C., president of M. M. Dillon and Company Limited, consulting engineers of London, Ont., and Toronto, has announced the formation of an organization known as Allied Consultants of Canada Limited.

The company, with head office in Toronto, is comprised of three firms of consulting engineers, Canadian, British and American. Names of the companies involved are, M. M. Dillon and Company Limited of London, Ont., and Toronto; Sir William Halcrow and Partners of London, Eng.; and Edwards, Kelsey and Beck, of New York, N.Y.

The president of Allied Consultants, Brig. Dillon has been a well-known consulting structural engineer in Canada for many years. Known before World War II for his work in the design of important buildings in London, Ont., he has since 1946 maintained the present company.

Brig. Dillon saw extensive service in both wars, won the Military Cross during the first conflict and was active in Canadian military circles in peacetime.

Vice-presidents of the firm are **H. D. Morgan**, London, Eng., and **L. T. Beck**, M.E.I.C., of Edwards, Kelsey and Beck, consulting engineers of New York.

Directors are **V. A. M. Robertson**, M.E.I.C., of the British firm; **G. E. Humphries**, M.E.I.C., senior partner in the firm of M. M. Dillon and Company Limited who has been in partnership with Brig. Dillion since the end of World War II; **D. E. Edwards**, M.E.I.C., of the New York firm; and **L. W. Brockington**, Q. C., of Toronto, Ont.

Appointed secretary-treasurer is **R. A. Crysler**, M.E.I.C., director and manager of the Toronto office of M. M. Dillon and Company Limited. Mr Crysler became professionally associated with Brig. Dillon in 1953, after twenty-one years with the Canada Cement Company.

R. E. Williams, M.E.I.C., is chief engineer for the E. G. M Cape Company, builders and contractors, at Fort William, Ont, on the mill expansion being undertaken by Great Lakes Paper Company at that centre.

Within the last few years Mr. Williams has been affiliated with several firms which include the Thompson Construction Company Limited, at Galt, Ont., the Canadian Comstock Company Limited, at Montreal, and the Canadian Paper Company.

R. M. Coons, M.E.I.C., has left the Lloydminster Development Company, where he was vice-president in charge of operations, and is a consultant and permanent member of the Saskatchewan Conservation Board.

Mr. Coons has worked as a consultant for five years under the name Edmunds, Coons and Akehurst, at Lloydminster, Sask., and has also been associated with Excelsior Refineries.

He is a geological engineering graduate of the University of Saskatchewan.

David H. Johnston, M.E.I.C., has been appointed manager of the engineering

A. Sandilands, M.E.I.C.

D. E. Haig, M.E.I.C.

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

department of the Electrohome Products division of the Dominion Electrohome Industries, Kitchener, Ont.

Formerly associated with the Canadian General Electric Company Limited electronics division in Toronto, he became manager, manufacturing section, of the firm's electronic equipment department, in 1954.

Mr. Johnson is an electrical engineering graduate of Queen's University, class of 1941.

J. P. Leroux, M.E.I.C., of Montreal is an engineer with the National Harbours Board.

Mr. Leroux who has spent seventeen years in government service, started in the civil aviation branch of the Department of Transport in Montreal in 1940. Later he saw three years service with the R.C.E. overseas but returned to the Department to resume his work in the field of civil aviation.

In 1948 he transferred to the marine services branch of The Department of Transport serving as an assistant in the Montreal district office and as district engineer at Sorel, Que. and remained in that work until his present appointment.

Mr. Leroux graduated from the Ecole Polytechnique in the class of 1939.

W. L. Lindberg, M.E.I.C., of Edmonton was appointed in June, manager for H. F. Clarke Limited, a heating and control equipment firm, in that city.

Prior to his recent appointment Mr. Lindberg was associated with M. C. Minton Company Limited and Lockerbie and Hole Western Limited, also in Edmonton.

He is a 1949 graduate of the University of Alberta in mining engineering.

P. G. Campbell, M.E.I.C., an Ontario Hydro-Electric Power Commission employee for a number of years, formerly project manager of the Manitou Falls development of the organization, now serves the firm as a construction engineer-generation, in Toronto

B. L. Phomin, M.E.I.C., of Toronto is a resident engineer with the St. Lawrence Seaway Authority at Montreal.

Mr Phomin was formerly associated with the Department of Public Works in Toronto which he joined in 1946 on discharge from the R.C.E.

He graduated from the University of Manitoba in 1938 and gained his initial engineering experience with Dominion Bridge Company, Winnipeg.

Reside McCallum, M.E.I.C., is with the communications equipment division of the Northern Electric Company, Montreal. He is assistant superintendent, of test facilities.

He has recently returned to the manufacturing engineering department. For the past three years he was concerned with production, as assistant superintendent, manual and toll equipment.

J. Douglas Campbell, M.E.I.C., has accepted the appointment of general manager with Guelph Sand and Gravel Limited, at Guelph, Ont.

Employed with the Steel Company of Canada Limited in Hamilton from 1942 to 1945 he became manager of Chemical Lime Limited at Beachville, Ont., in 1945.

H. W. Willcock, M.E.I.C., is with the Halifax office of Defence Construction (1951) Limited

Mr. Willcock was previously associated with the Central Mortgage and Housing Corporation in that city as office engineer.

F. W. Iveson, M.E.I.C., has joined the staff of the Foundation of Canada Engineering Corporation Limited, in Montreal.

He was formerly with Giffels and Vallet, Windsor, Ont.

Elmore G. Gagnon, M.E.I.C., of the Northern Electric Company Limited, in Montreal, has been named contract services manager for the telephone contract division.

In 1952 Mr. Gagnon received the appointment of manager, following that of chief engineer of the communications

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equipment division which he held for five years.

P. L. Brisson, M.E.I.C., of Montreal, is working with the firm of Brett and Ouelette, consulting engineers in that city.

Practicing engineering in Canada since 1951 Mr. Brisson came to this country from France where he had worked since graduation in civil engineering from the Ecole Centrale de Paris in 1935. Gaining experience in various fields of engineering, his last position in France was that of repair depot chief.

In Canada Mr. Brisson has been associated with the Standard Construction Company Limited as a design engineer and with Canadian Arsenals Limited, explosives Division, at Valleyfield, Que.

K. H. Wheatley, M.E.I.C., who was at work with Defence Construction Limited, Halifax, N.S., earlier this year, has moved to Oceanside, Calif, where he is employed with D. F. Dresselhaus, a consulting engineer, in that city.

Mr. Wheatley is a graduate of the University of Sydney, Australia, class of 1952.

Bruce Wm. Hamer, M.E.I.C., is with the Department of Fisheries, Ottawa, following a transfer from the Prince Rupert office where he held the position of district engineer.

Mr. Hamer has at an earlier period of his career been engaged in engineering in Ottawa. In 1954 he was with the City of Ottawa as resident engineer.

A mining engineering graduate from the Nova Scotia Technical School he obtained the degree B.Eng. in 1939.

James S. C. Dunn, M.E.I.C., has taken up employment with the Standard Oil Company of British Columbia Limited as technical service engineer in Vancouver.

He was formerly associated with Canadian Industries Limited, polythene division, in Edmonton, as a technical assistant in 1954, and prior to that was assistant research engineer with the Research Council of Alberta, in Edmonton.

Mr. Dunn received a B.Sc. degree in chemical engineering in 1948, followed by an M.Sc. degree in the same field in 1952.

R. J. B. McNally M.E.I.C., has joined the staff of Northwest Nitro-Chemicals Limited, Medicine Hat, Alta, as a plant engineer.

A 1944 graduate in mechanical engineering from the University of Saskatchewan, Mr. McNally was formerly associated with Polymer Corporation in Sarnia, Ont., as maintenance methods engineer, and more recently was assistant works engineer with Sherritt Gordon Mines Limited, Fort Saskatchewan, Alta.

William M. Wood, M.E.I.C., has transferred his services from the Fraser Construction Company Limited, Winnipeg, to the Rolmac Construction Company Limited, in Hamilton.

Mr. Wood is a University of Manitoba graduate, class of 1939, in civil engineering. Some of his professional experience has been with Burns and Company Limited, Kitchener, Ont., as resident engineer in 1950; with Winnipeg Supply and Fuel Company Limited, Winnipeg, as a construction superintendent; and with the Universal Contractors Limited in that city, as general superintendent.

S. J. Medwadowski, M.E.I.C., has accepted a position with the firm of John Sardis and Associates, consulting engineers, in San Francisco, Calif.

Mr. Medwadowski was previously an associate in civil engineering on the staff of the civil engineering department of the University of California.

He received an engineering diploma from the Polish University College, London, Eng., in 1950 and was shortly after employed with the Canadian National Railways as a structural designer in Toronto. In 1952 he was on the staff of Foundation of Canada Engineering Cor-


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poration of Montreal as a project engineer.

Bernard G. King, JR.E.I.C., has joined the staff of Ford Motor Company of Canada Limited, Windsor, Ont., in their plant engineering office.

For some time employed with B. Perini and Sons, Canada Limited, in Ottawa, and the C. D. Howe Company, Mr. King was among the civil engineering graduates of McGill University, class of 1952.

A. M. Clark, M.E.I.C., formerly branch manager with the Canadian Blower and Forge Company Limited in Toronto, has been moved to the firm's Hamilton office. He again serves as branch manager.

Mr. Clark is a University of Saskatchewan graduate in mechanical engineering.

E. H. Allen, M.E.I.C., has left the employ of Costain John Brown Limited and is with the London, Eng, firm of Leverstart Limited, precision engineers. He holds the position of factory manager with the company.

Mr. Allen joined the former company in 1952 and served at that time as deputy resident manager of a refinery at Essex, Eng.

R. C. Mordan, M.E.I.C., formerly with the Inter-provincial Pipe Line Company central division at Regina, Sask., is superintendent of the firm's disric No. 1, Edmonon, Alta.

Mr. Mordan is a University of Toronto graduate of 1949.

R. Westwood, JR.E.I.C., graduate of Imperial College, London University, is with the atomic energy division of the Canadian Westinghouse Company Limited in Hamilton, Ont.

He was at one time associated with the C. D. Howe Company Limited in Montreal and the Austin Motor Company in Grimsby, Ont.

D. J. P. Coleman, M.E.I.C., formerly of the Aluminum Company of Canada at Isle Maligne, Que, has accepted a position with Noranda Mines Limited, Noranda, Que.

He is a Queen's University graduate in mechanical engineering, class of 1947.

G. E. Matthews, JR.E.I.C., is district service manager, Moncton district, for the Canadian Westinghouse Company Limited, district apparatus division.

In 1953 he was an apparatus service engineer with the company.

He is a McGill University graduate, class of 1951 in electrical engineering.

Donald H. Pyne, JR.E.I.C., is with Canadian Wire and Cable Company Limited, at Smith Falls, Ont.

Last year Mr. Pyne was with Pigott Construction Company at Toronto.

Mr. Pyne graduated from the University of New Brunswick in 1954, with a degree in civil engineering, and then joined the Ontario Hydro-Electric Power Commission as a junior engineer.

G. D. Stephen, JR.E.I.C., is forest engineer with the timber division of Canadian Colleries Limited.

A B.A.Sc. graduate in forest engineering, class of 1951, from the University of British Columbia, he has had previous experience with the Pioneer Timber Company and with the Alaska Pine and Cellulose Company Limited, also in British Columbia.

John D. Dorey, JR.E.I.C., has moved from Toronto to Montreal in order to accept a position with the Sperry Gyroscope Company of Canada Limited.

Mr. Dorey has previously been affiliated with the Rogers Majestic Electronics


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A. E. Toole, JR.E.I.C., has accepted a position with the National Research Council in Ottawa.

A mechanical engineering graduate of Queen's University, class of 1951, he has formerly been engaged in work with Canadian Industries Limited at their nylon intermediate plant at Maitland, Ont.

T. J. Rusk, JR.E.I.C., has accepted a position with the Public Health Engineering Division of the Department of National Health and Welfare in St. Catharines, Ont.

W. J. Roy, JR.E.I.C., has become waterworks production engineer with the City of Calgary.

Mr. Roy has been associated with the engineering department of the City of Lethbridge and was Town engineer at Fort MacLeod, Alta.

K. E. Kummant, JR.E.I.C., holds the position of superintendent of electrical maintenance with the Mannesman Tube Company Limited, Sault Ste. Marie, Ont.


K. E. Kummant, JR.E.I.C.

Until early this year employed with the Canadian General Electric Company in Peterborough, systems application engineering section, he is originally from Vienna, where he received a diploma in electrical engineering in 1950.

G. W. Morgan, JR.E.I.C., has been appointed chief engineer of Coast Steel Fabricators Limited, Vancouver.


G. W. Morgan, JR.E.I.C.

A graduate in civil engineering, Mr. Morgan received his degree from the University of British Columbia and for the past six years has been associated with the structural steel industry, most recently as chief design engineer of Standard Iron and Steel Works Limited, Toronto.

W. A. Grobicki, JR.E.I.C., has joined the staff of Messrs. Ewbank and Partners (Canada) Ltd., engineering consultants in Toronto.

Mr. Grobicki has for the past four years been associated with the Northern

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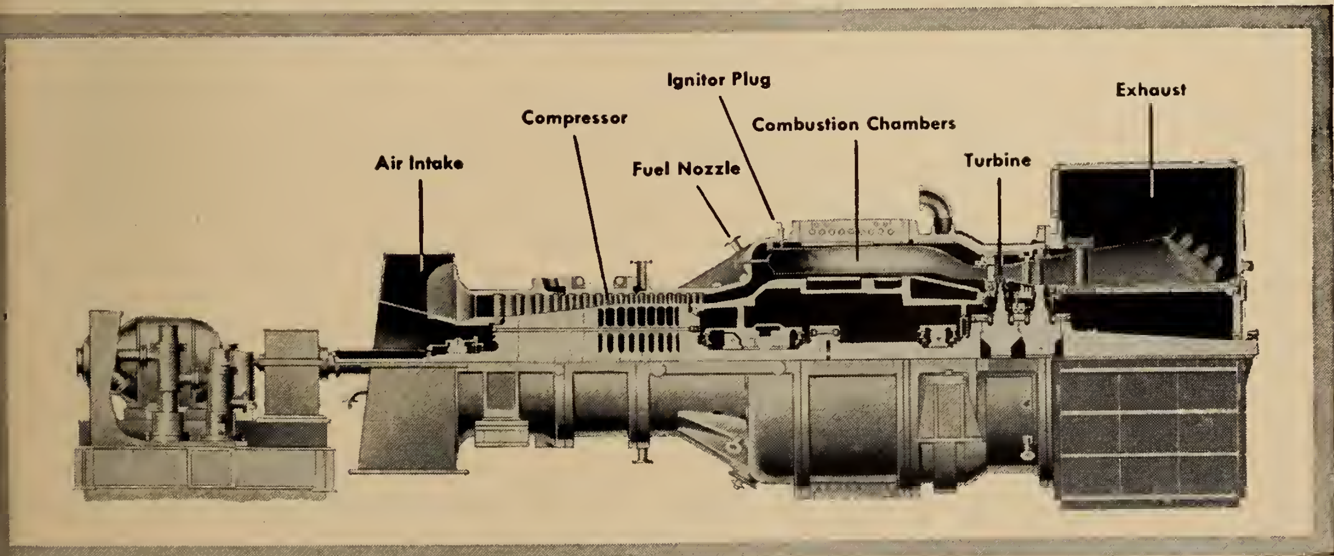

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Electric Company Limited, in the communication equipment division in Montreal.

Mr. Grobicki studied at the Polish University College in London and obtained a diploma in engineering in 1951.

Ronald J. Rushka, JR.E.I.C., is working with the industrial products division of the Canadian Westinghouse Company Limited at Hamilton, Ont.

Formerly with the Canadian Comstock Company at St. Catharines, Ont., he is a 1949 graduate of the University of Saskatchewan.

A. T. Nikiforuk, JR.E.I.C., is with Defence Construction (1951) Limited, at Vancouver. He has previously served the company at Edmonton.

Earlier in his career he was an electrical inspector with the Department of Industries and Labour, Province of Alberta, at Edmonton.

Mr. Nikiforuk graduated from the University of Alberta with a B.Sc. degree in electrical engineering, in the class of 1951.

O. J. Gratton, JR.E.I.C., recently of the City of Montreal engineering department has accepted the position of building and grounds superintendent at the University of Montreal.

Mr. Gratton joined the Franki Compressed Pile Company of Canada at Montreal shortly after receiving a B.A.Sc. degree from the Ecole Polytechnique in 1949 and in 1952 was with Cimentaciones Franki de Mexico. More recently he has been associated with J. D. Campbell and Company, in Montreal.

Robert McWhinnie, JR.E.I.C., lately of Canadian Bridge Company Limited, Walkerville, Ont., has joined Smith, Hinchman and Grylls, Inc., at Windsor, Ont.

He is a graduate of the University of Toronto in civil engineering, class of 1953.

A. H. Ruddell, JR.E.I.C., is with the Dupont Company of Canada engineering department at Montreal following a period of employment in the United States. Mr. Ruddell was a design engineer with the Industrial Rayon Corporation at Cleveland, Ohio, and prior to that was in 1953 associated with the American Ship Buildng Company, also at Cleveland.

He is a Queen's University graduate in mechanical engineering, class of 1952.

James G. Boone, JR.E.I.C., is at Grand Falls, Newfoundland, as design engineer with the Anglo-Newfoundland Development Company Limited.

After graduation from the Nova Scotia Technical College in 1953, with a B.Eng. degree, Mr. Boone accepted a position with Lever Brothers Limited, Toronto.

Maurice Paquet, JR.E.I.C., formerly of the firm of Leblanc, Montpetit and Dorval at Quebec, Que., has gone into private practice as a consulting engineer in that city.

Mr. Paquet has had professional experience with Canadian Fairbanks-Morse Company Limited and the firm of Tasse, Sarault and Associates at Quebec, since graduation from Laval University in 1950. He studied electrical engineering.

E. L. Littlejohn, JR.E.I.C., has been appointed sales manager for thermoplastic products, of the Bakelite Company division of the Union Carbide Canada Limited, at Montreal.

Mr. Littlejohn joined the Bakelite Company after graduating from the University of Toronto in chemical engineering in 1949. He spent some years in the production department before transferring to the sales department in 1954.

He is the treasurer of the Quebec section of the Society of Plastics Engineers.

• PERSONALS

L. G. Boucher, JR.E.I.C., a Laval University graduate of 1949 in electrical engineering holds the position of branch manager for Reliance Electric and Engineering (Canada) Limited at Trois Rivières, Que. With the firm for some time, he was a sales engineer with the company in Montreal in 1951.

Ralph G. Smylie, JR.E.I.C., was recently named production manager of Dominion Bridge Company Limited's Pacific division at Vancouver.

Mr. Smylie was born in Vancouver, where he received his early education. After service with the R.C.A.F. in World War II, he graduated from the University of British Columbia in mechanical engineering.

He joined the company in 1950, since then he has held positions in the drawing office and as chief inspector. For a brief period in 1954 he was superintendent of the firm's pipe-coating plant in Regina during the completion of the major portion of the Buffalo Pound pipeline project.

Keith Ebbern, JR.E.I.C., has been appointed contract engineer with Dominion Bridge Company Limited for the Winnipeg area, Manitoba and Saskatchewan.

Mr. Ebbern was born in Manitoba, graduated from the University of Manitoba in civil engineering in 1948 and later obtained his master's degree at the University of Toronto.

He has been associated with Dominion Bridge Company since 1948, chiefly in the drawing and design offices before entering sales work some years ago.

W. R. MacLean, JR.E.I.C., is with the Department of Highways, Province of British Columbia, at Merritt, B.C.

A 1952 graduate of the Nova Scotia Technical College, Mr. MacLean has spent some time in western Canada being previously associated with the Trans-Canada Highway and the Department of Public Works in that province.

L. M. Bluteau, JR.E.I.C., associated with the Canadian Pacific Railway Company since 1941 has accepted a position with the Du Pont Company of Canada Limited as a steam plant design engineer in Montreal.

Working with the railway on a permanent basis for the last six years, he resigned as assistant engineer of tests.

Mr. Bluteau is a McGill University graduate, class of 1950.

Douglas W. Hawes, JR.E.I.C., has joined Ewbank and Partners (Canada) Limited, engineering consultants, in Toronto. He was formerly associated with the Canadian General Electric Company and the National Steel Car Corporation Limited.

Mr. Hawes is a 1950 graduate of McGill University in electrical engineering.

Paul Henri Fillion, JR.E.I.C., has been appointed executive in charge of Janin and Company Limited, general contractors, for the Quebec district.

A graduate of Laval University in civil engineering, Mr. Fillion recently obtained his master of science degree at Laval University. Prior to this he attended a post-graduate course in Paris at the Ecole Nationale des Ponts et Chausees. He was also engaged in civil engineering projects in France for a period of six months.

C. Bachovzeff, JR.E.I.C., is design engineer with the Ford Motor Company of Canada mechanical section, plant engineering staff, at Windsor, Ont.

An Athlone Fellowship winner, Mr. Bachovzeff studied at the Manchester College of Technology, following his graduation from McGill University in 1951 in mechanical engineering.

Shortly after this he began a period of employment with the Aluminum Company of Canada at Arvida, Que.

Jean Ghanime, JR.E.I.C., has been transferred from Quebec City to Montreal with Canadian General Electric Com-

pany. Formerly at work in the capacity of meter engineer his new appointment will be that of sales engineer.

Mr. Ghanime joined the organization shortly after graduating from the Ecole Polytechnique in 1952.

Charles P. Bennett, JR.E.I.C., has moved from Winnipeg to Edmonton where he is associated with Texaco Exploration.

Formerly with the Winnipeg and Central Gas Company in Winnipeg he was a 1950 graduate of the University of Manitoba.

N. Moysa, JR.E.I.C., has resigned from the Shell Oil Company of Canada Limited preventive maintenance department and is now employed with the Sidney Roofing and Paper Company Limited in Victoria, B.C.

A University of British Columbia graduate, class of 1953, he has worked in eastern Canada with the Hydro Electric Power Commission of Ontario on the Sir Adam Beck No. 2 generating station at Niagara Falls, Ont. in 1954.

John J. Killin, JR.E.I.C., is now associated with the firm of Porritts and Spencer (Canada) Limited, in Hamilton, Ont.

A University of New Brunswick graduate in civil engineering, class of 1950, he was formerly employed by the Great Lakes Paper Company Limited, at Fort William, Ont.

Mr. Killin was secretary-treasurer for the Lakehead Branch of the Institute in 1955.

A. H. Austin, JR.E.I.C., a 1953 graduate of the University of Toronto has left the staff of the Ontario Hydro Electric Commission as design engineer in Toronto and taken up work in Guelph, Ont., with the Armco Drainage and Metal Products.

At the beginning of his graduate career, Mr. Austin was known in British Columbia as a field engineer with Stone and Webster Canada Limited at Trail, B.C.

S. A. Luciani, JR.E.I.C., holds the position of assistant superintendent with the Quebec Iron and Titanium Corporation at Havre St. Pierre, Que.

Mr. Luciani was formerly maintenance supervisor with Shawinigan Chemicals Limited, carbide division.

He graduated from the University of Detroit, class of 1951.

R. E. Chamberlain, JR.E.I.C., is with the Bailey Meter Company Limited in Montreal as production engineer.

A B.Eng. graduate in civil engineering Mr. Chamberlain received his degree at McGill University in 1951 and later was awarded a Ph.D. degree from the University of Birmingham. Since then he has been associated with the structural design department of the Dominion Bridge Company Limited, Lachine, Que.

J. Looyestein, JR.E.I.C., civil engineering graduate of Delft University, class of 1952 is a designer for reinforced concrete structures with H. G. Acres, Niagara Falls, Ont.

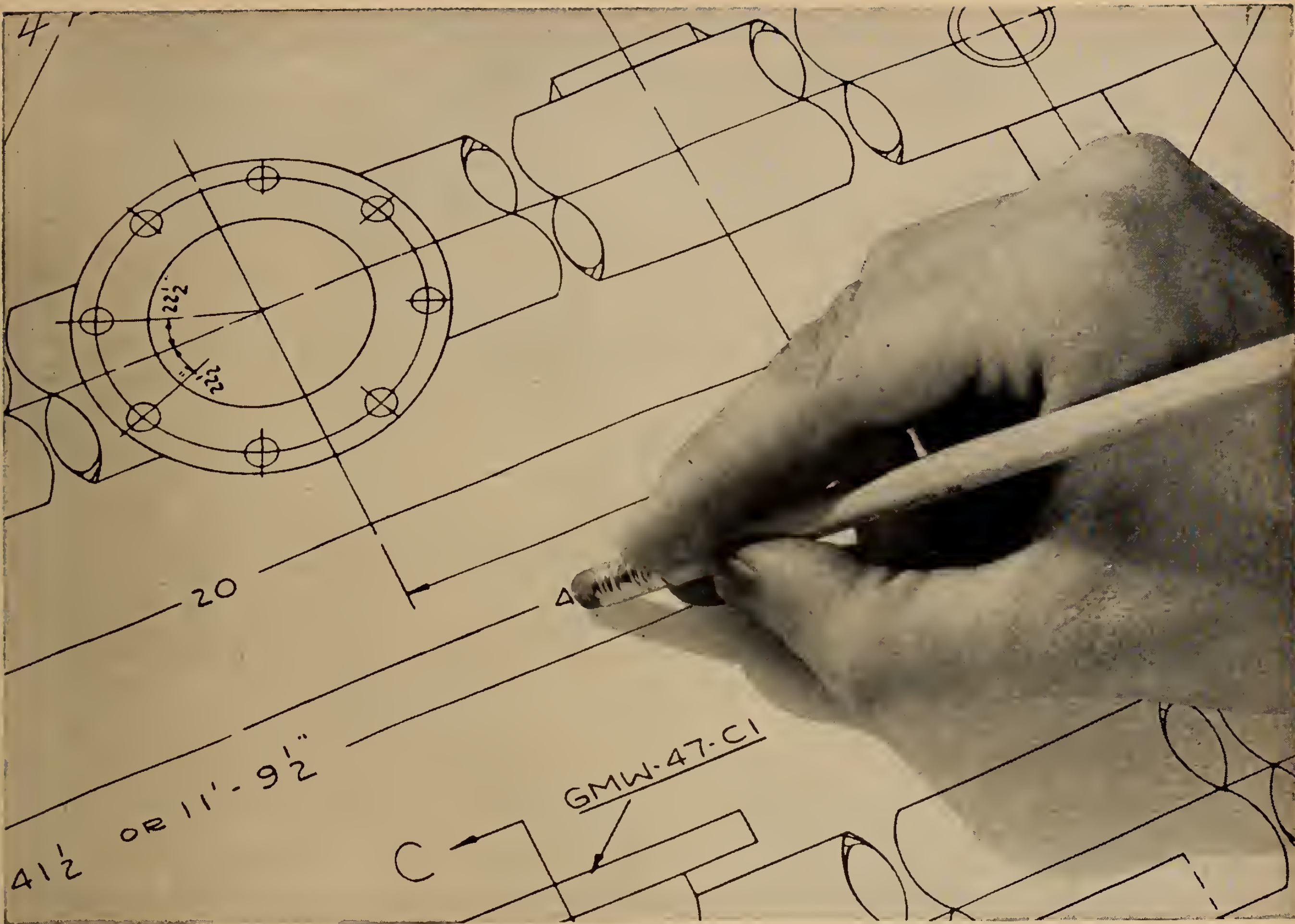
He joined the firm of consulting engineers in May, after an association as resident engineer with Underwood, McLellan and Associates Limited of Saskatoon, Sask., in 1955.

Emiro Noussan, JR.E.I.C., of the Polytechnical Institute of Torino, Italy, who was at the beginning of this year associated with Willie St. Laurent, consulting engineer in Montreal, has accepted a position with E. G. M. Cape and Company, Spanish American Mine, Spragge, Ont.

Selwyn Fox, JR.E.I.C., who this year gained a master of science degree in timber engineering at the University of Toronto is with the Canadian Institue of Timber Construction, Ottawa.

Mr. Fox was awarded a Fellowship to carry out his recent studies in Toronto by the Canadian Lumberman's Association. In 1952 he was among the graduates of the University of British Columbia in forest engineering.

Lloyd E. Davies, JR.E.I.C., a University of Saskatchewan graduate, class of 1954,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• PERSONALS

formerly with the Department of Highways government of Saskatchewan, has accepted a position with Haddin, Davis, and Brown Limited, in Calgary.

D. Keith Marshall, JR.E.I.C., formerly of the Foundation Company of Canada Limited, Chalk River, Ont., has transferred his services to the firm of H. G. Acres and Company Limited, consulting engineers of Niagara Falls.

Mr. Marshall is a 1952 graduate of the University of New Brunswick.

F. Panchuk, JR.E.I.C., has joined the B. F. Goodrich Canada Limited in Kitchener, Ont., as development engineer.

He was awarded the degree Master of Business Administration from the University of Western Ontario in May of this year.

I. C. Smith, JR.E.I.C., is on the staff of the Nova Scotia Light and Power Company Limited.

He is a 1954 graduate of the Nova Scotia Technical College, with a B.Eng. degree in electrical engineering.

J. Paul Chamberland, JR.E.I.C., has been an operation engineer with the Beauharnois division of the Shawinigan Water and Power Company in Valleyfield, Que., since February this year.

An Ecole Polytechnique graduate of 1952 in mechanical engineering, Mr. Chamberland was an industrial representative with the company at Montreal in 1953.

L. B. Gendreau, JR.E.I.C., has accepted a position with Canadian Allis-Chalmers Limited at Montreal.

Mr. Gendreau was formerly located at Ottawa with the Department of National Defence, naval technical services, as a mechanical engineer. Prior to that he was with Sorel Industries Limited, Sorel, Que.

R. P. Proctor, JR.E.I.C., is employed with the Nova Scotia Light and Power Company at Halifax, N.S.

Mr. Proctor's previous engineering affiliations include Canadian Celanese Limited at Drummondville, Que., and the Dow Chemical Company of Canada.

He is a 1947 graduate of the Nova Scotia Technical College.

J. Ross Raymond, JR.E.I.C., has accepted a position with Municipal Planning Consultants in Toronto.

A 1953 civil engineering graduate of the University of Toronto, Mr. Raymond was previously a planning engineer in the department of development of the Municipality of the Township of Toronto and prior to that worked with the Department of Development in Cooksville, Ont.

John S. Pringle, JR.E.I.C., formerly of the Canadian International Paper Company, Three Rivers and Temiskaming, Que., has transferred his services to firm of Hygrade Containers Limited, Montreal.

He is a B.Eng. graduate in mechanical engineering from McGill University, class of 1953.

R. Youngberg, S.E.I.C., a 1955 graduate of the University of Manitoba who this year obtained an M.Sc. degree in civil engineering from that University has joined the staff of the Aluminum Company of Canada at Vancouver. His work is that of engineering-town planner.

A. D. Nordstrum, S.E.I.C., a University of Saskatchewan graduate, class of 1955, holds the position of field engineer with Ford, Bacon and Davis Construction Corporation at Medicine Hat, Alta.

Last year he was employed with Canadian Industries Limited at Edmonton.

E. A. Daoust, S.E.I.C., a 1956 graduate from McGill University who was awarded a B.Eng. degree in civil engineering has found employment with the firm of Delisle and Laquerre, at Chicoutimi, Que.

News of Other Societies

Canadian Industrial Management Association

The fourth annual conference of the Canadian Industrial Management Association will be held at the Royal Connaught Hotel in Hamilton, Ontario, October 30 and 31, 1956.

The conference is presented, in line with the association's primary aims and policies, "to develop in industry, a wider adoption of scientific organization and managerial methods, as an aid to finding ways to compete against rising production costs, intensive domestie and low-cost foreign competition."

The program promises a comprehensive discussion by eminently qualified speakers from the United States and Canada, on such pertinent and timely subjects as: production scheduling, operations research, problems of decentralization, linear programming, profit sharing, plant layout, inventory control, new developments in time study, job evaluation and merit rating, promotion of executives, employee motivation, evaluation of automation, employee selection and testing, preparation and use of statistical presentations.

At a luncheon on October 30, G. L. Wilcox, president of Canadian Westinghouse Co. Ltd., will speak on "New Approaches to Modern Management". The Hon. Dana Porter, Q.C., M.A., Provincial Treasurer for Ontario, will present a talk at a dinner the same day on "Management's Responsibility to the Province and the Nation". The subject "Management and Its Responsibility to Society" will be taken up by Rt. Rev. W. A. Bagnall, Bishop of Niagara, at a luncheon on October 31.

More information about this national conference can be obtained from W. E. Jolliffe, executive secretary of C.I.M.A., Suite 303, 33 Front St. W., Toronto 1, Ont.

Fellowship Offered

The Canadian Construction Association (Construction House, Ottawa) is offering a fellowship of $2,000 for post-graduate study in construction. The fellowship will supplement C.C.A. awards to senior undergraduate engineering students at Canadian universities.

The association wishes also to encourage the establishment of such courses in Canada. President A. Turner Bone has said, "The commencement of a post-graduate course in highway engineering in 1957 at the University of Alberta will be additionally welcome as a step in this direction. At the present time, however, specialized courses in building construction or construction engineering are not available at any of our universities."

Applications may be made by engineering graduates of a recognized university who are Canadian citizens and who have had at least three years' employment in some phase of construction operations since graduation. Fellowship winners may attend the university of their choice, provided that it meets with the approval of the C.C.A. selection board.

Application forms are available from the Association, Construction House, 151 O'Connor Street, Ottawa 4, Ont. Applications may be made no later than December 31, 1956.

Calendar

The International Union of Crystallography has accepted the invitation of the National Research Council of Canada to hold its fourth assembly and congress in Canada from July 10 to 17, 1957, followed by two symposia on the subjects "Physical Techniques of Crystallographic Interest" and "Electron Diffraction" on the 18th and 19th

Through the cooperation of McGill University and the University of Montreal, the meetings are being held in the city of Montreal.

The Canadian National Committee on Crystallography is preparing to provide details of the technical program, and accommodation. Secretary of the Canadian Committee is Dr. W. H. Barnes, Division of Physics, National Research Council, Ottawa 2, Ontario. (Communications should be marked "Personal").

Canadians attending the Road Show in Chicago next January will enjoy special privileges provided by the International Road Federation, it has been announced by C. W. Gilchrist, managing director of the Canadian Good Roads Association (270 Maclaren Street, Ottawa).

The IRF, with which CGRA is affiliated, will maintain an International Centre for guests from outside the United States, from January 28 to February 2, 1957. IRF has arranged an excellent program of discussions on highway design and construction methods, equipment, soils problems and research developments.

To take advantage of the services provided by the International Centre, reservations must be made through the Canadian Good Roads Association (270 Maclaren Street, Ottawa, Ont.).

The Canadian Construction Association have announced the sixth annual award for theses on construction subjects.

Brian Akins, S.E.I.C., a 1956 graduate of the University of Manitoba has received the top prize in this competition for which there were entries from senior engineering students at eight Canadian universities. The subject of his thesis was "Techniques of Winter Construction".

Delegates of 34 member countries are expected to attend the third congress of the International Commission on Irrigation and Drainage, at San Francisco, Cal, April 29 to May 4, 1957. This is the first such congress to be held in the United States, former ones having taken in India in 1951 and in Algeria in 1954.

Information can be obtained from the United States National Committee, P.O. Box 7826, Denver 15, Col.

The 64th annual meeting of the Society of Naval Architects and Marine Engineers will be held in New York City at the Waldorf Astoria Hotel on November 14 to 17, 1956.

Further information can be supplied by Harold M Wick, chairman of the Public Relations Committee of SNAME, c/o American Bureau of Shipping, 45 Broad Street, New York 4, N.Y.

The Canadian Chamber of Commerce

• NEWS OF OTHER SOCIETIES

annual meeting is scheduled for October 15-18, 1956, at Quebec City, Que.

The American Society of Mechanical Engineers (29 West 39th St, New York) lists the following meetings: October 24 25, 1956, ASME-AIME Joint Fuels Conference, Sheraton Park Hotel, Washington, D.C., November 25-30, 1956, the ASME annual meeting, at the Hotel Statler, and the National Power Show at the Coliseum, New York City; March 10-16, 1957, E. J. C. Nuclear Engineering and Science Congress, Convention Hall, Philadelphia. For the Nuclear Congress, final date for submitting papers is November 1, 1956.

The Association of Canadian Testing Laboratories held its fourth annual meeting in Toronto in August. Members represented testing laboratories in every province, discussed ethics and standards guaranteed by membership in the organization.

New officers elected at the meeting are: president, J. H. White, Haileybury; vice-president, J. C. O'Neill, Toronto; secretary-treasurer, Wm. Gerrie, Swastika; publicity, J. E. Burgener, Toronto; membership, Dr. Kerr Lawson, Sudbury.

A new association for the growing field of cost engineering as organized in June for the United States and Canada under the name of American Association of Cost Engineers.

The Community Planning Association of Canada (77 Maclaren St., Ottawa 4) plans for the annual National Planning Conference in Ottawa, sessions on Urban Development, The Objectives of Redevelopment in Canadian Cities, City Renewal in Action, and Methods of Strengthening Town and Regional Planning. There will also be a review of redevelopment in our cities.

The National Planning Conference will be at the Chateau Laurier Hotel, Ottawa, from October 28 to 31, 1956.

The fourteenth annual conference on electric furnace steel at the Morrison Hotel, Chicago, December 5-7, 1956, will commemorate the fiftieth anniversary of the electric arc process in steelmaking.

This meeting will be arranged by the American Institute of Mining and Metallurgical Engineers (29 West 39th Street, New York 18, N.Y.).

The first European Congress on Corrosion will be held in Paris, France, 22 Nov. to 3 Dec.

The British Nuclear Energy Conference will hold a symposium on the Calder Works nuclear power plant at the Institution of Civil Engineers in London, England, 22 and 23 Nov.

The 36th annual meeting of the American Petroleum Institute will be held in Chicago, Ill., 12-15 Nov.

C.I.M.M. Western Meeting

The Canadian Institute of Mining and Metallurgy (906 Drummond Building, Montreal, Que) announce their annual western meeting at Vancouver, for November 5-7, 1956.

The theme of the meeting will be a salute to Western Canada's expanding mineral industry. All six of C.I.M.M.'s technical divisions are contributing to the technical program, for which eight sessions have been arranged. Subjects of these sessions are: industrial minerals, physical metallurgy, petroleum and natural gas, metal mining, extractive metallurgy, coal mining.

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• CANADIAN DEVELOPMENTS *(Continued from Page 1383)*

Two More Aluminium Projects for Quebec

Canadian British Aluminium Co. Ltd. awarded a $15 million contract in mid July to Anglin Norcross Ltd. and Atlas Construction Co. Ltd., for construction of its new aluminum smelter at Baie Comeau, Que. The contract calls for construction to proceed in two stages. The first, to be completed in the fall of 1957, will be for production of 80,000 tons annually for 1958. The second stage is to extend the project for ultimate production of 160,000 tons, but as yet no firm commitment has been made to go ahead with the latter program. Power will be supplied from the Outarde and Manicouagan Rivers.

British Aluminium Ltd. entered the aluminum picture in Canada last fall in partnership with Quebec North Shore Paper Co., a subsidiary of Ontario Paper Company. Canadian British Aluminium is a subsidiary of British Aluminium Co. Ltd. of London, England. Total cost of the project is estimated to reach $130 million.

Announcement of this project follows the award a short time earlier of a $135 million contract by Aluminum Co. of Canada to a joint venture group including Perini, MacNamara and Quemont Construction Companies, for construction of a hydroelectric power development on the upper Peribonka River at Chute des Passes. First power will be available in about three years.

A few miles below the existing storage dam at Passe Dangereuse, an intake tunnel 6 miles long will be built to a point downstream where a gross head of 636 feet can be developed. Here an underground generating station will be installed. The project will add 700,000 firm horsepower to the Saguenay system as a whole and will reduce chances of recurring power shortages.

This power project is part of a $250 million expansion program in Northern Quebec announced earlier this year by Aluminium Ltd. Included therewith will be 120 tons of new aluminum smelting capacity at Isle Maligne in the Saguenay Valley.

This Quebec expansion, together with the British Aluminium Ltd. project at Baie Comeau, added to Arvida production and ultimate output from Alcan's Kitimat project in British Columbia, will bring Canada's total aluminum production to well over a million tons by 1955 and close to 1¼ million tons with British Aluminium's second stage.

Announcement of these two projects for Baie Comeau and Isle Maligne, which together will add 230,000 tons of ingot production raises conjecture whether they are merely designed to meet the growing demand for ingot, or as a hedge against possible breakdown of negotiations for developing the huge Volta project in Africa's Gold Coast, which would have an equivalent capacity when completed.


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Library Notes

Additions to the
Institute library
Reviews, Book Notes
Standards

BOOK REVIEW

Who's who, 1956

London, Black, Toronto, Macmillan, 1956. 3301p., $16.50.

Are you in the latest edition of Who's Who? No? Don't let it worry you, there are millions who aren't, but for authoritative up-to-date information on everyone who is anyone in the world today, this is *the* reference book.

Now in its one hundred and eighth year of issue, this indispensable source of accurate facts contains over forty thousand biographies, including nearly one thousand new ones. The main factors contributing to the value of this work are three. First, coverage is worldwide, for although it is published in England, included are many biographies of members of the Commonwealth and of outstanding figures from all over the world, from Professor Waino Aaltonen of Finland to Arnold Zweig. Secondly, inclusion is determined by an anonymous board of editors; nobody can pay to be included. Finally, the information given is as accurate as possible, for each biographee is sent a proof of his entry for correction or revision.

In general the details given include full name, nationality, age, address, telephone number, parents, education, publications, career, decorations, hobbies, etc.

Who's Who 1956 is fascinating reading, as well as an essential reference book for any library.

S.C.

BOOK NOTES

Prepared by the Library The Engineering Institute of Canada

* Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

Abac or nomograms

A. Giet. London, Iliffe, Toronto, British Book Service, 1956. 225p., 35/-.

In this translation from the 1953 French edition, some adaptions have been made to make the text clearer to British readers.

Written primarily for engineers rather than mathematicians, this is essentially a practical book, and shows both the applications of nomograms, and the methods of constructing charts for them. Both Cartesian abacs and alignment charts are considered, and the practical examples given are drawn from the fields of mechanics, physics and electrical engineering.

This English edition will prove very useful to anyone needing a time saving method of performing repetitive and complicated calculations.

Members may borrow the books mentioned in these Notes on application to the librarian. Two books may be borrowed for two weeks.

LIBRARY HOURS

Monday to Friday
9 a.m. — 5 p.m.
Saturday 9 a.m. - 12 noon.

A. C. switchgear, v.1.

J. R. Mortlock. Toronto, British Book Service, 1956. 387p., diagrs., $8.50.

This volume has been written to give some guidance to systems engineers in the problems associated with the determination of the ratings of switchgear. It considers the principles of operation of different types of protection and relay, the measurement of fault currents and voltage. The voltage aspects of the problem are discussed under such topics as the initiation of arcs, restriking voltages, and insulation.

The second volume, to be published later, will cover the details of switchgear and the basic design principles.

American universities and colleges, 1956.

Mary Irwin, ed. Washington, American council on education, 1956. 1210 p., $12.00 (U.S.)

This seventh edition brings up-to-date a classic reference for student counselors, college administrators and others. It provides full descriptive data on 969 accredited universities and colleges in the United States and its territories, and brief data on 2016 approved professional schools in 23 fields. Seven chapters on the administration and organization of higher education in the United States constitute another important feature.

*Applied structural design of buildings, 2nd ed.

T. H. McKaig. New York, Dodge, 1956. 442p., diagrs., $12.50 (U.S.).

This practical handbook for structural and plant engineers, architects, draftsmen, and license applicants contains a wide range of formulas, tables, and typical computations for the design of steel, concrete, and wood structures. The eleven sections of the book contain data and calculations covering properties of materials, properties of sections, beam and column design, connections, wind stresses, shallow bins and bunkers, etc. Design procedures are based on the various standard codes.

Body engineering; design and construction of motor vehicle bodywork, 2nd ed.

S. F. Page. Toronto, British Book Service, 1956. 190p., illus., $4.25.

In this second edition, alterations have been made to bring the text up to date, and information has been included on such developments as the introduction of rubber fenders and the use of plastics.

After an historical introduction, the remaining sections cover materials used, design, draughting, sheetmetal projection, trailers, bodywork interior and bodywork construction.

The book is well illustrated, and carrying as it does the recommendation of the Institution of engineering draughtsmen and designers, will prove most useful to all those connected with the automobile trade.

CAMBA register, 1956-57, of British products and Canadian distributors.

London, Iliffe and Kelly's Directories, 1956. 729p.

Now in its fourth edition, this Register is published to stimulate trade between Canada and the United Kingdom. In the buyers' guide are listed over 4,000 British products available for export, together with their manufacturers. The names and addresses of 4,500 British firms interested in the export trade are listed together with their Canadian agents or distributors. Lists of proprietary names, trade marks and a French glossary complete this very useful book.

Cams: designs, dynamics, and accuracy.

H. A. Rothbart. New York, Wiley, 1956. 350p., diagrs., $9.50.

Intended primarily for the designer concerned with high-speed machinery, mechanical computers, etc, this work is an up-to-date treatment of kinematics, dynamics and machine design, using

cams as a basis. Some of the subjects covered are basic curves; cam size determination; cam profile determination; advanced curves; and polydyne cams.

Although this is essentially a theoretical work, the author makes concrete recommendations on such topics as mass, acceleration, materials, and the type of cam and follower to use. He does not go into the details of cam manufacture. There are bibliographical references at the end of each chapter.

Canadian trade index, 1956.

Toronto, Canadian manufacturers' association, 1956. 1107p., $10.00.

Once again the Trade index is packed full of valuable information. In addition to the classified section, listing alphabetically all the products manufactured in Canada, together with the names of the firms manufacturing them, there is also an alphabetical list of manufacturers, giving for each address, products manufactured, and foreign representatives, if any. There is a French key to the classified section.

Short articles discuss the export trade and how to enter it, and there are lists of Canadian commercial representatives abroad.

Chambres d'équilibre.

André Gardel. Lausanne, Rouge, 1956. 158p., diagrs., Sw. fr. 24.85.

Based partly on experiments conducted in the laboratories of the University of Lausanne, the object of this book is to present simplified methods for the calculation of surge tank size.

In the first part of the work, the various factors influencing size are considered, including the dimensions of the upstream basin.

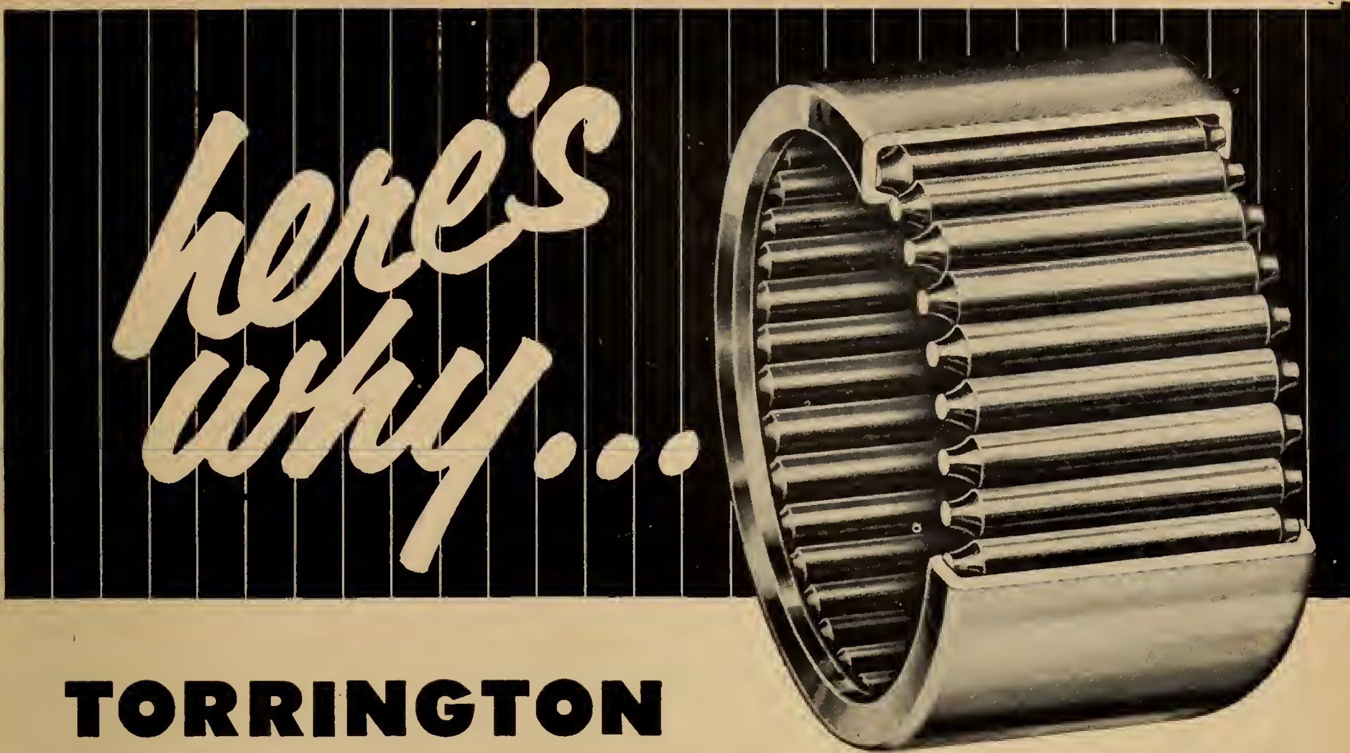
The second part of the book presents the method of calculating tank sizes by the use of abacs. It is also possible to construct graphs which will give the size of the tank.

Written by an engineer who has a wide knowledge of the subject, this will prove a very valuable addition to the information available on surge tank design.

°The chemical process industries, 2nd ed.

R. N. Shreve. Toronto, McGraw-Hill, 1956. 1004p., illus., $11.50.

This text and reference book presents a cross section of the manufacturing procedures employed by modern chemical industries. For the most part, a separate chapter is assigned to a given industry such as glass, paper, rubber, or sulfuric acid, and within each chapter the discussion is developed around flow sheets which are used to show the sequence of operations and processes. Selected references are listed after each chapter, and a section of problems is given at the end of the text.



TORRINGTON

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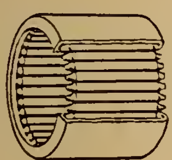
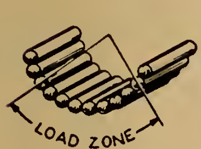
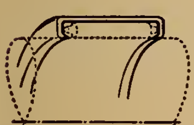


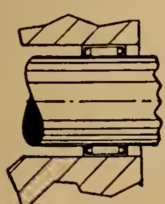
Unique construction—accurately drawn, surface-hardened shell retains rollers and serves as outer raceway.



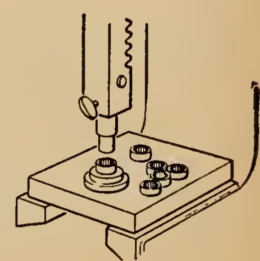
Full complement of small diameter rollers—precision-ground and through-hardened—assures top capacity by distributing load over large number of contacts.



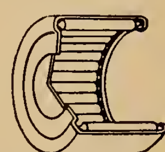
Turned-in lips of the case-hardened outer shell keep dirt and grit out, lubricants in—while retaining trunnion ends of rollers. All wear surfaces of outer race are case-hardened.



No inner race required on surface-hardened shafts—reduces space requirements, lowers unit costs.



Simple assembly—arbor press seats bearing in round housing bore. No collars, shoulders or retaining rings needed.



Closed end type DC Needle Bearings are available for stub shaft applications. The closed end provides a perfect seal at no extra cost.

Needle Bearings are made in a Precision Series for most applications and an Extra Precision Series where low radial play and minimum eccentricity are required. Easy lubrication through optional hole in shell or through hole in shaft assures long service life. Bearings can be pre-packed with suitable grease for those applications requiring grease lubrication.

See our new Needle Bearing Catalog in the 1955 Sweet's Product Design File—or write direct for Catalog No. 55.

THE TORRINGTON COMPANY
925 Millwood Road, Toronto 17, Ont.

District Offices and Distributors in Principal Cities of United States and Canada

TORRINGTON BEARINGS

THE TORRINGTON COMPANY 90th ANNIVERSARY 1866–1956

Needle • Spherical Roller • Tapered Roller • Cylindrical Roller • Ball • Needle Rollers

• LIBRARY NOTES

The climate of central Canada.
W. G. Kendrew and B. W. Currie. Ottawa, Queen's Printer, 1955. 194p., illus., $1.00.

For the purposes of this report, "Central Canada" includes the Prairie Provinces and the Districts of Mackenzie and Keewatin, some forty per cent of the whole of Canada.

There is a description of the general climatic features of the region, and the physical factors determining these features. The remainder of the book is divided into five chapters, each covering one region of the area, and discussing in each case topography, winds, temperature, humidity, clouds, sunshine, precipitation and visibility. Climatological tables for each region are also given, based on data which, in some cases, is available for a very few years only.

The report, condensed from that written by Dr. Currie, is one of a series describing the climate of a large part of Canada. The series should prove invaluable to those whose work is any way influenced by the climate.

Commercial waxes, 2nd ed.
H. Bennett, ed. New York, Chemical publishing, 1956. 668p., $15.00 (U.S.).

The revised edition of this reference work on commercial waxes has been expanded to include data on the new waxes, and new applications of natural and synthetic waxes which has accumulated since the first edition was published.

For the purpose of this volume, "wax" is "a plastic, slippery solid which is easy to melt", and includes mineral, vegetable, animal, synthetic and compound waxes. Data given for each wax includes melting point, specific gravity, hardness, surface tension. and other chemical and physical properties. There are chapters on wax technology and the uses of wax in industry, and there is an extensive wax formulary.

Concrete roads; design and construction.
Gt. Brit. Road research laboratory. London, H.M.S.O. 1955. 404p., illus., 25/-.

Rather than attempting to present a complete textbook on concrete road construction, the authors have confined their remarks to topics which have been investigated at the Road research laboratory. The greater part of the book was written in 1954, and at that date there had been little large scale post-war construction of concrete roads in Britain.

The book is divided into three sections, the first of which deals with the properties of cement, aggregates and water, and the mixes used in road construction. Section two considers pavement design, and the estimation of stress in concrete road slabs, together with some discussion of prestressing, joints, and defects occurring in concrete roads. Finally in the third part, there are several chapters on the use of machinery in mixing and placing concrete.

Although the book is based on English conditions and practices, much of it is applicable to Canada, and the references at the end of each chapter will prove specially useful.

Co-operative electrical research, no. 1.

Leatherhead, Surrey, Electrical research association, 1956. 2/6 an issue.

It is planned to issue this new publication semi-annually. It will contain articles by the staff of the ERA, reviewing the Associations' activities in more detail than is possible in the annual report.

Electronic measurements and measuring instruments.

F. G. Spreadbury. London, Constable, Toronto, Longmans, Green, 1956. 459p., illus., $10.00.

The use of electronics in measuring techniques is relatively new, but there are already many different instruments in use. Two of the earliest instruments, the valve voltmeter and the cathode-ray oscillograph now form essential parts of other instruments of much greater complexity.

Although there are so many instruments, there are certain types and techniques which are basic, and these the author describes. Covered are instrument stability, and that of their components; valve characteristics relative to measurement; stabilization by negative feedback; a number of basic-type instruments; and the potentials of various instruments.

Facing the atomic future.

E. W. Titterton. Toronto, Macmillan, 1956. 379p., illus., $4.00.

Written for the layman by a distinguished atomic scientist, this book presents clearly declassified information on atomic energy and atomic weapons. The author also discusses the international, sociological, political, ethical and military problems which have been created by the advent of atomic energy, and concludes by stating his belief that this new power has come before man is prepared for it. He believes, however, that man can meet the challenge which is now facing him.

***Handbook of welded steel tubing, rev. ed.**

Cleveland, Formed steel tube institute, 1956. Various paging, $10.00 (U.S.) each part.

This handbook is in two parts, the first part dealing with welded carbon steel tubing, the second part with welded stainless steel tubing. Both parts provide designers, engineers, and fabricators with a wealth of information on manufacturing processes, available sizes and shapes, specifications and tolerances, properties, ordering from mills, and structural, mechanical, and pressure applications in a wide range of industries. In addition to the engineering data given in the text, an extensive section of design information is appended. There is also a glossary.

***History of American technology**

J. W. Oliver. New York, Ronald Press, 1956. 676p., $6.50 (U.S.)

This is a comprehensive account of the status and development of the various areas of technology — mining, manufacture, transportation, communication, etc. — during each of the four historical periods into which the book is divided: pre-Revolutionary, Revolution to Civil War, Civil War to 1900, and 1900 to the present. Stressed throughout is the influence of technological progress on the economic and political growth of the United States and on American civilization as a whole.

Industrial wage and salary control.

R. W. Gilmour. New York, Wiley, 1956. 261p., illus., $7.50.

A detailed presentation from a practical viewpoint of the development, installation, and administration of point evaluation plans for wage and salary programmes. The methods described are intended for use in a large decentralized company, but can be adapted for use in a smaller organization.

In addition to the theoretical development of the subject, many actual work sheets and examples have been included, and there are explanations of the statistical techniques involved for those who do not have a detailed knowledge of the subject. The author is careful to point out the dangers resulting from adopting plans not specifically adapted to the needs of the company.

A useful bibliography of books and periodical articles on the subject is included.

An introduction to the theory of structures.

W. Merchant and A. Bolton. Glasgow, Blackie, 1956. 210p., diagrs., 30/-.

Intended as a text for undergraduate students, the book is based on a series of lectures. It can also be used as a basis for more advanced developments.

The book covers the theory of statics, then considers beams, trussed frames, deflection of beams, and fixed end and continuous beams. Further chapters discuss stress, stress distribution, the use of theory in design, earth pressures and retaining walls, moving loads, pillars and slope deflection and movement distribution.

As the authors state in their preface, the book is essentially a re-interpretation of the classical principles of the subject.

Kraftfahrtmechanik, Teil 1.

Alfred Jante. Leipzig, Teubner, 1955. 237p., diagrs., 16.50 DM.

After a brief historical introduction, this undergraduate text on automobile mechanics considers traffic density and allied problems; road location; automobile and road operating expenses; and traffic safety. The two main chapters of the book discuss the kinematics and kinetics of automobiles. There are many diagrams and graphs, and a bibliography of periodical articles in German. The second volume, which is in preparation, will deal principally with gears and gearing.

• LIBRARY NOTES

Linear transient analysis, v. 2.

Ernst Weber. New York, Wiley, 1956. 452p., $10.50.

The first volume of this work, published in 1954, covered lump-parameter two-terminal networks. This second volume covers two-terminal-pair networks in filters and in transmission lines.

There is a brief introductory review of the Fourier and Laplace transforms and of their importance in the analysis of fourpoles and lines.

The first section of the book is devoted to two-terminal-pair networks (fourpoles) including both passive and active fourpoles, network characteristics, etc. The second part of the book considers transmission lines, noninductive cables and approximations and solutions for the general transmission lines.

Although essentially a mathematical presentation, practical applications are shown, and the various methods of solution are presented by means of problems worked out in the text.

***Marine cargo operations.**

C. L. Sauerbier. New York, Wiley, 1956. 548p., $10.50.

The main part of this detailed treatment of the theory and techniques of efficient and economical cargo handling deals with the following subjects: weight distribution, stability, longitudinal stress, and other principles; planning for stowage; stowage of different types of cargo; loading and discharging equipment; materials handling principles and equipment; and ventilation of cargo holds. Two short chapters are devoted to administrative organization for handling cargo and to responsibility for cargo. The last chapter reviews recent research in the field.

***Neutral grounding in high-voltage transmission.**

R. Willheim and M. Waters. Toronto, Van Nostrand, 1956. 669p., illus., $16.50.

A comprehensive discussion of the the various European and American methods of neutral grounding and other measures for reducing the fault rate in transmission systems. The first third of the book, devoted to ground faults and grounding practice, deals with the theory of neutral grounding, transient phenomena in three-phase systems, and methods of fault suppression. The rest of the book is a detailed treatment of resonant grounding, covering the theory, design, applications, and testing of the ground fault neutralizer (arc suppression coil). A great many numerical examples and actual tests and measurements are included, and each chapter is followed by a list of references and a bibliography.

***Petroleum refining with chemicals.**

V. A. Kalichevsky and K. A. Kobe. Toronto, Van Nostrand, 1956. 780p., $16.00.

This volume is a systematic treatise on the use of chemicals and solvents in the preparation of liquid petroleum products and waxes. Crude oil emulsions, petroleum composition, and testing methods are dealt with in introductory chapters, and the next five chapters cover refining with acids, alkalies, adsorbents, desulfurizing agents, and solvents. One chapter is devoted to deasphalting and dewaxing, and the last two chapters describe the use of additives in non-viscous petroleum fractions and in lubricating oils. Over 8000 literature and patent references are included in the bibliographies following each chapter.

***Practical design of simple steel structures, vol. 1, 4th ed.**

D. S. Stewart, London, Constable, Toronto, Longmans, Green, 1955. 221p., illus., $3.75.

A new edition of a standard British text written as a detailed guide to actual design procedures. This first volume covers the choice of sections; the making of drawings and templates; simple riveted joints of plates; flange-plate and other splices; eccentric riveted connections; wind pressure calculations; and beams. The last two chapters present complete designs of a joist and channel crane gantry girder and of a gallery, suitable for light work, to be attached to existing columns of a workshop. Tables giving properties of rolled sections, rivet values, bolt values, and other data are included in the appendix.

***Reactor shielding design manual.**

Theodore Rockwell, ed. Toronto, Van Nostrand, 1956. 472p., diagrs. $6.50.

A detailed presentation of procedures and data used in the design, construction, and testing of shielding for the reactor plants of the Naval Reactors Program and for the Shippingport Pressurized Water Reactor. Intended as a practical guide for designers of stationary as well as mobile reactors, the manual covers basic theory, setting allowable radiation levels, core and cooling system shields, plant layout as a factor in design, materials, provision for access for repair and maintenance, the effect of irregularities in shields, and the effect of the geometry of radiation. Basic data and calculation aids are provided in the last chapter.

***Resistance welding, theory and use.**

Resistance welding committee, American welding society. New York, Reinhold, 1956. 163p., illus., $4.50 (U.S.).

A review of fundamental principles and techniques, intended as a manual for experienced engineers and designers as well as an introduction to the subject for those unfamiliar with the method. The book treats spot, seam, projection, flash, upset, and percussion welding; describes the different types of welding machines, electrodes, and controls used; and discusses weldability, quality control, and testing.

Rural water supply and sanitation, 2nd ed.

F. B. Wright. New York, Wiley, 1956. 347p., illus., $4.96.

Almost completely rewritten, this edition includes many new developments in the field of water supply and sewage disposal.

• LIBRARY NOTES

The first part of the book considers the sources of water available, methods of calculating the amount needed and of securing an adequate supply, water treatment, and the design and installation of plumbing systems, both for water supply and sewage disposal.

Part two describes a variety of problems which may be encountered in installing and maintaining water and sewage disposal systems.

Science and civilization in China, v. 2. History of scientific thought.

Joseph Needham. London, Cambridge, Toronto, Macmillan, 1956. 696p., illus., $13.50.

This second volume of the author's scholarly work on science and civilisation in China is devoted to the history of scientific thought, which is equally as complex as that of Europe.

The Confucians are considered first, for although their contribution to science was almost completely negative, they had great influence over all later Chinese thought. The great Taoist school of organic naturalism was founded during the Confucian period, and its beliefs lie at the basis of all Chinese science. Other influences were the Mohists, Logicians and Legalists.

In the Chinese middle ages, the dominant force was provided by the theories of the naturalists: the theories of the Five Elements, and the Two Fundamental Forces. Dr. Needham then writes of the sceptical tradition, the effects of Buddhist thought, and the Neo-Confucian climax of Chinese naturalism. In the final chapter there is a discussion of the concept of the laws of nature and human law in China and in the West.

This extremely interesting and valuable work concludes with three lengthy bibliographies of Chinese and western books and periodical articles.

Soviet air power.

R. E. Stockwell. New York, Pageant press, 1956. 23Bp., illus., $7.50 (U.S.).

The author, a former editor of Aviation Age, reports on the great advances made in the Soviet Union in the last ten years which have transformed its air force from a backward force to one of the stongest in the world. The information in the book has been obtained from personal interviews, foreign contacts and written material, and the author quotes his sources. A separately bound supplement contains technical data on seventy Soviet aircraft.

***The steel skeleton, v. 2, Plastic behaviour and design.**

J. F. Baker, M. R. Horne and J. Heyman. Cambridge, University Press, Toronto, Macmillan, 1956. 40Bp., diagrs., $10.25.

A report of investigations made by the Steel structures research committee of the department of Scientific and industrial research in Great Britain. Detailed accounts are given of tests and theoretical studies on rigid frames, beams, and columns, made in order to develop a simplified method for the design of steel structures, based on their plastic behaviour. A proposed design method for multi-story frames is presented, and some actual applications of the method are briefly described.

***The structure of turbulent shear flow.**

A. A. Townsend. Toronto, Macmillan, 1956. 315p., diagrs., $6.75.

This is an attempt to develop a consistent view of the nature of turbulent flow by considering the properties of simple forms of turbulent flow, and to apply this view to the analysis of the more common types of turbulent shear flow. The analysis covers jet, wake, and boundary-layer flow as well as flow in pipes and channels and shear flow between rotating cylinders. A bibliography is included.

Supersonic inlet diffusers and introduction to internal aerodynamics.

Rudolf Herman, Toronto, Minneapolis-Honeywell, 1956. 378p., illus., $16.00.

This systematic and comprehensive treatment of supersonic inlet diffuser flow characteristics is by an engineer who has had many years experience in the field, both in Germany where he was a director of the rocket programme, and in the United States where he has worked with the Air Force, and with Minneapolis-Honeywell.

Much of the material used in the book has not previously been published, and stems from research done under the author's supervision on two-dimensional and spike inlet diffusers. The fundamentals of one-dimensional, two-dimensional wedge-type and axisymmetric conical inlet diffusers are covered. The author has evolved a new condensed notation system to simplify the theoretical analysis.

***Technical education.**

P. F. R. Venables. London, Bell, Toronto, Clarke, Irwin, 1955. 645p., $8.00.

This study of the present state and likely developments of British technical education includes two chapters devoted to engineering education. One of these is a general survey, the other a discussion of the relationship of university engineering education to technical education. Most of the book, however, is a critical survey covering curricula, selection of students, teaching staffs, and other aspects of education in technical institutes. Special studies of education for the building trades and of art, commercial, and science education are also included.

Television engineering; principles and practice, v. 2.

S. W. Amos and D. C. Birkinshaw. New York, Philosophical library, 1956. 270p., illus., $15.00.

Another in the series of training manuals issued by the B.B.C., this volume describes the fundamental principles of video-frequency amplifiers and examines the factors which limit their performance at the extremes of the passband.

A wide variety of circuits is described, and the use of feedbacks is also considered.

The first volume in the series dealt with basic television principles, and subsequent volumes will cover waveform generation and circuit techniques.

The theory of prestressed concrete design: statically determinate structures.

H. J. Cowan. Toronto, Macmillan, 1956. 264p., illus., $6.15.

In two brief introductory chapters the author outlines the fundamental principles and manufacture of prestressed concrete, and the properties of the steel and concrete used.

The main part of the book is devoted to a theoretical, mathematical treatment of the design of statically determinate prestressed concrete strucutres in accordance with British, American and Australian practices. It deals with direct design and covers the assessment of losses, the bending resistance of pretensioned sections for any condition of loading, resistance to shear and torsion, deflection and ultimate strength. A final chapter is devoted to prestressed concrete tanks and pipes, while numerical tables giving the properties of various sections are included in the appendix.

***Transistors handbook.**

W. D. Pevitt. New York, Prentice-Hall, 1956. 410p., diagrs., $9.00 (U.S.).

The first half of this practical manual for engineers, technicians, and students covers fundamental concepts, measurements, noise and temperature effects, methods of analysis, and characteristics of the different types of transistors-point-contact, junction, power, tetrode, pentode, photodiodes, and phototransistors. The last half of the book deals with specific circuits and practical applications, including audio and radio frequency amplifiers and oscillators, power amplifiers, amplitude and frequency modulation, radio and television receivers, relaxation oscillators, and computer circuits.

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

Air pollution

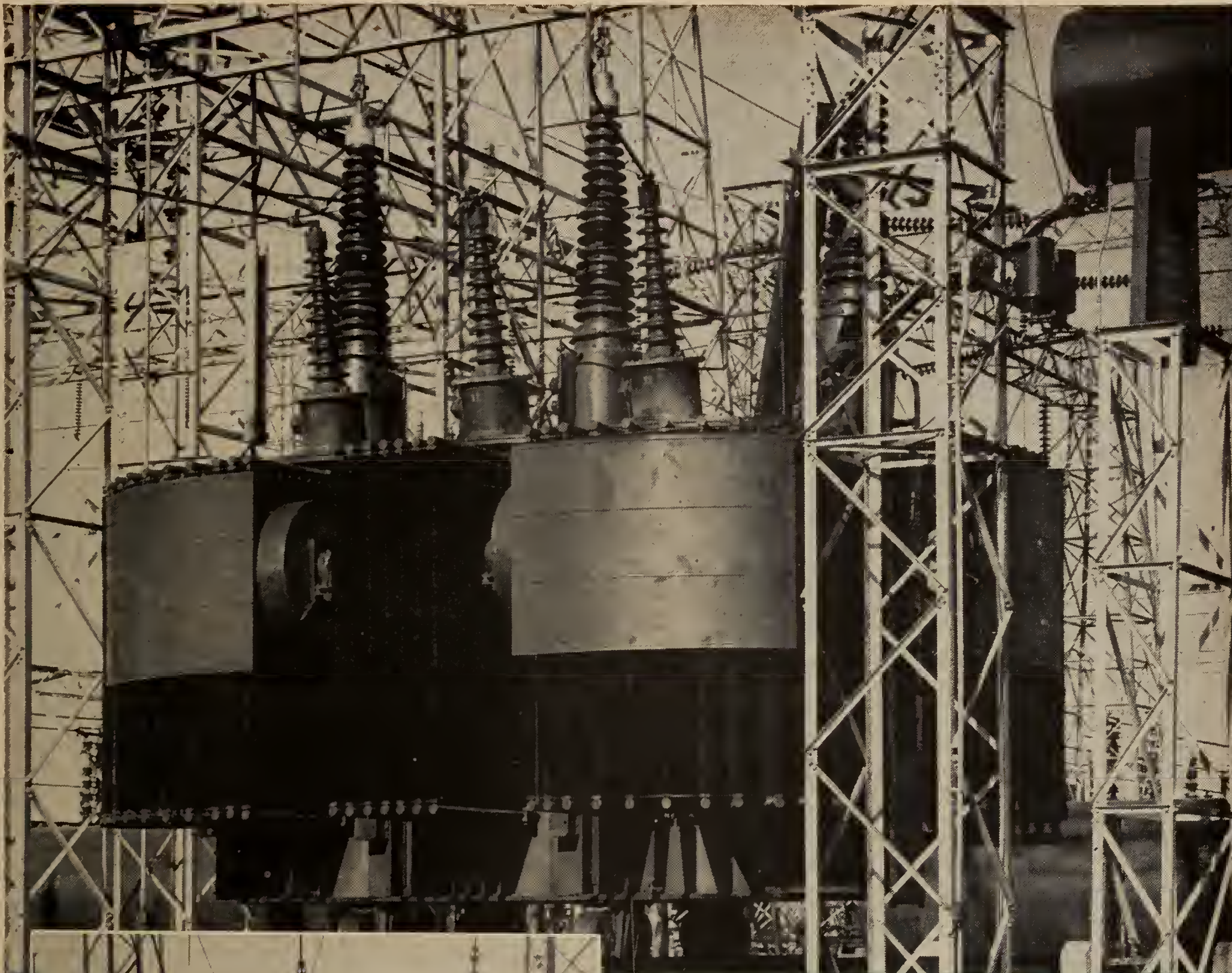
Research dollars fight air pollution. G. M. Read. (Air pollution control association)

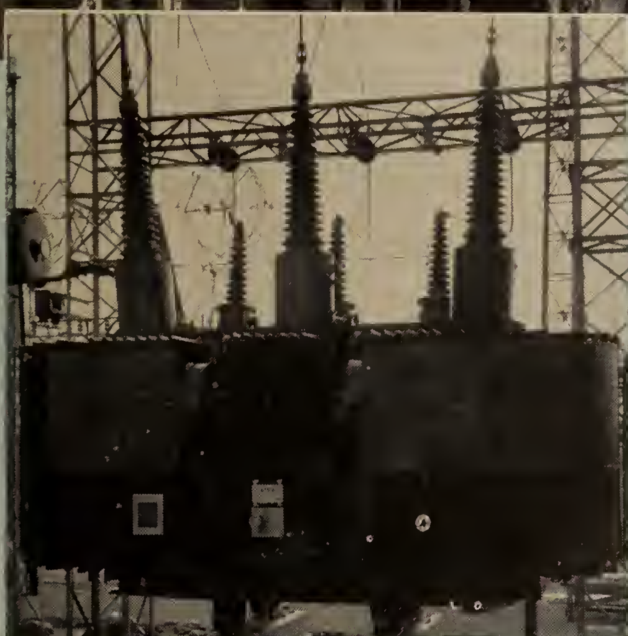
Atomic energy

Atom 1956. (2d annual report, United Kingdom atomic energy authority)

The biological effects of atomic radiation. v.1 Summary reports v.2 A report to the public. (Washington. National research council 1956)

Selected readings on atomic energy (U.S. atomic energy commission 1955)





• LIBRARY NOTES

Bridges

Stochastic study on uniform live load in the design of highway bridge.
A study of composite grillage girder bridge. (Kyoto university. Technical reports of the engineering research institute. Nos. 28 and 30)

Canada. Industries

Metallurgical works in Canada. Part 1: Primary iron and steel. Petroleum refineries in Canada. (Canada. Department of mines and technical surveys. Lists 1-1 and 5-2)

Construction industry

Beitrag zur Berechnung von Aussendruck beanspruchten kreiszylindrischen Rohren. C. F. Kollbrunner and S. Milosavljevic (A. G. Conrad Zschokke, Stahlbau und Kesselschmiede. Heft Nr. 19)
An econometric analysis of construction. J. M. Mattila (Wisconsin. University. Bureau of business research and service. 1955)
Housing and urban growth in Canada. (Central mortgage and housing corporation)
Insulation of the home. (N.R.C. Div. of building research. Bulletin no. 2)
National building code of Canada. Appendix 4-1-B. Fire resistance ratings. Part 4-design, Section 4:1. (N.R.C.)
Windstorm damage prevention. (National board of fire underwriters research division)

Electrical engineering

Picture book of TV troubles. v.6 Horizontal and vertical sync circuits. (Rider)
Superheterodyne converters and 1-F amplifiers (Rider)

Engineers. Opportunities

Raising professional standards and improving employment conditions for engineers. (E.J.C. report)
The shortage of scientists and engineers: a threat to economic progress. (McGraw-Hill department of economics.)

Industrial relations

Financing health services in Canada. (Joint committee on health insurance. 2d ed. 1956)
The regulation of collectively bargained health and welfare plans. (Princeton university. Industrial relations section. Selected references. no. 70)
Postwar changes in California unemployment insurance experience 1946-1950 to 1951-1955. M. T. Wermel (California institute of technology. BIRC publication no. 1)

Maps

Canadian maps 1949 to 1954. (Canada Dept. of mines and technical surveys. Bibliographical series no. 16)

Materials testing

American society for testing materials. Proceedings, v.55, 1955.
Evaluation of insulating oils—European developments. (A.S.T.M. s.t.p. no. 172)
The non-destructive testing of engineering materials. (A. E. Cawkell)
Panel discussion on pyrometric practices. (A.S.T.M. s.t.p no. 178)
Symposium on atmospheric corrosion of non-ferrous metals. (A.S.T.M. s.t.p. no. 175)
Symposium on metallic materials for service at temperatures above 1600 f. (A.S.T.M. s.t.p no. 174)

Welding

Tentative specification for nickel and nickel-base alloy bare welding filler metals (A.S.T.M.: B304-56T and A.W.S.: A5. 14-56T)
Tentative specification for surfacing welding rods and electrodes (A.S.T.M.: A399-56T) and A.W.S.: A5.13-56T
Tentative specifications for welding rods and covered electrodes for welding cast iron. (A.S.T.M.: A398-56T and A.W.S.: A5.15-56T)
Welding data book (Eutectic welding alloys corp.)

Miscellaneous

Alberta trade index manufacturers. (Edmonton. Department of industries and labour)
The story of the United Nations. (Distillers corp.-Seagrams Ltd.)
State of Michigan. Mackinac bridge authority. Ninth quarterly engineers construction progress report and report of auditors examination. 1956.
American concrete institute. Journal. Supplemental 5-year index 1950-1954.

STANDARDS REVIEWED

**A.S.T.M. Standards, American society for testing materials,
1916 Race St.,
Philadelphia, 3.**

Copper and copper alloys

A compilation of 127 standards covering copper, copper-alloy, and copper covered steel electrical conductors; copper and copper-alloy plate, sheet, strip, and rolled bar; rod, bar, shapes, and die forgings; castings; filler metal; and methods of test for copper and copper alloys. Fifty of these specifications are revised and a new specification for threadless copper pipe is included. 654p., $5.75 (U.S.)

Electrical insulating materials

This 1956 edition includes 12 revisions and 2 new items covering methods of testing silicone insulating varnishes and a recommended practice for cleaning plastic specimens for insulation resistance testing. Specifications and test methods widely used in the electronics industries for the following materials are given: insulating shellac and varnish; plates, sheets, tubes, rods and molded materials; mineral oils for electrical insulation; ceramic products; solid filling and treating compounds; insulating fabrics and papers; mica products. Also included are proposed recommendations for writing statements on the usefulness of tests of electrical insulating materials, proposed methods of test for dielectric contant and dissipation factor of aviation fuels, and a number of electrical tests and conditioning requirements for electrical testing, which are generally applicable to insulating materials. 656p. $6.00 (U.S.)

Metallic electrical conductors

These standards cover: copper, copper alloy and copper covered steel: wire, stranded conductors, rods and bars; aluminum: wire, stranded conductors, rods and bars; galvanized steel core wire; and galvanized iron and steel guy, messenger, span, overhead ground, and line wire. 300p. $3.50 (U.S.)

**American society of heating and air-conditioning engineers,
62 Worth St.,
New York.**

A.S.H.A.E. code for testing and rating heavy duty furnaces and direct-fired unit heaters.

This code is applicable to forced warm air furnaces and direct-fired unit heaters having output ratings in excess of 250,000 Btu an hour. Eight sections cover purpose, scope, definitions, rating limits, testing equipment, testing procedures and rating procedures. 10p. .50 (U.S.)

**American society of mechanical engineers,
29 West 39th St.,
New York 18.**

**Boiler and pressure vessel code.
Section 8. Unfired pressure vessels.**

This edition "contains rules covering the use of all classes of materials and methods of fabrication that have been approved for code construction. These rules are to be used without supplement from earlier editions or from code cases applicable only to earlier editions. Code cases which apply to the 1949 edition have been annulled. It is the intent of the Boiler and pressure vessel committee that vessels built after January 1, 1957, in accordance with the 1949 and earlier editions should be marked with the Code symbol."—preamble. 194p. $5.00 (U.S.)

OMISSION

In the review of "Foundations: design and practice" in our August issue the author's name was inadvertently omitted. He is Elwin E. Seelye.

ENGINEERING CAREERS

The Petroleum Industry

THE OIL INDUSTRY in Canada has developed enormously in the past ten years, since the discovery of great oil reserves in the western provinces. Proved reserves of crude oil now exceed 2,500 million barrels, Alberta natural gas reserves exceed 15,000 billion cu. ft., and new discoveries and developments continue to increase these figures. Refining facilities are being developed to keep pace with increasing demand for petroleum products, and crude oil is finding markets outside Canada, particularly in the United States. The demand for Canadian oil is likely to continue to increase and will be promoted by such factors as higher tanker freight rates and uncertainties about supplies from the Middle East.

The industry may be roughly divided into three main groups — production, manufacturing, and marketing — and there is scope for engineers in each of these.

Exploration and Production

The search for crude oil may be taken as the starting point for a review of the industry and the place of the engineer in it.

Initial exploration is carried out by geological teams, but when the basic data on a possible oil-bearing area are established the co-operation of engineers with field experience is required to work out the best means of developing the field and what equipment will be needed. Under the broad term petroleum engineer, men with varied technical backgrounds work on problems of drilling, well completion, operation of electrical and mechanical equipment, and so on. Electrical engineers and engineering physicists may find scope in the field of geophysical exploration.

Storage and distribution facilities for crude oil — and for the increasingly important petroleum product, natural gas — have to be provided.

By far the largest producer of crude oil and natural gas at present is the province of Alberta, but Saskatchewan and Manitoba are playing an increasing part in the western oil industry.

Manufacturing

Although the main source of Canadian petroleum is in the west, the largest refining (manufacturing) centres are at present in the provinces of Quebec (Montreal) and Ontario, near the major Canadian markets. However, there is also considerable refining capacity in Saskatchewan, Alberta, British Columbia, and Manitoba, which together amounts to some two-thirds of that of the two eastern provinces and will undoubtedly continue to grow.

Mechanical, electrical, civil, and chemical engineers play an important part in manufacturing operations. The design of a modern refinery calls for specialized engineers and incorporates a great amount of electrical and mechanical equipment. Refinery operation demands engineers for technical and supervisory posi-

A corner of a typical control room in a modern petroleum refinery. The control room is the heart of the refinery process and here the plant operators can observe operating variables and overall conditions at any time. Many processes are almost fully automatic, and mechanical, electrical, and electronic recording and controlling instruments play a large part in the successful operation of the plant.

tions for the safe and efficient running of the plant. Processes are more and more approaching the fully automatic, and consequently involve much mechanical, electrical, and electronic control apparatus which may be part of the responsibilities of the engineering staff.

Civil engineers are required for the construction of refineries and their associated facilities for storage and distribution.

Technical positions in manufacturing operations may lead to administrative posts such as chief engineer, refinery manager, or other appointments.

Marketing and Distribution

The third major division of the petroleum industry is the field of marketing, and this is a major undertaking not only for its competitive nature, but because of the increasing complexity of petroleum products and their applications.

Apart from the distribution of various types of fuel (gasolines, fuel oils, petroleum gas, and so on), such fields as lubrication are becoming more and more specialized. Lubrication engineers have to be experienced in many branches of industry and the particular problems of lubricating such diverse equipment as that found in a steel rolling mill or in a pharmaceutical processing plant.

Another increasingly important field is that of the petroleum-chemical industry, for which the oil industry supplies the raw materials. A subsequent article will deal with the role of the engineer in the chemical industry, including petro-chemical manufacturing.

The distribution of petroleum products (and of crude oil and natural gas) requires the construction and operation of various facilities and permanent installations. The two major ways of distributing petroleum products are by tanker and by pipeline. Considerable engineering experience is needed during the planning and construction of a pipeline and its attendant storage and pumping facilities.

Engineers are also required for the construction and maintenance of other distribution outlets such as local bulk distributing plants and service stations.

Many oil companies have marine departments, in which there are usually only limited opportunities for the engineer, apart, of course, from the field of marine engineering. Marine and lake terminals may have to be constructed and maintained as part of the overall distribution system.

Opportunity

In all, then, there are many positions within the petroleum industry to be filled by the civil, electrical, chemical, and mechanical engineer, and the engineering physicist.. Opportunities for advancement are good, most companies generally filling senior posts by promotion from within their own organizations.

There is a wide range of responsibility in the fields in which the engineer can apply his professional training and experience, and there are also opportunities for him to progress to senior administrative and management positions.

Crude oil and petroleum products must be transported over great distances, and the pipeline is the chief means of overland distribution. The picture shows a centrifugal pump and speed increaser at a pump station of one of the major pipeline companies. Engineers play a large part in pipeline construction.

Training

Most oil companies take students for summer work, particularly in the refineries.

Graduate engineers, on joining a company, are trained to fit them for their future career in the industry.

In general, training schemes in the industry are carried out over a considerable period and may be based on on-the-job experience to give the new engineer a broad background in the operations involved. In addition, the sales engineer usually receives intensive training in all aspects of the products marketed and their applications. As mentioned above, the lubrication engineer is one example of those who must have considerable specialized knowledge in a particular field.

Salary and Benefits

Starting salaries for newly-graduated engineers are generally competitive with the rates current in other industries. Advancement is then based on ability and experience, and salaries are usually reviewed at regular intervals. The highest executive positions may be reached by the right man.

Paid vacations, pension and health plans, and other benefit schemes are general in the industry.

Further Information

There is much material available in the libraries on various aspects of the petroleum industry, but two recent articles in *The Engineering Journal* give an insight into the overall industry in Canada and into the particular problems involved in the construction of a modern refinery. These are:

(1) Canada's Petroleum Industry; G. M. Furnival, M.E.I.C. *The Engineering Journal,* 1955, Aug., p. 1035.

(2) Engineering for a New Petroleum Refinery in Montreal; J. Alexander, M.E.I.C., and E. Alzner, M.E.I.C., ibid, 1956, April, p. 421.

Business and Industrial Briefs

A DIGEST OF INFORMATION RECEIVED BY THE EDITOR

Appointments and Transfers

Union Carbide Canada — John S. Dewar is appointed vice-president of Union Carbide Canada Limited, continuing as president of that company's division, National Carbon Company. It is also announced that Gordon W. Patterson has been appointed vice-president of National Carbon Company.

B. F. Goodrich — P. B. Mason, production superintendent, B. F. Goodrich Canada Limited, has announced the following appointments: E. R. Current, staff manager; R. Knowlton, production manager, tire division; and Marshall W. Roth, manager, tire construction, will report to the production superintendent.

William B. Flora becomes vice-president, sales.

Air Reduction Canada — J. R. Morrison has been appointed to the technical sales staff of Air Reduction Canada Limited.

Stewarts and Lloyds — The appointment is announced of George F. Clark as the Toronto manager of Stewarts and Lloyds of Canada Limited.

George F. Clark

International Nickel — Kenneth B. Young has been appointed to the staff of the Canadian development and research division of The International Nickel Company of Canada, Limited.

Canadian Ingersoll-Rand — James W. Kennedy has been appointed manager, pump division, of the Canadian Ingersoll-Rand Company Limited with headquarters in Montreal.

Thompson Products Limited — J. K. Abel is appointed manager, replacement division, Thompson Products Limited, comprising the sales organizations Thompson Service, Toledo Steel Products, and Ramco Rings.

Le Roi Division — Milton R. Conroy has been appointed manager of Canadian sales for the Le Roi Division, Westinghouse Air Brake Co., Milwaukee, Wis. Mr. Conroy's offices are in Toronto.

B. J. Coghlin Co. — F. O. Peterson, chairman of B. J. Coghlin Co. Limited, announces the appointment of S. H. Dobell, D.S.O., as president of the company and of its subsidiaries, Watson Jack-Hopkins Limited and Boulevard Equipment Limited.

E. G. M. Cape Appointment — E. G. M. Cape and Company announce the appointment of Robert Devlin as general superintendent in charge of a number of the company's projects in Ontario. Mr. Devlin's headquarters are at 688 The Queensway, Toronto 14.

Progressive Welder, Canada—The board of directors of Progressive Welder, Canada Limited announce the appointment of E. J. Formhals as general manager of Canadian operations, with headquarters in Chatham, Ont.

Josam Canada Appointments — J. S. Newman, vice-president and general sales manager of Josam Canada Limited has announced the appointments of Harvie Ashman as Northern Ontario representative, and of Roy Gibbon Agencies as sales representative in the Lakehead territory.

J. W. Hutchinson

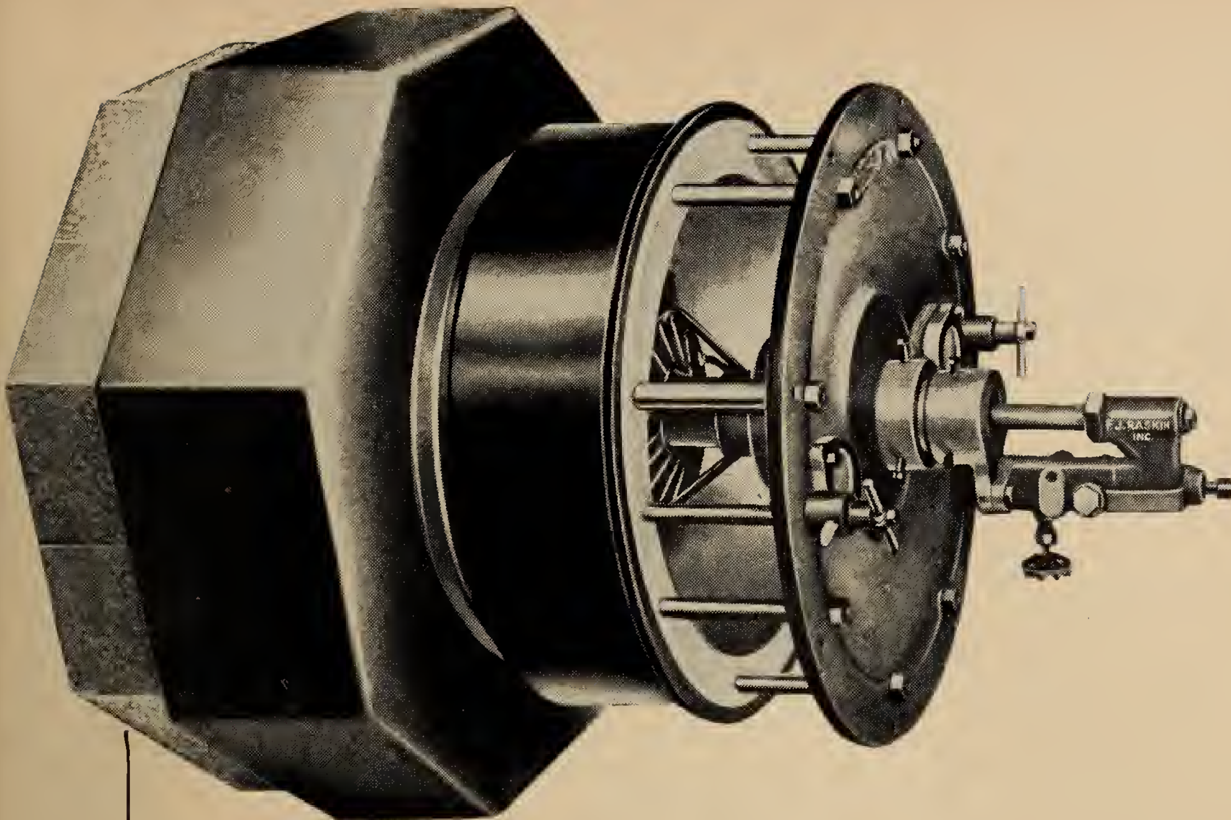
Powerlite Devices — J. W. Hutchinson has been appointed manager, switchgear and accessories engineering, Powerlite Devices Limited.

Canadian Zurn Engineering — Kenneth H. Tremain has been elected vice-president of Canadian Zurn Engineering Ltd.

Dominion Bridge Subsidiaries — Several changes are announced in the senior staffs of Manitoba Bridge & Engineering Works Limited, and Manitoba Rolling Mill Co. Ltd., subsidiaries of Dominion Bridge Company Limited. A. Campbell, M.E.I.C., becomes president of both Manitoba companies on the retirement of H. A. Mackay; J. Stewart Campbell, M.E.I.C., becomes manager of Manitoba Bridge & Engineering Works, Ltd.; Hugh Lindsay Smith, formerly works manager, becomes manager of Manitoba Rolling Mill Co. Ltd. Operating staff changes include: J. Munro E. Dale, works manager, Manitoba Bridge, on the retirement of P. G. Meurer; R. G. Honeyborne, superintendent; and H. A. Mackay Jr., superintendent, Manitoba Rolling Mill.

Collins Radio Company — Appointments announced by Collins Radio Company of Canada Limited are: Anthony Davies,

(Continued on page 1476)



CSA *Approved*

RASKIN
OIL AND GAS BURNERS

The above illustrated oil burner unit, approved by CSA Approvals Laboratories, is equipped with "Raskin" steam atomizing oil gun. It is adaptable to either natural, induced or forced draft operation and in many installations proved a capacity range of 25 to 1 without having to change the burner tip or move the gun in and out. Through its simplicity and efficient operation it has made many friends for itself among consulting engineers and plant operators. Now that gas is coming into wider use, many customers will realize the advantages of this unit which is so easily adaptable to gas firing.

If you wish to obtain any free literature, tear off this page and mail to us. We will forward to you our catalogue No. DN-54 showing industrial oil burners. We shall also include a reply card which indicates many other "Raskin" products.

"Raskin" representatives are located from coast to coast. They are capable to solve most problems and to service all types of "Raskin" burners. Please ask for name and address of "Raskin" Representative nearest you.

F. J. RASKIN INC. 4220 IBERVILLE ST. MONTREAL CANADA director of sales; Albert C. Petrasek, sales manager of ground communications equipment; and E. H. Edge, general communications sales department.

Spannall of Canada — Murray Griffin has been appointed Canadian sales representative for Spanall metal horizontal shoring for concrete floor forms.

Mines and Technical Surveys—W. Keith Buck is appointed chief of the mineral resources division, Department of Mines and Technical Surveys, as announced by Mines Minister George Prudham.

Canada Iron Foundries—R. Lyle, vice-president sales, Canada Iron Foundries Limited, announces the appointment of K. E. Walker as district sales manager, pipe division, Toronto, succeeding George M. Gass, who has retired after 45 years service.

New Equipment and Developments

Canadian Agent— The English Electric Company of Canada Limited has been appointed Canadian agent for the products of the P. and B. Engineering Company Limited, of England, who manufacture thermal relays for motor protection, thermal indicators to register maximum demand and maximum load, earthing clamps and operating poles, cable tracers and instruments for cable fault detection.

Rolling Stock Manufacture—E. J. Cosford, president and managing director of Canadian Car & Foundry Company, Limited, of Montreal, has announced that his company had been licensed by the Budd Company of Philadelphia to build and sell all-stainless steel railway passenger cars, railway disc brakes and Budd Rolokron, an anti-wheel slide device. The agreement will permit the Canadian manufacture of all types of stainless steel passenger equipment, including the Budd self-propelled rail diesel car and scenic dome type passenger equipment.

Laticrete Distributors—The appointment of three distributors for Laticrete has been announced by W. M. MacLean, general sales manager of the Latex and Reclaim Division of Dominion Rubber Company Limited. The distributors appointed are Bostwick and Company, Moncton, New Brunswick; Roy Gibbon Agencies, Port Arthur, Ontario; and Industrial Coatings Limited, Vancouver, British Columbia. Laticrete, developed in Canada by Dominion Rubber, is now also being produced under licence in the United States. It bonds readily to concrete, steel, or other materials, and is widely used to repair damaged concrete, or over sound concrete or steel where properties of corrosion resistance, skid-proofness, non-sparking qualities, and flexibility, are desired.

Chain Link Fence— An announcement has been made recently of arrangements having been completed between The Steel Company of Canada, Limited, Hamilton, the Dominion Bridge Company Limited, Vancouver, the Riverside Iron and Engineering Works Limited, Calgary, the Standard Iron and Engineering Works Limited, Edmonton, and the Manitoba Bridge and Engineering Works Limited, Winnipeg, to provide a complete chain link fence service throughout Western Canada. Through the arrangement, complete stocks of Stelco fence materials have been established at Vancouver, Calgary, Edmonton, and Winnipeg where the companies representing Stelco are prepared to offer a service which includes surveys, without obligation, of properties to determine the fence requirements and estimates of cost with or without erection.

New Airco Distributor— It is announced by Air Reduction Canada Limited that

(Continued on page 1480)

NEW..."M" Frame Molded Case Circuit Breakers are fully designed for 800 ampere applications

C.S.A. APPROVED

For applications which formerly required larger and more expensive equipment, you can now use the new I-T-E "M" frame molded case circuit breaker without sacrifice of quality. It offers optional pressure connectors for double or triple cable connections per phase contained within the circuit breaker case. Exclusive 3″ pole center design dimensions permit easy accessibility for front cable or rear bus and stud connections. And the "M" frame breaker is ideally suited for use in panelboards, power panels, switchboards, motor controls, bus duct plugs, and individual enclosures.

Available with interchangeable trip units providing continuous 600, 700 or 800 amp ratings in 2- or 3-pole construction for 250 volt d-c and 600 volt a-c service. Interrupting ratings (NEMA test procedure): 600 v a-c, 25,000 amp; 480 v a-c, 35,000 amp; 240 v a-c, 50,000 amp; 250 v d-c, 20,000 amp.

EASTERN POWER DEVICES LTD.

29 WABASH AVE. TORONTO.

Triple cable connectors accommodate three 300-400 mcm cables per phase.

Optional double cable connectors accommodate two 400-500 mcm or 600-700 mcm cables per phase.

EPD **EASTERN POWER DEVICES LIMITED** / *SPECIALISTS IN SWITCHGEAR*

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5612

• BRIEFS

Standard Welding Supplies Limited, of Montreal, is an authorized distributor of Airco Products.

Josam Representatives—Josam Canada Limited announce the appointment of Marshall, Turnau, Boucher & Company as Josam sales representatives for the Province of Quebec.

Magnetic Drives—Tormag Transmissions Ltd., Vancouver, has granted The Whitney Chain Company of Hartford, Conn., manufacturing and didstribution rights for the United States and Canada of products to be known as Whitney-Tormag Magnetic Drives. The units will be manufactured by The Whitney Chain Company in their factory at Hartford, Conn., and distributed throughout the United States and Canada. The Tormag unit transmits power through the use of permanent magnets and therefore requires no mechanical connection between the driving and the driven elements, nor does it need any electrical connection or hydraulic fluid.

Sales Agreement — A reciprocal sales agreement has been signed between Canadian Marconi Company, Montreal, and National Aeronautical Corporation, Pennsylvania, U.S.A. whereby Canadian Marconi will distribute NARCO standard line equipment for business aircraft, and the new Sapphire line of navigation and communications equipment, which is type certified by C.A.A. for airline use. At the same time Canadian Marconi announced that NARCO will market Marconi's new automatic direction finder (CMA 301) through its regular channels throughout the United States.

Air Conditioning Units—The complete range of Westinghouse Air Conditioning units is now being marketed in Canada by the B. F. Sturtevant Company of Canada Limited (a subsidiary of Canadian Westinghouse Co. Ltd.). Sizes are available from the smallest half-ton window unit to the 100 ton hermetic compressor for large central plant systems. The complete Westinghouse line has recently undergone many changes in basic design and structure. Also announced is the introduction of a new air-cooled condenser for use with central type home units and certain of the packaged commercial models.

Separator Distribution—Pacific Industrial Engineering, Inc. announces the appointment of H. J. G. McLean Ltd. of Brantford, Ont., for the sale and service of Pacific separators in the Provinces of Saskatchewan, Manitoba, Ontario and Quebec. The Pacific separator operates on the fully pressurized flow flotation principle and is supplied in models ranging from 25 to 2000 U.S. gal. per minute.

B.C. Oil Refinery—A major interest in X-L Refineries Limited, Dawson Creek, first British Columbia refinery to process Peace River crude oil, has been acquired

• **BRIEFS**

by Pacific Petroleums Ltd., pioneer of the B.C. gas and oil fields, it was announced by George L. McMahon, president of Pacific. The 3000-b/d Dawson Creek refinery will be operated in conjunction with the new $20 million Peace River gas processing plant which Pacific and Westcoast Transmission Company Limited are building at Taylor Flats, B.C. This latter plant will clean the natural gas from Peace River fields before it enters the Westcoast pipeline. Production from the plant will include sulphur, propane, butane, natural gasoline and other liquid hydrocarbons. This is the first processing of B.C. crude.

Plant Expansion– A $500,000 expansion of the offices, laboratories and plant of Alchem Limited at Burlington, Ont., is announced by the company's vice president and general manager, W. C. Heim. The expansion will include a new two-storey wing to the offices and laboratories and a one-storey addition to the plant. Contract for the project has been awarded to the W. H. Cooper Construction Co. Ltd. of Hamilton. Prack and Prack, also of Hamilton, are the architects.

A.E.C.L. Fuel Element Contract– A long-term contract to fabricate fuel elements has been awarded to AMF Atomics (Canada) Limited by Atomic Energy of Canada Limited. A new 30,000 sq. ft. plant and nuclear laboratory will be built on a 30-acre site at Port Hope, Ont. This will be the first unit of a large nuclear facility and will be staffed by Canadians. AMF Atomics (Canada) is one of the first private companies in Canada to be organized solely for nuclear research and development engineering. Denton Massey is general manager.

New Company Formed– Formation of a new company, Prenco Products Company, Lakeshore Road, Clarkson, Ontario is announced by John M. Atwood, general manager. Specializing in treatment of porosity in metal castings of all kinds, the new company will manufacture foundry supplies and equipment of various types. Initial products to be made are Porlox seal, a metal oxide type seal for casting impregnation, and See-O-Two core binder which is used in the production of foundry cores and moulds by the carbon dioxide hardening process.

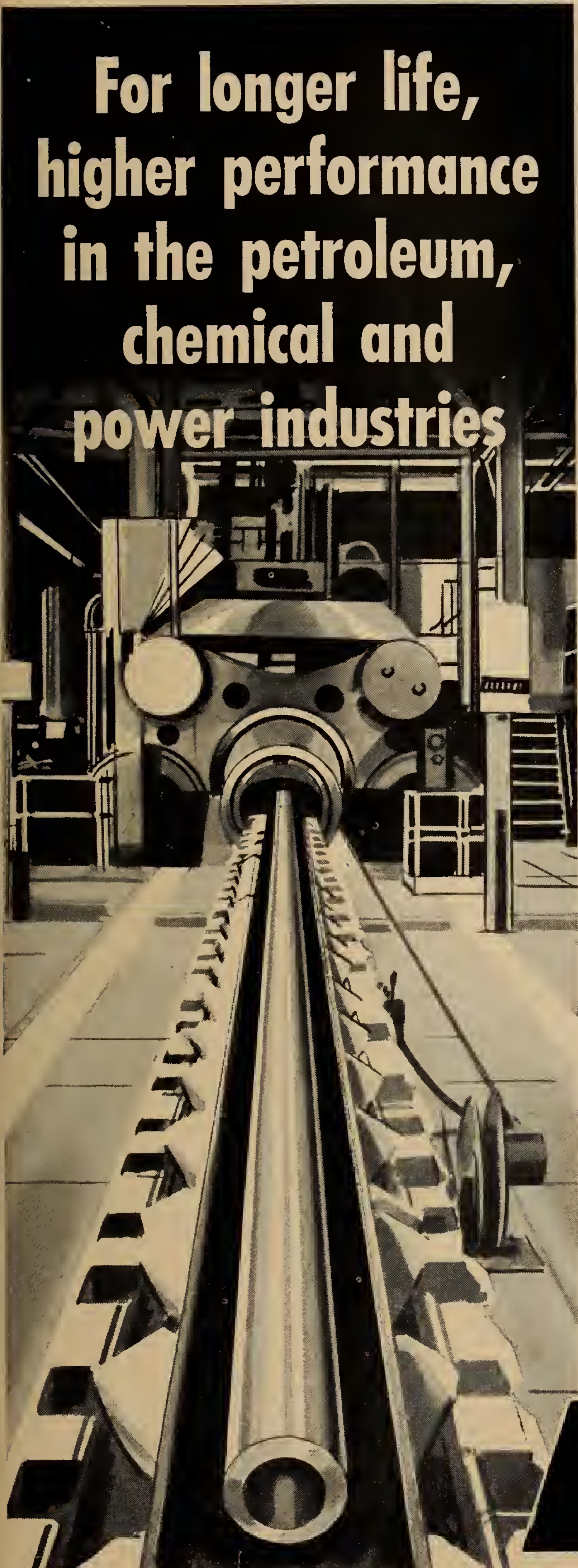
Dynapump Representatives — Jenkinson and Company Ltd., Toronto, have been appointed by The Fostoria Pressed Steel Corporation as exclusive Canadian representatives of the new improved Dynapump. The outstanding characteristics of this new pump are the high head, up to 25 feet, capacities to 1330 square feet of radiation, elimination of noise, improved flange design, simpler installation and one size for all small building applications.

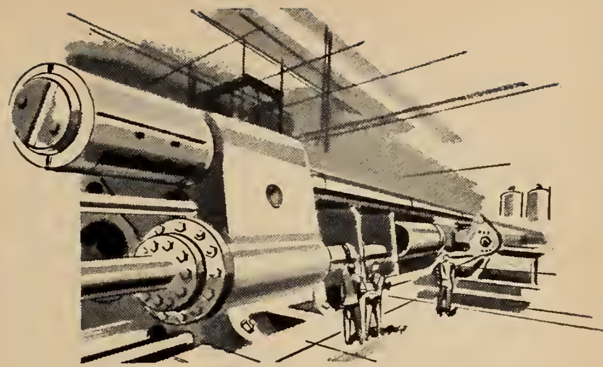
Engineering Office– Arthur G. McKee & Company of Canada, Ltd., has opened a Canadian engineering office on Toronto's lakefront, H. E. Widdell, president, has announced. Carl L. Nilson has been named general manager of the new engineering office.

To Manufacture in Canada–The Ric-wiL Company of Canada Limited announces establishment of manufacturing facilities in St. Thomas, Ont. It is affiliated with Ric-wiL Incorporated of Barberton, Ohio, U.S.A. H. S Boring is president of Ric-wiL Incorporated and the Canadian company; Earle R. Hall has been elected vice-president; and Charles Hammersley, former chairman of the St. Thomas Industrial Board, has been appointed works manager. Production of Ric-wiL insulated piping systems has begun.

Organization Changes– A change in organization structure has been announced by CHAIN Belt Company, Milwaukee. The present divisional structure will remain unchanged with each division responsible for its own operations, but it is now planned to group these divisions in accordance with the major end use of their various products. An industrial

(Continued on page 1486)





Corrosion-Resistant, Heat-Resistant EXTRUDED Steel Pipe

Curtiss-Wright's Metals Processing Division now offers the petroleum, petrochemical and power industries a line of high-quality, extruded steel tubular products to meet the most severe demands of modern processing. Inherent corrosion and heat-resistant properties of the steel alloys used are amplified by extrusion because the finished tube is produced with only one heat, in one pass of the giant 12,000 ton press . . . formed under compression in a matter of seconds without seams, in lengths up to 50 feet. Extra margins of resistance to corrosion and heat are built in easily by extruding heavier pipe wall thicknesses at no sacrifice in production speed. The most up-to-date quality control facilities, including ULTRASONIC TESTING, are employed in production.

Curtiss-Wright's extrusion facility is a specialty mill, ideally equipped for the production of special purpose, premium quality tubing. Conformance to A.S.T.M. specifications and other exacting standards is assured by an experienced engineering staff and the most modern metallurgical testing equipment.

When higher pressures and temperatures, or more corrosive service conditions demand more than the ordinary in large diameter pipe, let Curtiss-Wright serve you through the nearest Metals Processing Division Branch Office, or write to the address shown below.

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OF CANADA, LTD.
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• BRIEFS

equipment section and a construction machinery section are therefore being established. The industrial equipment section will be made up of the company's Roller Chain Division, the Chain and Transmission Division, the Conveyor and Process Equipment Division, and the Shafer Bearing Division. The construction machinery section will consist of the Construction Machinery Division, Milwaukee, the California Division, Los Angeles, and CHAIN Belt (Canada), Toronto.

Steam Generating Station— As part of the Commission's long-term planning for the northwestern part of the province, Ontario Hydro property officers are arranging options on possible future sites for a steam generating station at the Lakehead. It is expected that, in the near future, crews will go into the area for test-boring of the sites under consideration. The activities now under way are stated to be a safeguard for the future power supply of this rapidly expanding district.

Canadian Oil Expansion— Contract for the $3,000,000 petrochemical plant at Canadian Oil's Sarnia refinery has been awarded to The Fluor Corporation of Canada, Ltd., refinery and chemical-engineer contractors of Toronto. The contract calls for the engineering and erection of a Udex plant having a design capacity of 3,650 barrels a day, and a 4,400 barrels per day Platforming unit. Completion of the new plant is scheduled for next summer. A modern glass and aluminum building in Toronto will house the new head office of Canadian Oil Companies, Ltd. A feature of the new structure, which will be named the Canadian Oil Building, is multi-storey parking. This comprises five storeys—two and a half storeys above ground and two and a half below ground—accommodating 110 cars. Modelled on the Lever Building in New York City, the Canadian Oil Building is of steel construction with aluminum curtain walls, plate glass windows, and structural glass spandrel panels.

Power for Ore Bridge— All electrical drive equipment for the Algoma Steel Corporation ore bridge will be supplied by the Canadian Westinghouse Company. The bridge, to be the fastest in North America, will be located at Algoma's Sault Ste. Marie, Ontario, plant and will be built by Heyl & Patterson Inc. of Pittsburgh. It will have a free digging capacity of 1,540 gross tons per hour.

The main drives, bucket hold and close, trolley and bridging are adjustable voltage d.c. The adjustable voltage drives are controlled by Rototrol speed regulators, with Magamp current limit override. Power is brought on to the bridge at 2300 volts, 3 phase, 60 cycle. A six unit M.G. set comprising a 1000 hp. synchronous motor, two 300 kw. d.c. generators for the bucket drives, two 300 kw. d.c. generators for the trolley drive and a 50 kw. constant voltage d.c. generator, powers the main drives and d.c. auxiliaries

The 20 gross ton bucket is driven by hold and close motors, each rated 250 h.p., 1 hour. The trolley is driven by two 250 h.p. continuous rated motors. Bridging is done with the hold generator powering four 45 h.p., 30 minute, pier leg motors, and the close generator powering two 65 h.p., 30 minute, shear leg motors. A power centre, 150 kva., 2300-575 volts, provides power for bridge lighting, the apron hoist and rail clamp drives, and auxiliaries. The bucket turntable is driven from 250 volts d.c. constant voltage.

Core for Nuclear Reactor— The John Inglis Co. of Toronto, who have just completed the construction of the heart of the new Chalk River NRU reactor, are

(Continued on page 1490)

Using

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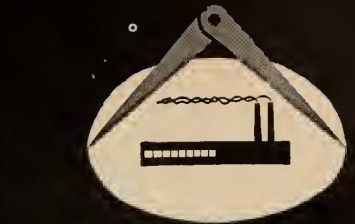
NEOPRENE • HYPALON®



in Industry

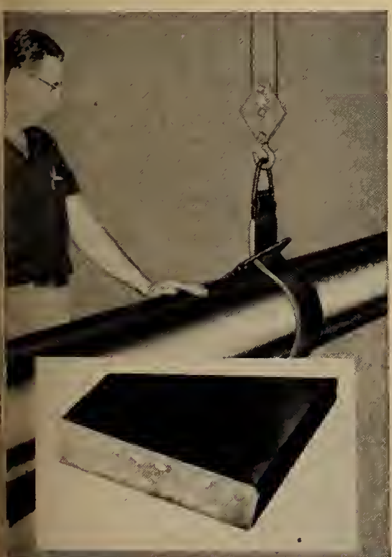
NEOPRENE sling handles highly finished metal stock

Long service life is expected from the neoprene-cushioned sling shown below handling a piece of finished bar-stock. The conventional woven wire sling has been completely encased in neoprene, providing a soft, smooth cradle that won't mar the highly polished surface.

The manufacturer used neoprene for the sling because of its superior resistance to oils, greases and aging. Even under the most severe service conditions, neoprene offers long, dependable performance.

In your plant, neoprene offers cost savings wherever you need a durable, resilient material. Hose, belts, gaskets, tank linings and many other applications profit by neoprene's unusual resistance to heat, oil, chemicals, aging and flex cracking.

Use the coupon for more complete information on neoprene. If you have a specific problem, let us know on the coupon.



Neoprene wire slings can be supplied in any length or width, used in a basket or choke hitch for handling a variety of metal shapes. Sling pictured is 4" wide and 5' long.

New rubber-based paints resist ozone, chemicals, heat and weather

There's a new kind of industrial maintenance paint on the market. These paints are based on HYPALON, Du Pont's new synthetic rubber. They resist ozone, strongly oxidizing chemicals, heat and weather. And, what's more important for color-conscious plant engineers and purchasing agents, HYPALON paints come in a range of colors, all of which are stable to sunlight exposure.

HYPALON coatings can be brushed or sprayed. A sprayed coating, applied with standard lacquer or enamel spray equipment, gives a glossy finish and can be built up in the same way as other coatings.

Whichever method you use, you can get colors that start bright and stay bright —applied inside or outside of your plant. They can be used to color-code piping systems or to color-condition your equipment. In all cases, your equipment is protected by a resilient, long-lasting coating. The end result is reduced plant maintenance costs.

We'll be glad to send you a list of suppliers. Write "Suppliers list" on the coupon. Clip the coupon, also, for information on the many other uses for HYPALON.

EASY TO APPLY, HYPALON coatings are brushed or sprayed on like enamel. They add bright, light-resistant color and long-lasting protection to your plant equipment.

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EJ-10

to build another for India. They are to supply, under the Colombo Plan, the pile core components and the control and shut-off rods for a special research reactor that will be installed near Bombay. This new reactor is similar to the NRX, constructed for Chalk River some years ago, but incorporates latest modifications. It is scheduled for delivery about the middle of 1957.

Plant Completed— Leo E. Ryan, president of Monsanto Canada Limited, announced the completion in September, of the new synthetic resin plant at Clover Bar, Alberta, near Edmonton. Production of phenolic and urea resins is under way. The plant was built on schedule, with operations in progress four months after ground was broken.

Mill Lubrication System— A contract has been awarded Dravo Corporation, Pittsburgh, for a custom-designed mill lubrication system to be installed on the Minton vacuum dryer section of a new pulp mill for British Columbia Forest Products Ltd. at Crofton on Vancouver Island, B.C. Dravo was given the order by Dominion Engineering Co. Ltd., of Montreal designers and builders of the 178-inch pulp machine which will be equipped with a Minton dryer. The lubrication system will have a metered flow of 115 U.S. gallons per minute of 900 SSU oil at 100 deg. F.

Surface Grinders— Atlas Copco Canada Ltd. has announced two new air-powered surface grinders—the 6 lb. LSS 61 model developing 1.3 h.p. at 600 r.p.m. and the 12 lb. LSS 81 developing 2.6 h.p. Both machines are effective for sanding and polishing, for grinding with the new reinforced-hub wheels at surface speeds up to 15,000 feet per min. as well as for heavy work with cup wheels or wire brushes to which LSS 81 is particularly adapted. Reliability and low maintenance cost stem from extreme simplicity of design. Main housing is a single light alloy casting, while governors do not require adjusting.

New Scholarships— The setting up of six $500 scholarships and one $2,000 fellowship annually in four Canadian universities was announced recently by Walter C. Koerner, president of Alaska Pine & Cellulose Limited. Four scholarships each worth $500 will go to the University of British Columbia, one each in forestry, chemical engineering and civil engineering. One $500 scholarship will be open only to sons and daughters of Alaska Pine & Cellulose employees. One $500 scholarship in chemical engineering will go to both McGill and the University of Saskatchewan. In addition a $2,000 fellowship in graduate chemical engineering will be established at the University of Toronto with preference in this case being given to a student coming from British Columbia. All scholarships go into effect this fall.

E.I.C.
TECHNICAL PAPERS

The Institute maintains a fund for the separate publication of high-calibre original technical papers. Interest in such papers is limited to a relatively small audience of specialists in the subjects to which the papers relate, and it is not economically sound to publish them in the *Journal* which aims at the interest of some 16,000 engineers in all branches of the profession.

It is an obligation of the Institute to publish original works which contribute to the reference literature of the profession. The Technical Papers are distributed to the world's major engineering societies and technical libraries. Similarly it is an obligation of those engineers qualified to write these papers to submit them for possible inclusion in the literature. The publications committee invites authors to present such manuscripts for submission to qualified reviewers and publication if warranted. Written discussion will be accepted and published as supplements.

Technical papers issued to date are:—

No. 1—Flow in Conduits and Canals:— *French and Wood.* Comprises tables and diagrams for the solution of problems of flow in open and closed channels. Price $1.50

No. 2—A Revised Manning Flow Formula:— *Blench.* A discussion of the various hydraulic flow formulae in use or proposed. The author, formerly Director of Irrigation Research, Punjab, Pakistan, and now on the staff of the University of Alberta, concludes that the Manning formula, with modifications, is the best now available. Price $1.00

No. 3—Air Entrainment by Water in Steep Open Channels:—*Priest.* A theoretical solution of a problem of interest to hydraulic engineers $1.00

No. 4—Graphical Solution of Partial Differential Equations with Engineering Applications:—*Wood.* Solution by simple, almost automatic, methods of equations arising from the study of water hammer phenomena, impact, and other common engineering problems. This paper will be of particular value to hydraulic engineers and structural and machine designers. Price $3.00

No. 5—Economy in Rigid Frames:— *Monti.* Charts and diagrams to facilitate rapid preliminary design of the common types of rigid frames, eliminating the cut-and-try methods previously necessary before a final analysis could be attempted. This paper belongs in the library of every structural designer. Price $1.00

N.B.—Remittance with order please, payable at par in Montreal.

Index to Advertisers

The revenue derived from the sale of advertising space assists the Institute in publishing THE ENGINEERING JOURNAL on a regular monthly basis. Listed below are the names of the Companies and Individuals whose advertisements appear in this Issue.

OCTOBER, 1956

(All advertising page numbers are printed in bold type. On pages carrying both editorial and advertising matter the advertising page number is bracketed.)

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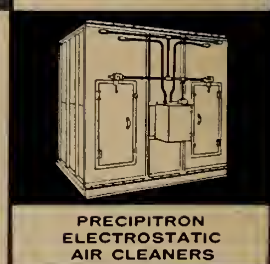

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Problems of

Development of International Rivers

on the Pacific Watershed of Canada and the United States

General A. G. L. McNaughton, M.E.I.C.

Chairman, Canadian Section, International Joint Commission

Paper presented before the Fifth World Power Conference, Vienna, Austria, 17-23 June 1956

The northern portion of the Pacific watershed of North America divides between the jurisdictions of Canada and the United States. In this region many of the more important rivers, including the Columbia and the Yukon, rise in Canada and in their course to the Pacific Ocean flow across the international boundary into United States territory. By the Boundary Waters Treaty of 1909 the riparian state is vested with exclusive jurisdiction and control over the use and diversion of all waters on its own side of the line subject only, should injury result on the other side, to the same legal remedies as if such injury took place in the country where the diversion or other interference occurs.

Not only are the flows of the rivers in question very large, but the heads which may be created by diversion amount, in several cases already investigated, to 2,000 or more feet, with consequent potentials for power development measured in terms of millions of kilowatts.

The jurisdictional, topographical and hydrological conditions and problems at issue in the watershed are indicated and the solution proposed in the Canadian portion of the basin of the Columbia is described as an example.

THE problems presented to Canada in the development of her water resources in the Pacific region are partly international under the several treaties which govern relations between Canada and the United States and partly national as between the federal, provincial and territorial authorities concerned with particular areas. Then, these external and internal jurisdictional aspects being resolved, there are great questions of engineering to be answered by the acquisition of comprehensive data in regions as yet only partially surveyed; also in the selection of projects which will not only make optimum use of resources within river basins but will also take advantage of the topography of the Pacific coast where inlets from the ocean penetrate the coastal mountain ranges into close proximity with southern, eastern and northern drainage. The great lakes and rivers, which exist in the high valleys, open up imaginative possibilities of immense storages at high altitudes and of diversions of substantial flows to be used in the large and concentrated heads available on the Pacific slope. Here, the power plants may be placed in easier access for the supply of raw material to be processed and for the despatch of finished goods to markets. The milder climate and more pleasant living conditions of the coastal region, warmed by the Japanese current, is also a very significant advantage for the residents of the many new communities which will come into existence in consequence of the power developments.

Within the restricted limits of this paper an outline of the international and national jurisdictional aspects will be given sufficient to show the wide choice of action which is open to Canada in the particular Treaty and legal situation which exists and which, with recent legislation, has now been firmly gripped by the Parliament and Government of Canada for the Canadian people.

Space does not permit detailed description of the multiplicity of projects which are under investigation and study in various stages. However, data for the several river systems sufficient to indicate the order of magnitude of the possibilities will be included.

The possible projects in the Columbia system including diversion into the Fraser will be described in general outline. The studies of these particular projects are at present well advanced but the descriptions given are subject to verification in details when reports are received on the field investigations currently in progress.

International Boundaries

Figure 1 is an outline map of the Pacific watershed of Canada and the United States showing the international, provincial and territorial boundaries in the south, in the west, and in the north. The principal drainage basins and their rivers and important tributaries are also depicted. In this region sovereignty is

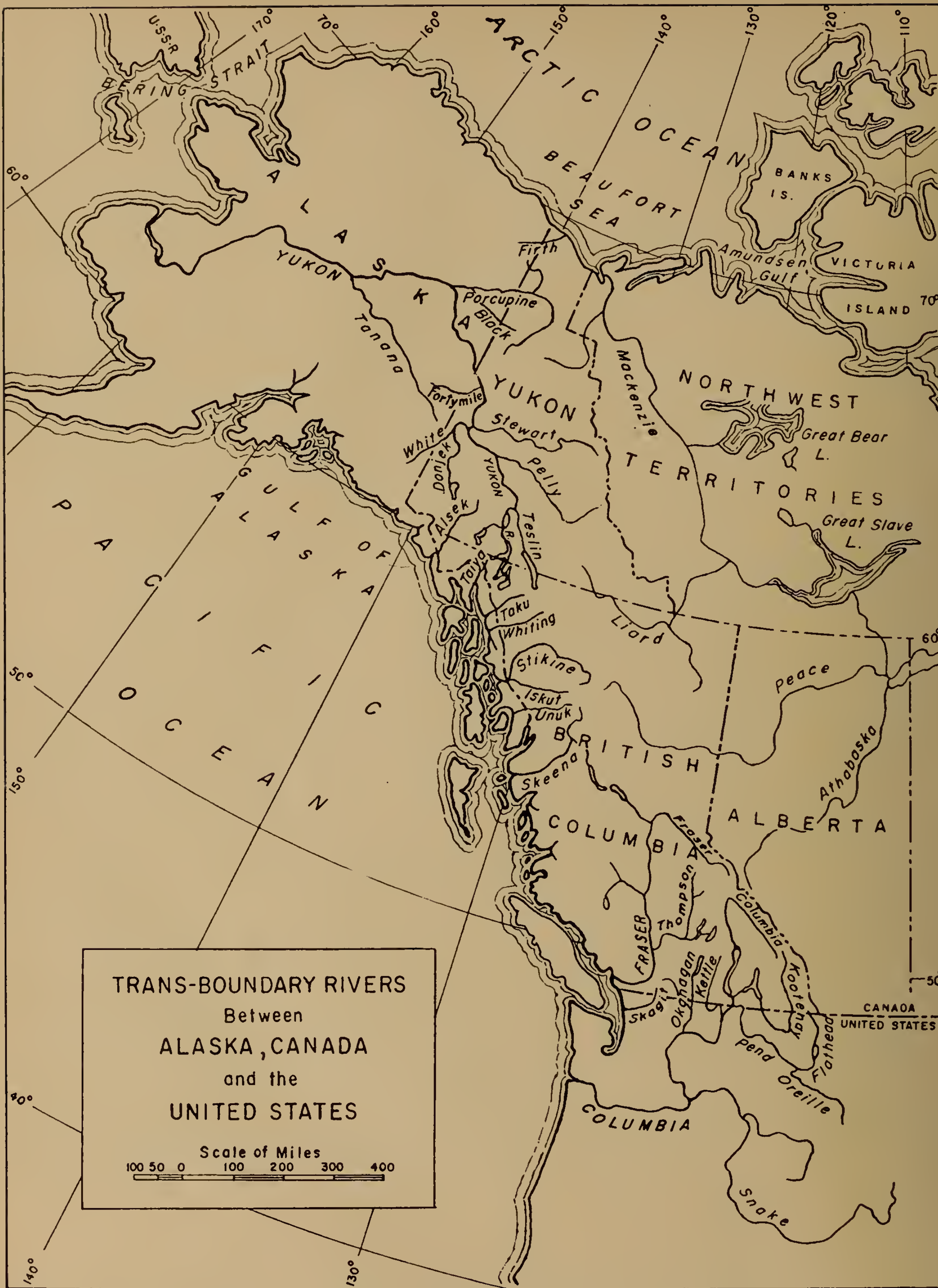


Fig. 1. Outline map of the Pacific watershed of Canada and the United States, showing the trans-boundary rivers between Alaska, Canada, and the United States.

divided between Canada and the United States as follows:

In the south by the 49th parallel of north latitude; on the west, along the Alaska panhandle, by a line following the summits of mountains some ten marine leagues back from the ocean, including the principal fiords extending inland therefrom, until the 141st degree of west longitude is reached; thence the boundary follows this line north to "la mer glaciale".

In every case along these boundaries the rivers which are of international concern flow from one country to the other *across* the boundary.

Treaty Provisions in Respect to Jurisdiction over Waters Flowing Across the Boundary

The international provisions for jurisdiction and control of such waters are contained in the following articles of the "Treaty between His Majesty and the United States of America relating to Boundary Waters, and questions arising along the boundary between the United States and Canada", signed at Washington, 11 January, 1909.

Article II — "Each . . . reserves . . . exclusive jurisdiction and control over the use and diversion . . . of all waters on its own side . . . but . . . any interference with or diversion from their natural channel . . . resulting in any injury . . . shall give rise to the same rights and entitle . . . to the same legal remedies as if such injury took place in the country where such diversions or interference occurs . . .; neither . . . surrender any right, which it may have, to object to any interference with or diversions of . . . productive of material injury to the navigation interests on its own side . . ."

The Parliament of Canada in approving the Treaty of 1909 vested the Exchequer Court of Canada with "jurisdiction . . . in all cases in which it is sought to enforce or determine as against any person any right or obligation arising or claimed under or by virtue of this Act".

Article IV — "The High Contracting Parties agree . . . not permit the construction or maintenance . . . dams or other obstruction . . . or in waters at a lower level than the boundary *in rivers flowing across the boundary, the effect of which is to raise the natural level of waters on the other side* . . . unless . . . approved by . . . the International Joint Commission."

Article VIII — ". . . In cases involving the elevation of the natural level of waters on either side of the line as a result of . . . obstructions . . . or in waters below the boundary *in rivers flowing across the boundary*, the Commission shall require . . . protection and indemnity of all interests *on the other side* of the line which may be injured thereby."

The Treaty of 1909 contemplates that matters other than those in which jurisdiction has been vested in the International Joint Commission may be arranged by "special agreement between the parties". (Article III and Article IV.)

Article IX — ". . . any other questions or matters of difference . . . along the common frontier . . . shall be referred . . . to the International Joint Commission . . . to examine into and report upon the facts . . . together with such conclusions and recommendations . . . subject, however, to any restrictions or exceptions which may be imposed . . . by the terms of reference."

On occasion the Commission's recommendations in references under Article IX have included a request for the approval by the Governments of particular provisions for further action beyond the authority specifically vested in the Commission by the Treaty in order that the Commission might undertake to solve particular difficulties or matters of difference. And, when these recommendations have been approved, the powers of the Commission have been enlarged accordingly.

By such procedures a measure of flexibility is given to meet conditions which could not have been fully foreseen or provided for specifically in the Treaty itself.

Jurisdiction over waters flowing from within to without Canada

In the session of 1955 the Parliament of Canada enacted "the International Rivers Improvements Act", which states that an "international river" is "water flowing from any place in Canada to any place outside Canada" and that "an international river improvement" is:

"a dam, obstruction, canal, reservoir or other work, the purpose or effect of which is:

(i) to increase, decrease or alter the natural flow of an International River, and,

(ii) to interefere with, alter or affect the actual or potential use of the International River outside Canada".

By this Act, Parliament has given precision to powers over water which flows from within Canada to without Canada which are implicit to the Federal Government in the terms of the British North America Act which accomplished Confederation in 1867.

For the future, any "International River Improvement" will require a permit from the Federal Government. Similarly the export of electricity generated in Canada has for many years been controlled by the requirement for a permit from the Federal Government which is only issuable or renewable for a single year at a time.

The Sovereign Right to Divert

It will be noted that the basic concept of international water law in "rivers flowing across the boundary" which is defined in Article II of the Treaty of 1909, quoted above, is in sharp difference to the riparian law under which a person on the banks of a stream has the right to have its water come to him "undiminished and undefiled" and he has an obligation to permit it to pass downstream in like volume of flow and freedom from pollution.

The only restrictions on the absolute sovereign power of a state given by Article II of the Treaty of 1909 to divert water, within its territory which in its natural channels would flow across the boundary, is the somewhat unique provision which has been added to this clause requiring the national authority itself to provide the means whereby, if anyone in the other country is injured, he may seek redress in the law courts of the upstream country where the diversion or interference occurs.

In the Pacific watershed, Canada, in almost all cases where major possibilities of diversion exist, is the upstream state; and in consequence, in this region of immense potentialities, Canada for the first time in the history of her relations with the United States over the use of water becomes the beneficiary of the sovereign powers of diversion prescribed in Article II of the Treaty of 1909.

It is important to recall that this Article was included in the Treaty on the insistence of the United States Secretary of State, Elihu Root, as a matter of fundamental United States policy, and as an inescapable requirement for any agreement. Since that time representatives of the Unit-

Table I — Pacific Watershed of North America. The Principal Waters Flowing Across the Boundary Between Canada and United States

Section of Watershed		River or Tributary	Direction of Flow From	Direction of Flow To	Included In	Crossing Boundary at/near	Elev. above M.S.L. Feet	Flow (Recorded) Min. C.F.S.	Max. C.F.S.	Mean Annual C.F.S.	Mean Annual 1000 Acre-feet	Period of Record Years*
Southern boundary of British Columbia with States of Montana, Idaho and Washington. Streams in order east to west	1	Flathead	B.C.	Montana	4	Flathead, B.C.	3970	65	14,600	1,030	746(a)	20
	2	Kootenay	B.C.	Montana	3	Newgate, B.C.	2309	994	98,200	9,570	6,925	18
	3	Kootenay	Idaho	B.C.	5	Port Hill, Idaho	1743	1,380	125,000	14,560	10,540	20
	4	Pend d'Oreille	Wash.	B.C.	5	Nelway, B.C.	1720	2,500	171,000	25,580	18,520	36
	5	Columbia	B.C.	Wash.		Trail, B.C.	1292	21,200	548,600	90,560	65,560	10
	6	Kettle River	B.C.	Wash.		Midway, B.C.	1466	60(b)	35,000	2,692	1,949	19
	7	Kettle R.	Wash.	B.C.	6	Grand Forks B.C.		.				
	8	Kettle R.	B.C.	Wash.	7	Cascade, B.C.	1890	14	21,000	1,384	1,002	20
	9	Okanagan	B.C.	Wash.		Osoyoos, B.C.	913	4.6	2,680	470	340	34(c)
	10	Similkameen	B.C.	Wash.		Keremeos, B.C.	1180	120	38,100	2,054	1,487	20(d)
	11	Skagit	B.C.	Wash.		——	1583	81	10,200(e)	913	661	22
Western boundary of British Columbia with Alaska Panhandle. Streams in order south to north	1	Unuk	B.C.	Alaska		Revillagigedo Is.	300(i)				1,200(j)	
	2	Stikine	B.C.	Alaska		Wrangell, Alaska	50(i)				28,000(j)	
	3	Whiting	B.C.	Alaska		Admiralty Island, Alaska	150(i)				2,200(j)	
	4	Taku(f)	B.C.	Alaska		Juneau, Alaska	40(i)	1020	34,600		11,000(a)	2(h)
	5	Alsec	B.C.	Alaska		Dry Bay	250(i)				4,700(j)	
Western boundary Yukon Territory with Alaska. Streams in order south to north	1	White	Alaska	Y.T.		Snag, Y.T.	2900(i)				690(j)	
	2	Fortymile	Alaska	Y.T.		Forty Mile Y.T.	1100(i)				1,670(j)	
	3	Yukon	Y.T.	Alaska		Forty Mile	850(i)	6350	279,000	73,000	52,850	8(g)
	4	Black	Alaska	Y.T.			1100(i)				740(j)	
	5	Porcupine	Alaska	Y.T.		Old Crow Y.T.	750(i)				8,400(j)	
	6	Firth	Alaska	Y.T.			1650(i)				150(j)	

* Terminal year is 1948 unless otherwise noted.

(a) Records generally available during ice free periods only.

(b) Minimum recorded at Cascade, B.C.

(c) Discharge records from Okanagan Falls, B.C.

(d) Discharge records from Nighthawk, Wash.

(e) Maximum recorded in 1950.

(f) Route of diversion of Yukon River through Atlin Lake — proposed by Frobisher.

(g) Terminal year 1952.

(h) Terminal year 1954.

(i) Elevations estimated from International Boundary Commission Reports.

(j) Annual run-offs estimated on the basis of drainage area and discharge per square mile.

ed States have quoted this Article, in cases where that country has been the upstream state, to the disadvantage of Canada and in the result an extensive body of precedent has become established through argument presented to the International Joint Commission principally by learned counsel for the United States and for various States of the Union. Analysis of these presentations shows, with reasonable clearness, the position which has been maintained consistently by the United States both as regards their claim to absolute right to make diversions in their territory and perhaps even more importantly what would and what would not, in their view, constitute an injury to parties in the country below the boundary which would entitle those parties to legal remedy.

It is perhaps needless to say that the position indicated in the following paragraphs is entirely consistent with the practice which has been urged by the United States in like circumstance.

International Rivers in the Pacific Watershed of Canada and the United States

In Table I, the "International Rivers", shown on Fig. 1, are listed and the place of crossing the boundary is given together with the elevation above mean sea level and the flow at that point so far as available data permits.

These waters originate mostly in the higher altitudes from the melting of snow and ice and the precipitation of moisture laden clouds sweeping in from the Pacific. Since remote ages, the rivers have kept their passage open to the sea by continued erosion of the mountain barriers as these have been pushed up by geological action. And in the result, the upper river courses run in rapids and falls through deep narrow valleys cut in the rock where conditions favour the construction of dams. In contrast, in the lower and often in the middle reaches, the valleys are sedimentary and are usually wide with long traverses of gradual slope. Here the concentration of head for at-site power development presents difficulties. On the other hand, immense potentialities for useful development are presented by the close proximity of the upper basins of some of the rivers in Canada to the fiords extending at near sea level well into the hinterland. Waters from the upper basins, it has been found, can often be diverted by comparatively short and moderately priced tunnels through the "divide", enabling the flows to be brought to places where very large heads can be concentrated. These favourable topographical conditions open the way to an advantageous use of water in the development of power which in many cases would not otherwise be possible — at least with like efficiency.

In this paper, all that can be undertaken is to give, as an example of the possibilities, a general description of the plans which are contemplated for the rearrangement, to the greater advantage of Canada, of the flows of the Upper Kootenay River into the Columbia River at the source of the latter, and the further diversion of the combined flows of the upper waters of these rivers into the Fraser which, from its source to its outlet into the Straits of Georgia near Vancouver, British Columbia, is a wholly Canadian river.

Another example of a similar rearrangement of flows now under consideration is the reversal of the direction of flow of the upper Yukon River and its diversion together with that of certain of its tributaries into the Atlin Lakes from which the waters will be taken by a series of tunnels into the valley of the Taku. Space does not permit a discussion of this project in this paper.

Canadian Studies in the Rearrangement of Flows

Figure 2 is an outline map of the Columbia Basin showing the location of the principal dams, power plants and reservoirs, built or planned, both in the upper basin in Canada and downstream in the United States; the adjacent basin of the Fraser and the routes of diversion thereto, which are under study; and other additional information which could not be shown on Fig. 1. Table II gives the elevation, head, mean annual flow, and installed capacity, existing or planned, at various sites in Canada and the United States, on the Kootenay, the Pend Oreille and the Columbia as far downstream as Grand Coulee Dam and tributaries thereto.

Reservoir capacity, existing or planned, is given in m.a.f. (million acre-feet, or 1.233×10^9 cubic metres) of storage usable for annual or cyclic release as the case may be.

The Columbia River rises in Columbia Lake, flows north-northwest to its junction with Canoe River at the Big Bend; thence south past Mica Creek, Revelstoke and through the Arrow Lakes; thence past Castlegar and Trail to cross the international boundary and enter Franklin D. Roosevelt Lake, the reservoir created by Grand Coulee Dam.

Figure 2 shows also the Kootenay River which rises on the high slopes of the Rocky Mountains, near the Continental Divide, which constitutes the Alberta-British Columbia boundary; flows southward to the near proximity of Columbia Lake which it passes at about the same altitude, and thence continues to cross into the State of Montana at Newgate, British Columbia.

In the United States the Kootenai* flows in a great loop through the northern parts of the States of Montana and Idaho and re-enters Canada just north of Porthill, Idaho. In this traverse, the Kootenay falls from approximately elevation 2309 feet (703.8 metres) to elevation 1743 feet (531.3 m.) — a total of about 566 feet (172.5 m.), of which it seems 194 feet (59.1 m.) at Libby and 263 feet (80.2 m.) at Katka, a total of 457 feet (139.3 m.), might be capable of development.

After entering British Columbia, the Kootenay flows into Kootenay Lake and along its west arm past Nelson and thence through the six power plants there situated, falling a total of some 360 feet (109.7 m.) to its junction with the Columbia near Castlegar, British Columbia. The hydraulic capacity of the power plants on the lower Kootenay is 13,500 c.f.s. (382 cubic metres per second) which is only about half the mean annual flow as will be seen from Table II. To use more water than this would require an expensive redevelopment not considered economically justifiable in the Canadian interest.

Another important tributary to the Columbia, the Pend Oreille, enters Canada from the south, near Nelway, British Columbia, flows for some 16½ miles (26.5 km.) westward just north of the boundary, falling a total of approximately 426 feet (129.8 m.) to its mouth. At Waneta, the lower of two power sites of similar potentialities, about 216 feet (65.8 m.) of head has been developed and the power plant partly equipped with turbines and generators.

Below Waneta the Pend Oreille joins the Columbia about one-half mile north of the international boundary.

To complement this information, the profile given in Fig. 3 shows the height of the water surface above mean sea level along the Columbia and Kootenay and also by way of the contemplated Columbia-Fraser diversion near Revelstoke and along the South Thompson and the Thompson to its junction with the Fraser at Lytton, and thence along the Fraser to the vicinity of Hope, British Columbia, at an elevation of approximately 100 feet (30.5 m.).

The bar graph in Fig. 4 gives the mean annual flows naturally occurring at representative points, both in c.f.s. and m.a.f. and as these would be rearranged by the possible diversions to be discussed later.

The Canadian Plan

Briefly, the Canadian plan for the most effective possible use, within Canada, of the flows of the Kootenay and Columbia, envisages the construction of a dam on the Kootenay River above the Bull River to elevation 2710 feet (826 m.) which will cause the Upper Kootenay to flow across the low divide at Canal Flats, into Columbia Lake. On the Columbia at Luxor, below Lake Windemere, another dam with similar top elevation will be built and will complete the Bull River-Luxor Reservoir, which will have a usable annual capacity of some 3.4 m.a.f. (4.2×10^9 cu.m). The contemplated diversion from the Kootenay above the

* Spelt Kootenay in Canada and Kootenai in the United States.

Table II. Particulars of Dams, Reservoirs, and Power Plants, existing and planned on the Kootenay, the Pend d'Oreille and the Columbia downstream to Grand Coulee Dam and tributaries thereto.

River	Site	Elevation feet m.s.l.	Head feet	Mean annual flow c.f.s.	Storage m.a.f.	Installed capacity	Remarks
Kootenay	Canada			(no diversion)		kw.	* No diversion to Columbia
	Bull River	2665 *	210	5640 (approx.)	2.92	285,000	
	Dorr	2415	43	9170 (approx).	Pondage only	100,000	
	International boundary	2309		9570			
Kootenai	U.S.A.						* Period of record 1928 - 1942
	Libby ка			10900 *			
	International boundary	1743		14,560			
Duncan Lake	Canada Howser	1835		3,950 *	1.0		* Sum of flows of Duncan River at Howser and Lardeau River at Gerrard
West Kootenay	**Kootenay Lake**	1739.32 * to 1745.32			0.75		* Limits of present 6 ft. storage. Additional 3 ft. of storage or 0.37 m.a.f. possible.
	Corra Linn		360 (approx.)		Pondage only	276,500	
	Upper Bonnington				"		
	Lower Bonnington				"		
	South Slocan				"		
	Brilliant			27,900 *	"		* Records from station at Glade, B.C. 1913 - 1944
	Junction with Columbia	1385					
Columbia	Canada (Bull River)	2710 *	210				* Bull River - Luxor Reservoir
	Luxor	2710 *	90	2,000 * (approx.)	3.4	47,000	* Bull River - Luxor Reservoir
	Donald Canyon	2554	114		Pondage only	135,000	
	Mica	2435	563	20,000 *	11.8	‡ 1,320,000	* Period of record 1947 to 1952
	Priest	1865	255	30,900 *	Pondage only	‡ 780,000	* Flow for Columbia River at Revelstoke, B.C.
	Little Dalles	1610	145	30,900 *	Pondage only	‡ 420,000	
	Murphy Creek	1402	60	69,200 *	4.0	250,000	* Flow for Columbia River at Birchbank B.C.
Pend d'Oreille	Canada						
	Boundary	1720					
	Six mile	1720	210		Pondage only	360,000	
	Waneta	1510	216		Pondage only	360,000 *	* 180,000 kw. at present installed
	Junction with Columbia	1294		25,580			
Columbia	Boundary United States	1292		90,560			
Spokane and others					2.98		
Columbia	**Grand Coulee**	1288	348		5.1	1,944,000	

NOTE: Existing plants and reservoirs in bold face.
Mean annual flows for period of record—No diversions assumed.
Terminal date 1948 unless otherwise noted.
‡ Installed capacity based on mean flow of Columbia supplemented by 5000 c.f.s. mean flow diverted from Kootenay.

Bull River expressed as mean annual flow is planned as approximately 5,000 c.f.s. (142 cu.m./sec.).

The dam at Bull River may be equipped with motors and pumps by means of which it would be possible to raise an additional 3,000 c.f.s. (85 cu.m./sec.) of water, derived from the Bull and the Elk Rivers, to the Luxor-Bull River reservoir from a pool to be created by a dam at Dorr. The factor of energy gain to Canada in bringing this water into the Bull River-Luxor reservoir at elevation 2710 feet (826 m.) for use in the Columbia and Fraser in conditions of full development would compensate several times over for the use of this water otherwise possible at the Dorr Dam, 43 feet (13.1 m.), and on the Lower Kootenay, 360 feet (109.7 m.).

The waters of the Bull River-Luxor reservoir, including a mean annual flow of 5,000 c.f.s. (142 cu.m./sec.) from the Kootenay, after use through power plants at Luxor (47,000 kw.) and Donald Canyon (135,000 kw.), will flow into the Mica reservoir at elevation 2435 feet (742.2 m.). In this reservoir the usable annual capacity contemplated is 11.8 m.a.f. (14.5 x 10^9 cu. m.) at 35 per cent drawdown. The average effective head at Mica will be 563 feet (171.6 m.) and the installed capacity 1,320,000 kw.

From the tailrace of the Mica power plant, the water will flow through a run-of-river plant at Priest Rapids with 780,000 kw. installed; thence into a pool to be created by a dam at the Little Dalles. From the Little Dalles pool at elevation 1610 feet (490.7 m.), a gravity tunnel will connect to Griffin Lake in the western slope of Eagle Pass, presently at an elevation of approximately 1490 feet (454.2 m.), raising it to approximately 1507 feet (459.3 m.) and utilizing it as a stilling basin and forebay for the envisioned power plant. The tunnel required for this project may possibly be some 16 or 17 miles (25.7 to 27.4 km.) in length.

On the South Thompson, the Thompson, and the Fraser, the head which might be utilized is at present the subject of investigation. For the purpose of preliminary studies, 1,000 feet (304.8 m.) of the 1610 feet (490.7 metres) elevation at the Little Dalles pool has been taken as an estimate of early possibilities.

Figure 5 gives hydrographs showing the mean monthly flows at a few representative points along the Kootenay, the Columbia, the Thompson, and Fraser Rivers respectively. Plots for high and low, as well as mean flows are given and also, on a separate graph on the right, the mean annual flow for each year of record to illustrate the very wide variation which occurs from year to year as well as from month to month.

This information emphasizes the great importance of storage, both annual and cyclic, as an essential facility in any comprehensive scheme for the economical development of rivers which depend primarily, as do the Columbia and Fraser systems, on ice melt.

Included on Fig. 5 (see D and E), superimposed on the hydrographs of the Thompson at Spences Bridge and of the Fraser at Hope, are lines showing the regulated flow which can be obtained in the low water period at these places from the addition of 15 m.a.f. (18.5 x 10^9 cub. m.) and 10 m.a.f. (12.3 x 10^9 cu. m.) respectively, of Columbia water.

It will be noted that with an added flow of 15 m.a.f. (18.5 x 10^9 cu. m.) the minimum dependable flows for the low water months have been increased, at Spences Bridge from about 4,500 c.f.s. (127 cu. m./sec.) to 42,000 c.f.s. (1,190 cu. m./sec.), and at Hope from about 17,000 c.f.s. (481 cu.m./sec.) to 60,000

Fig. 2. The northern portion of the Columbia River basin, showing developed, possible, and potential dam sites.

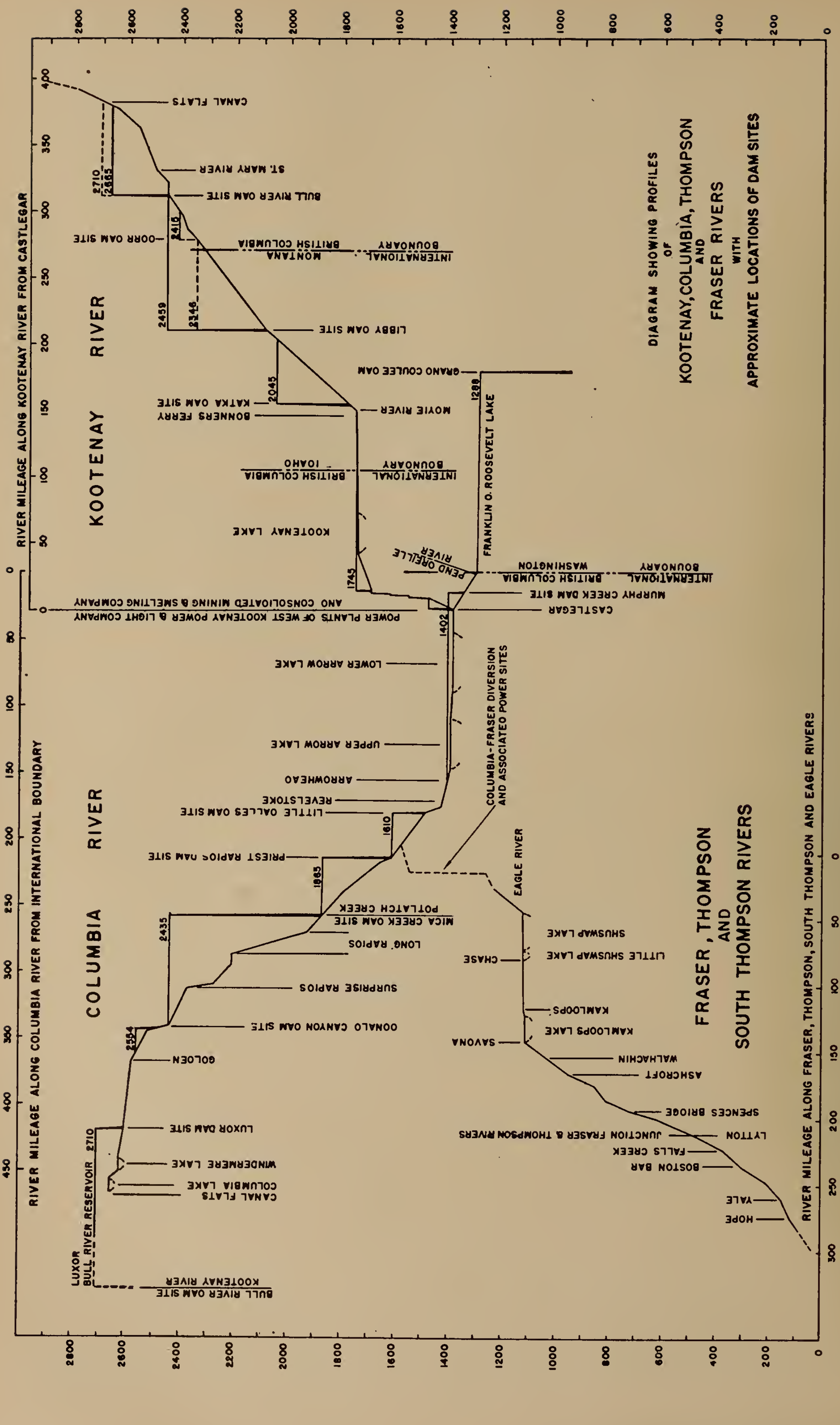


Fig. 3. Profile showing height of water surface above mean sea level along the Columbia and Kootenay, and also by way of the contemplated Columbia-Fraser diversion.

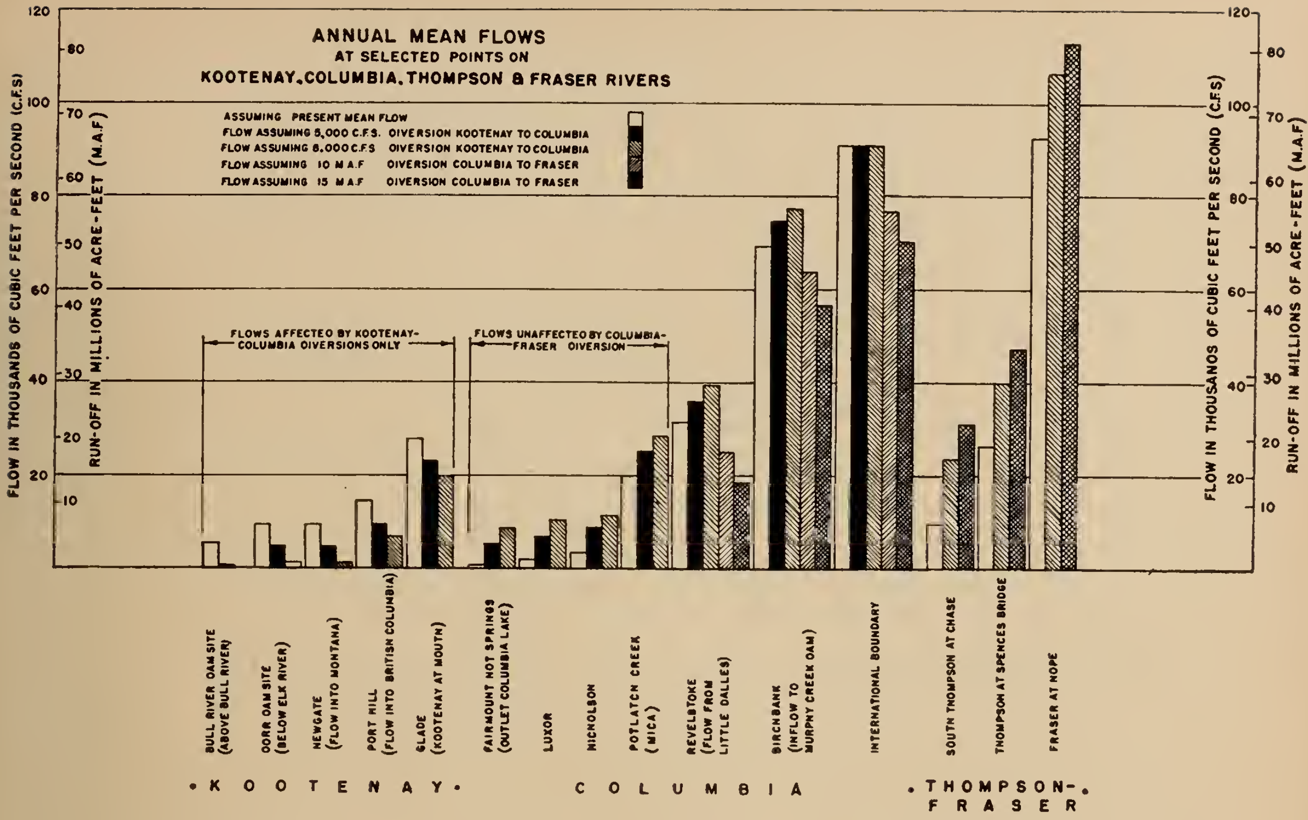


Fig. 4. Annual mean flows at selected points on the Kootenay, Columbia, Thompson, and Fraser Rivers.

c.f.s. (1,700 cu.m./sec.), that is, by a factor of more than 9.0 in the Thompson and of about 3.5 far down the Fraser.

This very desirable result opens the way to a development of the Thompson and the Fraser below Lytton at a reasonable cost; otherwise it is unlikely that hydro-electric development of these rivers could be undertaken at all for the reason that up to this time Canada has given primary consideration to the Fraser basin for the propagation of salmon. As matters stand on the Fraser River system it is not possible to store any considerable volume of water by raising the level of the lakes or creating new reservoirs by the construction of high dams which might interfere with the upstream migrations of salmon and their spawning and the growth and downstream passage of the young fish.

It is to be noted from these same hydrographs on Fig. 5 that the water diverted from the Columbia to the Fraser system will be added to coincide with the season of low flow, October through the following April only; in consequence the present serious flood problem on the lower Fraser will not be aggravated. Salmon migrations upstream to spawn and downstream to the sea occur in the natural high water seasons only, and so will not be affected by the diversions.

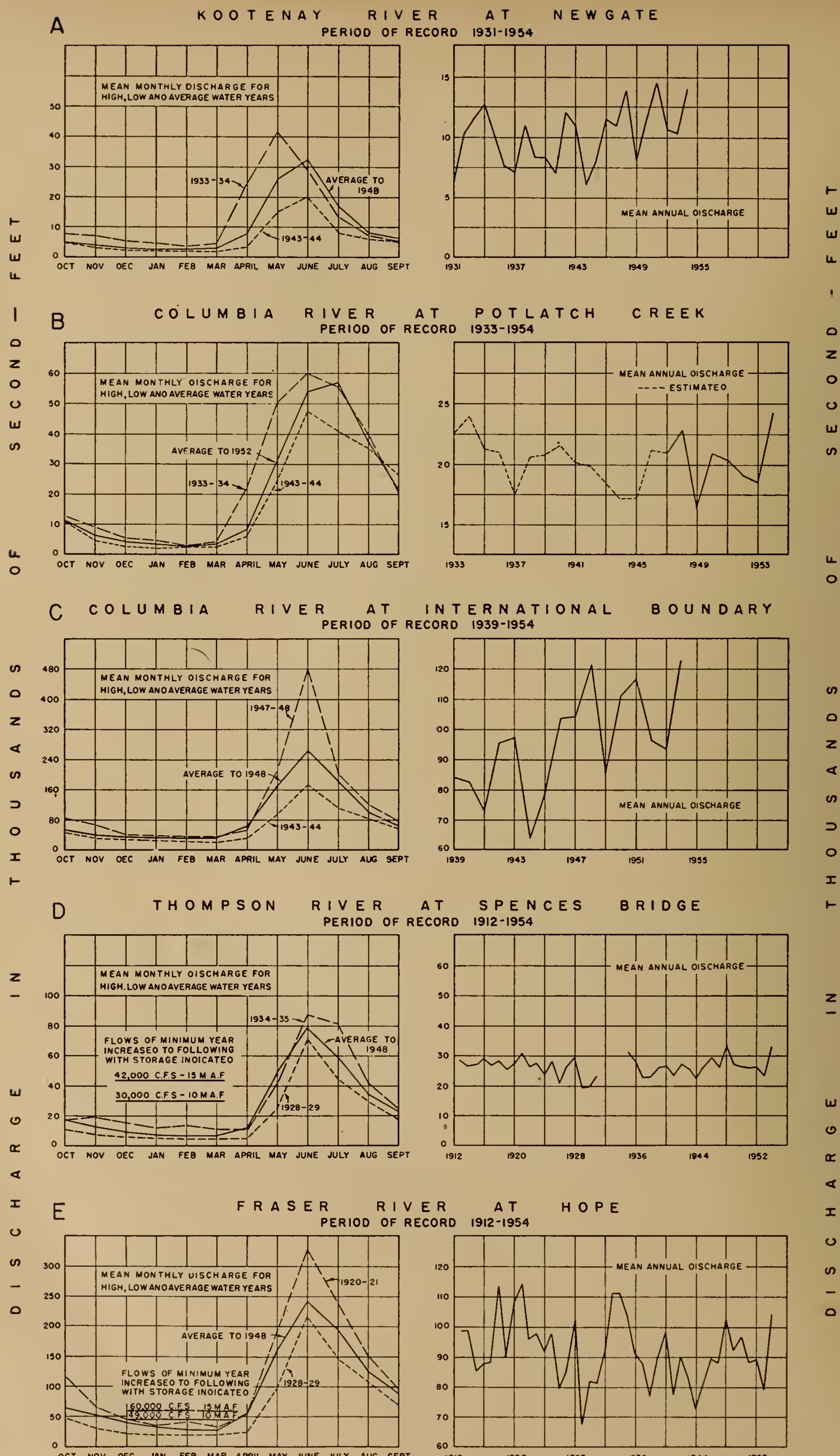
Until the field investigations in progress have been completed and the results studied, it will not, of course, be possible to give a precise estimate of the power capabilities of the South Thompson, the Thompson and the Fraser below Lytton, which may be made practicable for development by the diversion from the Columbia.

On the conservative assumption of a developed head of 1,000 feet (304.8 m.) below the Little Dalles pool, the energy generated from the 15 m.a.f. (18.5 x 10^9 cu.m.) to be transferred from the Columbia will be some 13 billion kwh. annually, for winter use in the regulation of peak loads. It seems that this will make economically possible the use of Fraser basin flows in the generation of at least three times this amount of energy in addition. That is, the power plants on the Thompson and the Fraser below Lytton will probably have an installed capacity in excess of 4.5 million kw. From this gain in power potential on the Fraser, there should be deducted 225,000 kw. approximately from the Little Dalles and 80,000 kw. approximately at Murphy Creek on the Columbia, because of the reduction in flows at these sites by reason of the diversion.

The figures given for the Fraser system development do not take into account the possibilities which may open in the future, either for the storage of water in the system itself, or of the large powers which may be developed on the Fraser itself above Lytton as and when the problems connected with the migration of the salmon are solved and the construction of high dams and reservoirs comes to be permitted.

If the regulated flows from Mica Creek reservoir, in the amount of 15 m.a.f. (18.5 x 10^9 cu.m.), were permitted to flow down the Columbia from the Little Dalles pool, the power plant there would probably have an installed capacity of 420,000 kw. and below the Arrow Lakes, at Murphy Creek, the installed capacity would be about 250,000 kw. After passing these projects the water would flow across the international boundary into Franklin D. Roosevelt Lake for use at Grand Coulee and the plants existing, being or to be built downstream.

When all the contemplated plants



DISCHARGE IN THOUSANDS OF SECOND - FEET
A
KOOTENAY RIVER AT NEWGATE
PERIOD OF RECORD 1931-1954
MEAN MONTHLY DISCHARGE FOR HIGH, LOW AND AVERAGE WATER YEARS
1933-34
AVERAGE TO 1948
1943-44
MEAN ANNUAL DISCHARGE
B
COLUMBIA RIVER AT POTLATCH CREEK
PERIOD OF RECORD 1933-1954
MEAN MONTHLY DISCHARGE FOR HIGH, LOW AND AVERAGE WATER YEARS
AVERAGE TO 1952
1933-34
1943-44
MEAN ANNUAL DISCHARGE
---- ESTIMATED
C
COLUMBIA RIVER AT INTERNATIONAL BOUNDARY
PERIOD OF RECORD 1939-1954
MEAN MONTHLY DISCHARGE FOR HIGH, LOW AND AVERAGE WATER YEARS
1947-48
AVERAGE TO 1948
1943-44
MEAN ANNUAL DISCHARGE
D
THOMPSON RIVER AT SPENCES BRIDGE
PERIOD OF RECORD 1912-1954
MEAN MONTHLY DISCHARGE FOR HIGH, LOW AND AVERAGE WATER YEARS
1934-35
AVERAGE TO 1948
FLOWS OF MINIMUM YEAR INCREASED TO FOLLOWING WITH STORAGE INDICATED
42,000 C.F.S - 15 M.A.F
30,000 C.F.S - 10 M.A.F
1928-29
MEAN ANNUAL DISCHARGE
E
FRASER RIVER AT HOPE
PERIOD OF RECORD 1912-1954
MEAN MONTHLY DISCHARGE FOR HIGH, LOW AND AVERAGE WATER YEARS
1920-21
AVERAGE TO 1948
FLOWS OF MINIMUM YEAR INCREASED TO FOLLOWING WITH STORAGE INDICATED
160,000 C.F.S. 15 M.A.F
149,000 C.F.S. 10 M.A.F
1928-29
MEAN ANNUAL DISCHARGE
OCT NOV DEC JAN FEB MAR APRIL MAY JUNE JULY AUG SEPT

on the main stem of the Columbia in the U.S.A. have been completed the total U.S. head will approximate 1200 feet (365.8 m.). With this head and the regulated flow permitted by the use of the 11.8 m.a.f. (14.5×10^9 cu.m.) of stored water from the Mica reservoir together with the additional 3.4 m.a.f. (4.2×10^9 cu.m.) from the Bull River-Luxor reservoir an additional 15 billion kwh. of electric energy could be generated to supply winter peak loads through the use of turbines and generators in the then existing plants. Much of this equipment would otherwise be idle because of low flows. In the absence of the regulated flow from Mica and Bull River-Luxor reservoirs to help carry on-peak loads, the alternative open to the downstream interests, until they can develop a like amount of storage, is the construction of thermal generation at costs now running to 7 mills* and more per kwh. when used intermittently. These costs are unlikely to fall below 5 mills even for the most modern thermal plants operating semi-continuously on base load.

For comparison, the present contract price in the Bonneville Administration, an almost solely hydro-electric system in the northwestern United States, is $17.50 per kw. year, which is equivalent to 2.0 mills per kwh.

An offer has been made by Canada to discuss the question of allowing the flows of regulated water from Mica and Bull River-Luxor reservoirs to continue for a relatively short period, at the end of which time it is expected that the additional water, largely conserved from the flood flows, would be fully needed for power development in the Fraser system. This would result in substantial assistance to the United States power entities in bridging the forthcoming period of serious shortages which are developing due to the very rapid load growth taking place in the States of the Pacific Northwest.

Canada has offered to discuss also the raising of the water level of the Columbia River at the international boundary some 42 feet (12.8 m.), flooding back into Canada to the foot of the proposed Murphy Creek dam. This 42 feet (12.8 m.) might be added to the height of Grand Coulee Dam, increasing the output of existing turbines and generators by some 230,000 kw. and adding 3.3 million acre-feet (4.1×10^9 cu.m.) to the storage capacity of the reservoir behind the dam.

A similar suggestion has been made in respect to 37 feet (11.3 m.) on the Kootenay River beween the Dorr site and the international boundary which might be added to the height otherwise fixed for the proposed power dam at Libby, Montana.

A further measure of assistance which has been offered for discussion is the cyclic use of the possible 4 million acre-feet (4.9×10^9 cu.m.) of storage at Murphy Creek, which would be of particular value to United States plants in years of extreme low flows.

In all these cases Canada will no doubt require from the United States due recompense for natural resources used in the various projects and for services rendered.

The investigation of the upper basins in Canada of rivers which traverse the Alaska Panhandle and the Yukon-Alaska boundary is being proceeded with as available resources and staff permit. In addition to the diversion of the Yukon to the Taku already mentioned there are indications of immense further possibilities on the Stikine, for example, and probably elsewhere as well. However, with the limited information at present available these potentialities cannot yet be assessed either as to the amount of power to be produced or as to the preferred locations for development.

* 1 mill is equivalent to 0.1 cent.

Fig. 5. Hydrographs showing mean monthly flows at representative points along the Kootenay, Columbia, Thompson, and Fraser Rivers.

Editorial Comment

A recent issue of *The Financial Post* has placed the spotlight on the crux of the Columbia River waterpower situation in these clear paragraphs:

"British Columbia can become the future industrial empire of the North American West. It can become the only now-settled area of North America with plentiful reserves of really cheap power. It can enjoy for decades to come all the advantages of owning great blocks of cheap power at a time when the rest of the continent is paying steeply rising power costs.

This is the foreseeable outlook for British Columbia. Only two things could upset it:

• If atomic power becomes available—by some unforeseen new discovery—at no more than about three mills per kwh. within about 25 years. No atomic expert has yet prophesied anything like this.

• If Canadian politicians barter away B.C.'s power heritage for the sort of quick return that always appeals to politicians—or to avoid unpleasantness with the United States —or for any other of the reasons that politicians like."

As *The Engineering Journal* has endeavoured to point out on previous occasions, and as informed members of the Institute believe, the second "upset" described above need not happen—and indeed must not ever occur. Our case in the forthcoming negotiations will be in capable and experienced hands. The Canadian Section of the International Joint Commission, under General McNaughton's leadership, needs only our full and outspoken support. They can handle the rest of the job.

It can no longer be any secret that heavy pressures are being brought to bear on the American officials who are charged with these responsibilities. This is obvious to any one following the press accounts these days, and we can sympathize with these men. We would not like to be in their shoes. Ottawa reports indicate that these pressures are even spilling over into Canada.

If calm judgment can prevail through the end of these talks, and it usually does in our important relations with the United States, two basic points will have been established. The *Journal* hopes that it will be useful to state them now:

1. There is not the slightest doubt that Canadian development will ultimately need all of this flood water.
2. If the U.S. authorities will take time to examine the Canadian proposals in detail, they will learn that our plans will actually work out to their own advantage.

Water, Steam, and Refrigeration for a Modern Brewery

R. E. J. Layton, M.E.I.C.

Chief Mechanical Engineer, T. Pringle & Son Limited

Read at the 70th Annual General and Professional Meeting of the Engineering Institute of Canada, Montreal, May 1956

REPORTS of growth and development in Canadian industry are not uncommon today. It is natural that, as we expand our known boundaries, extend our use of raw materials, increase our numbers and develop our personal and national resources, new ideas and operations will be found.

Perhaps typical is the expansion programme of the brewing industry with new plants and building extensions being constructed in all parts of the country. One most recent example is the self-contained brewery built by John Labatt Ltd. in Ville LaSalle, P.Q., close to the city limits of Montreal.

Differing from the average industrial plant, a brewery requires services which must meet the simultaneous demands of process and building. Quality, quantity, cost, and reliability of operation and control are all factors to be considered in the selection and application of the water, steam, refrigeration and drainage services.

In this paper, it is proposed to review design factors and to describe resulting applications as found in the company's new brewery.

General Description

This plant, now in production, includes under one roof five operating divisions. Approximately 850 feet long and 200 feet wide, the building is largely of concrete construction—steel frame being provided for the warehouse. Division No. 1 houses a grains handling system and a brewhouse (with initial capacity of over 1500 barrels a day); division No. 2 includes the ale and lager fermenting areas and their yeast storage rooms; division No. 3 covers the finishing storage cellars; division 4 the filtering and carbonating equipment and bottling plant; and division 5 the shipping-receiving warehouse. All these units are incorporated into a radical one-storey arrangement, using a straight-line process flow principle.

The paper describes the general layout of the brewery buildings and their function. The equipment for water and steam supply and for refrigeration, all of great importance in the brewing process, are discussed at greater length, with details of design, application, and economic considerations. Other essential services are also discussed.

The Grains Handling Area—Here malt and adjuncts delivered by rail are unloaded and transported pneumatically to storage silos, prior to use in production and also where wet spent grains are furnace dried before shipping. Baled hops are handled and stored separately in a refrigerated storeroom designed and sized to take an annual shipment of hops in season.

The Brewhouse—Here the grains and barley malt follow the brewing process, namely "cooking", "mashing", "boiling" of the extracted wort in the brew kettle, where hops are added for flavour, "separating" out of hops and "cooling" of the wort in preparation for fermentation.

Hot water, steam and refrigerated water at temperatures and in quantities as required to bring some 90,000 pounds of liquid and grain to 212 deg. F. and back to 50 deg. F. in just a few hours are some of the service requirements of the brewhouse.

The Fermenting Rooms—Fermenting is a process in which the sugars of the mashing process are converted to alcohols and small quantities of secondary products through the addition of yeast.

"Bottom fermenting" yeast in closed tanks produces the "lager" beer which has become so popular in recent years. The CO_2 gas, tapped off these fermenters, is liquefied for later use in carbonating.

Ale, on the other hand, is fermented with "top fermenting" yeast in open stainless steel tanks, the CO_2 from this process being collected and exhausted to protect the building occupants.

Both ale and lager fermenting processes, being organic reactions, require controlled temperatures and clean atmospheres to protect against contamination. Part of the yeast, drawn off during fermentation, is stored for use in future production. The new brewery provides separate refrigerated storerooms for ale and lager yeast storage where proper cultivation can be maintained.

The Finishing or Storage Cellars—After completion of the fermenting cycle, the beer is pumped into glass lined tanks in one of two sealed storage rooms. Held here for fourteen to twenty-one days at 32 deg. F., the beer develops some of its taste characteristics while yeast and other materials are settling out.

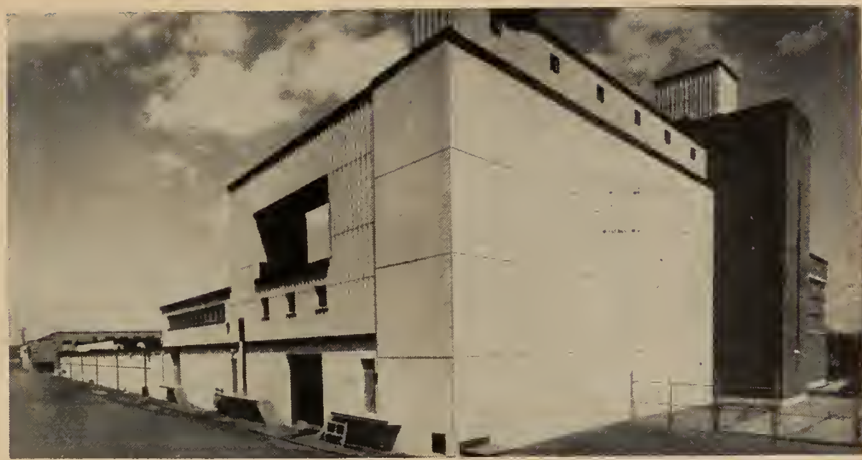
Conditions in these beer processing and handling rooms are affected by the wet floors which result from an almost continuous washing and flushing programme.

From storage, the beer is transferred to a cooling, carbonating and filtering cycle and then back again to storage. This cycle is repeated for accurate control of clarity and carbonation just prior to bottling.

The Bottling Plant — A modern high-speed operation, such as a bottling plant, will always attract the interest of an engineer. At the new Labatt brewery, this operation includes: soaking, where bottles are sterilized in caustic solutions and rinsed; filling, where the ale or lager is bottled at rates up to 400 bottles per minute (constant pressure is maintained at the filler by means of controlled counter pressure on the "bottling" storage tanks) crowning, where agitation of the bottle produces foam and eliminates air, at which moment the bottle is capped; pasteurizing, where the bottles and their contents are brought to a temperature of 140 deg. F. and held before being cooled, all by means of sprays; and finally labelling and packaging into the various containers in which beer can be found today.

The Shipping Warehouse—Conveyors carry completed cartons into the warehouse for transhipment by truck. Empties are also received here both bv truck and rail. Approximately 1,000,000 cubic feet of storage space has been provided, together with mezzanine offices and a truckers' lounge.

Not involved in the product flow, but, nevertheless, an integral part of this new brewery, are the offices and visitors' reception room, both of which are air-conditioned.



A general view of the new plant (from the right hand end of Fig. 1).

Services Building—The many operating divisions of the plant are linked by a service piping tunnel. This "right-of-way" for mechanical services originates in a separate building which houses the steam generating system, the refrigerating equipment and the water filtration plant.

Here, then, is the mechanical heart of a modern brewery. (Fig. 1)

General Service Requirements

The quantity requirements of the three major mechanical services are summarized in Table I.

Table I. Summary of Water, Steam and Refrigeration Requirements

Service	Initial Design
1. Water	525,000 g.p.d.
2. Steam	24,000 lb./hr.*
3. Refrigeration	400 tons

* Includes winter heating requirements

Each of the three major mechanical services will now be reviewed to indicate both design procedure and final design selection.

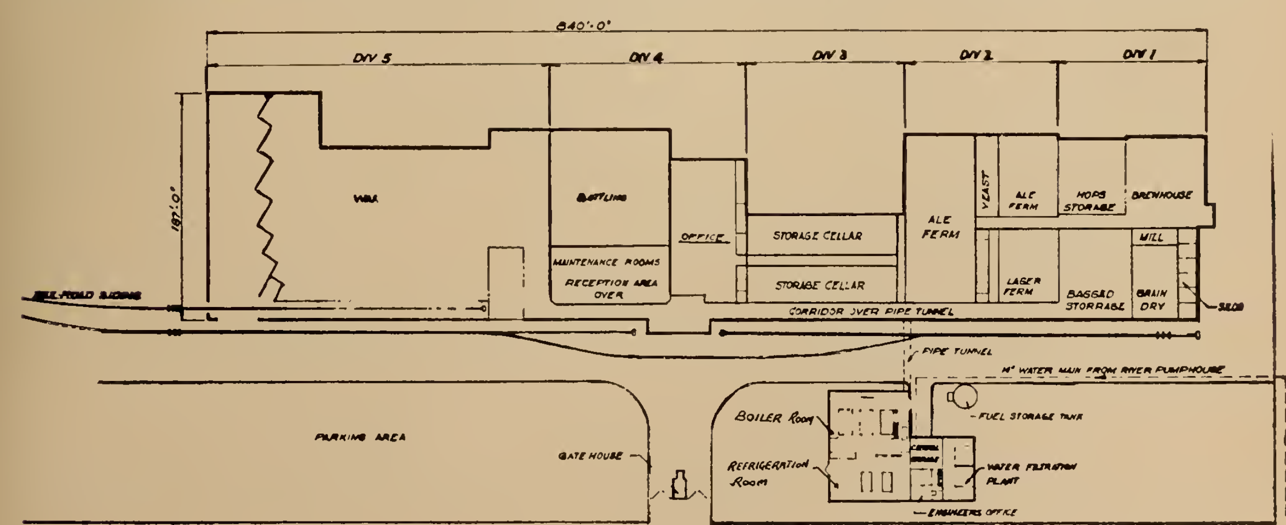
Although the initial kettle installation will limit the daily output of the brewhouse to 1,750 barrels, provision has been made in the process and building plans for an ultimate production of over six times this amount. In the mechanical design, an analysis of the effects and costs of future loads was necessary to compromise the initial requirements. In the interests of economy, this compromise was limited wherever possible to pipe sizing and space allocation.

Water Supply

The quality specifications for water to be used in the brewery are as follows. The water must be

(1) free from turbidity;
(2) free from organic matter;

Fig. 1. General area plan of the Labatt brewery at Ville LaSalle, Que. Design features single-storey straight-line flow.



(3) "zero" colour, i.e. less than 5 p.p.m. or equal to the best found in municipal service;
(4) controlled pH at 6.7 to 6.9;
(5) free from chlorine;

and, perhaps the most important factor of all, the water standard must be accurately and continuously maintained.

The site in Ville LaSalle was chosen for the new brewery for a number of reasons, one of which was availability of sufficient quantities of water. Being a little more than one quarter of a mile from the St. Lawrence River, the site permitted consideration of the river as an alternate source to the municipal supply and a study was made to compare the economics of a private water treatment plant compared with a contract for municipal service.

In favour of a city water connection is the rather negligible first cost for piping and connections. However, with the high plant demand — initially over 500,000 gallons per day, plus refrigeration condensing requirements — the annual water cost would total approximately $35,000.

Developing costs for a private water treatment installation includes consideration for river intake design, pumphouse and pump equipment, water piping from river to plant, chemical treatment, filtration equipment and building, and service pump requirements.

A summary of the estimated peak water loads for the process and plant are listed in Table II. The total of these loads indicates a peak demand of 700 Imperial gallons per minute. Operating experience in other plants indicates, however, that a continuous rating of 350-400 g.p.m. would be more realistic for the initial stage of this brewery. It is interesting to note from Table II that the largest water demand load comes from the hoses, many of which are in near constant use in the process areas.

Table II. Summary of Estimated Peak Water Demands

Equipment or Use	Water Req't. I.g.p.m.
1. Wort cooler	125
2. Soaker - Rinser	75
3. Pasteurizer	100
4. Hoses	350
5. Domestic	25
6. Boiler (peak make-up)	15

The condensing water requirement of the refrigeration compressors, though not treated, is included in the capacity of the river pumps and, therefore, the total anticipated first stage load on these units is 1,200 and 1,400 I.g.p.m.

The ultimate, rather than the initial requirements of the brewery dictate the size of intake pipe and force main to the plant as these two items would be very costly to expand in the future. On the basis of 3,600 gallons per minute, the intake in the river was set at 36 in. diameter and the 3,000 foot main from river pumphouse to filtration plant was selected as 14 in. diameter.

A large factor to be added into the first cost of the private system is the cost of the water treatment plant itself, including chlorinators, clarification equipment and gravity filters, controls, clear-water storage reservoir and plant service pumps.

The total cost of the private supply system was estimated at $160,000. Owning and operating costs were estimated as follows:

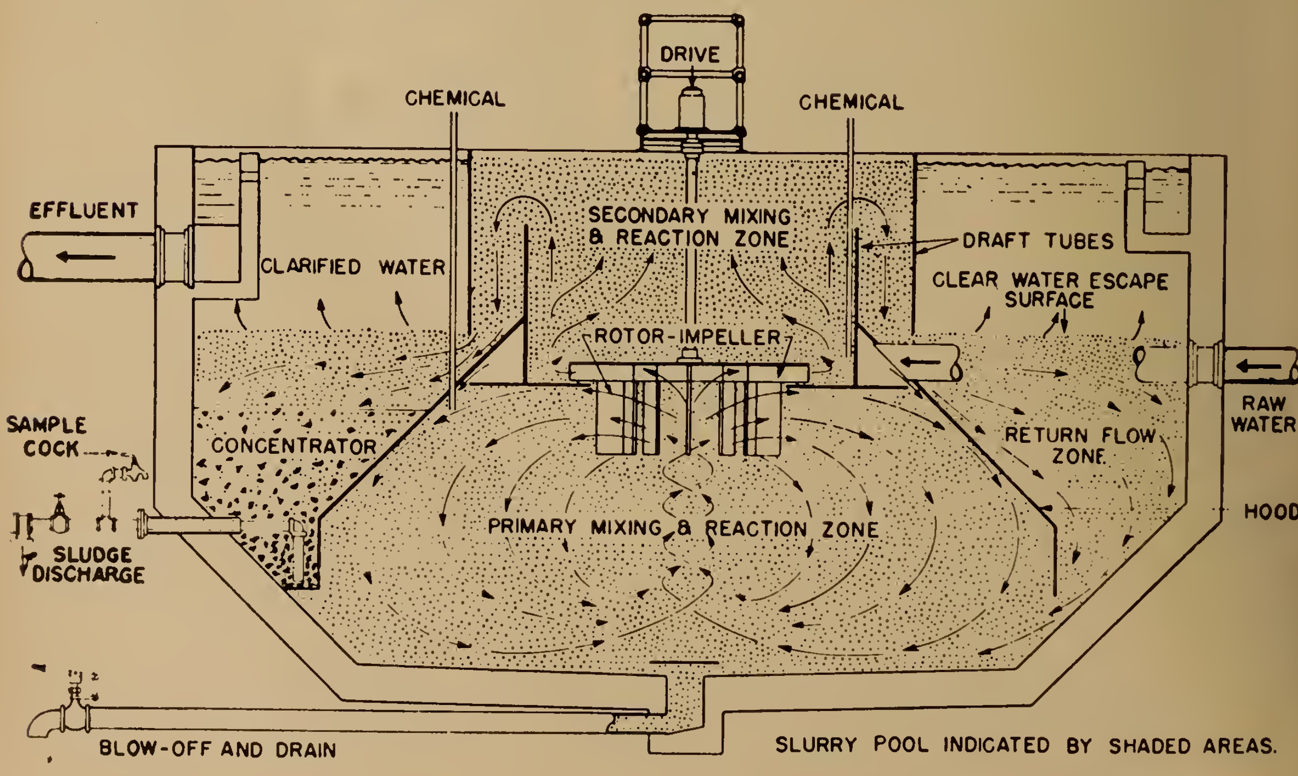
Operators	$5,500
Chemicals	2,500
Pumping	2,100
Depreciation and Interest	13,000

These figures total $23,100 and an annual saving of nearly $12,000 is indicated. Hence a decision that the design be developed on the basis of a private water supply system.

The growing interest in fluoridation of municipal water further justifies this decision, as the equipment necessary to remove the fluorine would be very costly.

Further refinements are now possible within the design scope of a private water treatment system.

Fig. 2. The Accelator high-rate water treatment unit incorporated in the design of the water treatment system.



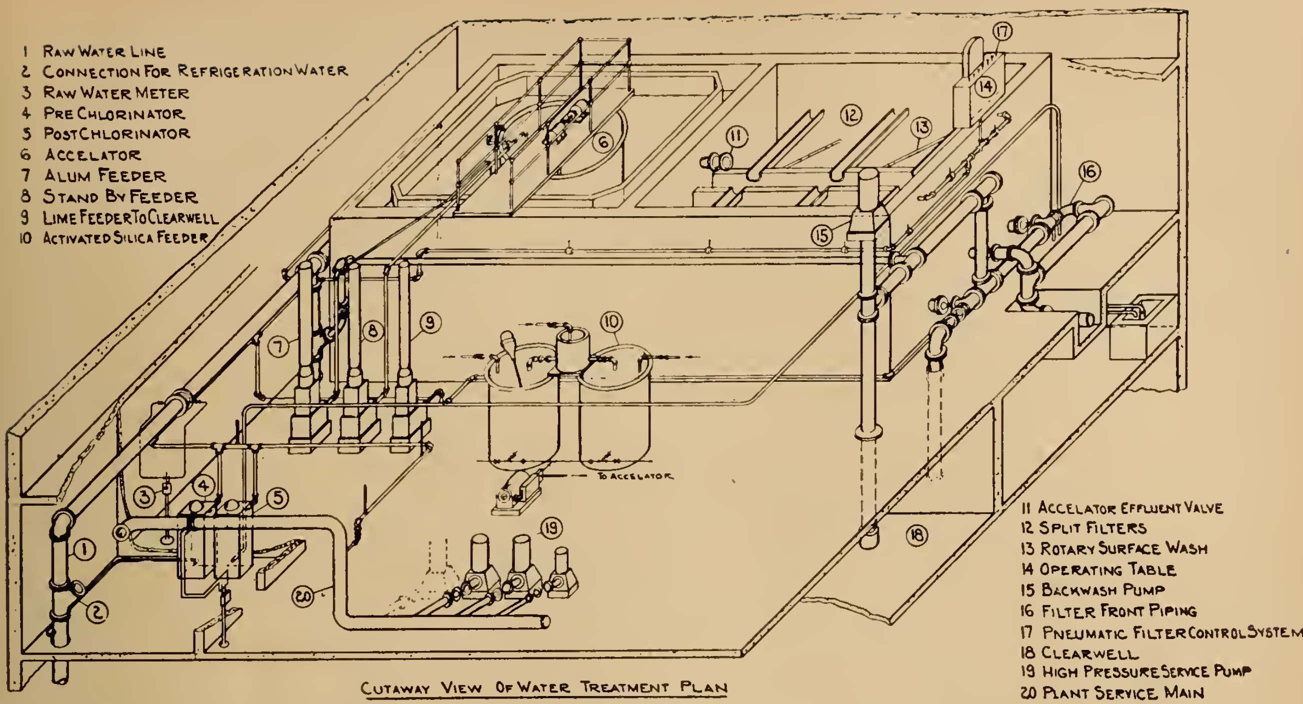


Fig. 3. A sectional view of the water treatment plant at the brewery, showing layout of piping and equipment.

Developments in the water treatment industry provide the designer with alternative selections for any particular application. There is the "conventional" system which calls for separate mixing, coagulating and sedimentation, and the high rate treatment plant which combines these operations into one unit.

An analysis of costs for these two methods of treatment shows that, for this brewery application, there is an installation and operating saving in favour of the "high rate" treatment system. Following approval by the Provincial Department of Health, an industrial high rate unit ("Accelator") was selected and the design of the treatment plant was completed to suit this equipment.

The Water Treatment Cycle

The Labatt Accelator consists of a formed concrete basin, an inverted conical steel baffle which encloses the primary and secondary mixing zones, and a radial blade impeller which is driven by a motorized reducer. (See Fig. 2.)

Raw water, having been prechlorinated, enters the primary mixing and reaction zone beneath the impeller. Alum and activated silica are introduced and the reactions take place. Coagulation tests on river water samples established that the combination of alum and activated silica would produce the most effective treatment. Cost studies indicated that this combination would also be most economical. A fixed quantity of "slurry" water which contains particles or floc resulting from the chemical reactions, is circulated upwards by the low head impeller through the secondary mixing zone and over a peripheral weir into the "slurry" pool. The greater part of this water volume is then re-circulated back under the conical baffle into the primary mixing zone. The remainder, equal in amount to the raw water, is separated off from the "slurry" pool as treated and clear water. Continuous concentration and automatic withdrawal of excess solids as sludge give positive control of conditions in the Accelator at all times. The clarified effluent flows on to "split-type" gravity filters where all traces of suspended matter are removed. This divided filter provides a saving in operating controls. The water flow from these gravel and sand filters passes into the clearwater reservoir where, for further protection, the water is post-chlorinated. The residual chlorine protects the water in storage and in transit to the brewhouse. Just prior to use in the brew cycle, this residual chlorine is removed by activated carbon purifiers.

During treatment, the pH of the water, originally 7.3, is reduced to 6.6, or slightly under the requirement for brewery water. This is corrected by feeding lime directly to the clear-water reservoir. Automatic control of the filters and Accelator is achieved pneumatically from the level in the clearwater reservoir. Alarms are provided to warn the operators of control or equipment failures.

Steam System

The steam services of the brewery are designed to meet three conditions.

(1) Process requirements of the brewhouse and bottling room. The steam pressure provided for these process purposes is 40 p.s.i.g. at the load and there is an estimated peak demand of 12,000 pounds per hour.

(2) Building heating and domestic requirements. This load, including all miscellaneous steam requirements, will also have an estimated peak of 12,000 pounds per hour.

(3) Steam for the power turbine on the refrigeration compressor.

The present boilerhouse is designed for three boilers, but only one of the final units has been installed in this first stage. (See Fig 1.) The steam generating unit is a cross-drum watertube boiler, equipped with cast iron economizer. The boiler has automatic combustion control on steam assisted mechanically atomizing burners designed for firing with bunker "C" oil. The boiler has been designed for 300 p.s.i.g. pressure, and a superheater has been added to give steam temperatures of 510 deg. F. at full load, and 480 deg. F. at half load conditions. The guaranteed boiler efficiency (including the economizer) is 84.8 per cent at full load, and 83.2 per cent at half load.

A finned type air heating steam coil is located between the forced draught fan and boiler. The purpose of this coil is to act as an extra condenser for the power turbine, increasing the available steam flow through the turbine, and thereby to contribute to the heat balance.

A pressure reducing valve with desuperheater provides steam to the low pressure system during cycles of low refrigeration and high heating requirements, such as will develop during the winter holidays. Both the high pressure and the low pressure steam headers are mounted at a convenient height in the refrigeration room with all valves arranged for easy access and identity.

The boiler feed water is conditioned by means of both external and internal treatment, the make-up water from the water filtration plant is softened by the Zeolite filters, all the feed water deoxygenized in a spray type de-aerating heater and finally conditioned by the chemicals supplied directly to the boiler drum.

The boiler is also equipped with a continuous blow-down and heat recovery system.

All pumps and fans which are vital to continuous boiler plant operation, such as the feedwater pumps, the oil pump and the forced and induced draught fans, are provided with both motor and turbine drives. This arrangement permits the completion of a brew cycle even in the event of an electrical power failure. Each turbine outlet is provided with a three-way valve, leading either to the low pressure header or to atmosphere. This arrangement allows for isolation of a turbine from the header without the risk of turbine damage due to a closed and forgotten valve. It is safer and also less expensive than the use of full capacity safety valves on each turbine. Furthermore, the turbine can be operated with direct exhaust to atmosphere, if and when such operation becomes desirable.

A stand-by boiler with capacity and pressure to meet summer shutdown or emergency loads is also provided in the steam plant.

This latter unit is a fire-tube "package type" boiler, selected for its economy, its adaptability to the system and its relative ease of relocation at the time of steam plan revisions. The steam pipe from this unit is connected directly to the low pressure header which is provided with a multiport-type relief valve for protection of either the stand-by boiler or the power turbine when high pressure steam is being produced.

Refrigeration System

Perhaps one of the most interesting of service designs for a brewery is refrigeration. With controlled temperature the requirement both in the process and the space which surrounds it, a refrigeration system is essential to the proper operation of the plant. The size and cost of the equipment and distribution systems requires an economic study similar to that for water, with initial and operating costs evaluated for each of the many alternatives.

To begin with, the design loads, which are summarized in Table III, consist of two main types — process and air conditioning. Included under the former heading are wort cooling, "fermentation heat", beer transfer cooling, and CO_2 liquefaction. Requiring air conditioning are hop storage and yeast rooms, fermenting storage cellars, carbonating and bottling tank rooms and lastly, for comfort, the offices and reception area.

With the design load established, answers must then be found to the questions of reciprocating versus centrifugal type refrigeration compressors and brine versus direct expansion as an "in-house" distribution system. From cost data, it is apparent that the first costs of a direct expansion system with electric motor would be lowest. However, these are offset by operating costs when the economics of heat balance and maintenance are applied to the centrifugal compression and brine system.

Table III. Maximum Refrigeration Loads

Process	*tons*
Wort cooling	80
Attemperators	50
Beer coolers	90
Co_2 liquefying system	25
Air Conditioning	
Ale fermenting room	47
Lager fermenting room	20
Storage rooms	30
Carbonating rooms	24
Hop storage	8
Bottling tank room	15
Yeast storage "ale"	8
Yeast storage "lager"	8
Office air conditioning	25
Brewery ventilation unit	40

The total of these calculated peak loads is 470 tons. However, when a diversity factor is applied, this total can be reduced by 15 per cent giving a net total of 400 tons for equipment selection purposes.

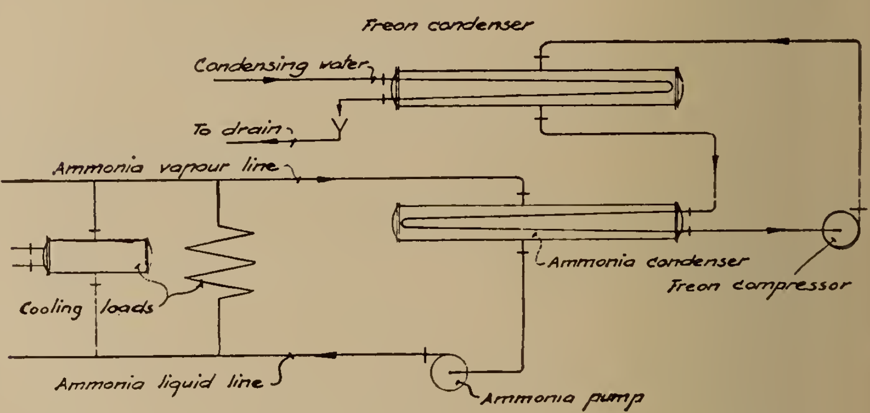


Fig. 4. Diagram showing the principles of the ammonia condensing cycle.

The refrigeration compressors with their drives, rated at this total, are designed to accommodate an overload of 50 tons.

The new Labatt brewery is equipped with two centrifugal compressors and an "ammonia condensing" in-house refrigeration system. This latter refinement — the use of ammonia in place of a standard brine — allows for a considerable reduction in piping and pumping costs due to the use of the latent heat of the ammonia brine rather than just the sensible heat of a standard brine. It also has many of the advantages of the direct-expansion system, without the ammonia having to come into direct contact with the compressors.

This is the first application of this system in a brewery in Canada, although installations in the United States date back to 1935.

The distinctive feature of the ammonia condensing system lies in the fact that low pressure ammonia gas returning from the brewery evaporators, or cooling surfaces, instead of being compressed to high pressures and consequently higher temperatures in order to liquefy it, is condensed at low pressure and temperature in the cooler of the centrifugal machine. The "collapse" of the ammonia, in changing from gas into a liquid, induces the flow of more gas to the cooler of the centrifugal machine, which in this case assumes the function of an "ammonia condenser". The accumulated low-pressure low-temperature ammonia liquid is then circulated to the various evaporators by an ammonia liquid pump. The ammonia portion of the system is free from oil contamination and variations in load (causing "liquid" slugs) would not be in the least harmful to the system, so often the case when a reciprocating compressor is used to compress and circulate the ammonia. The absence of oil in circulation with the ammonia refrigerant also greatly improves heat transfer and makes possible the more efficient use of the transfer surfaces available.

The principle is perhaps best illustrated by the diagram in Fig. 4.

The ammonia condensing cycle eliminates flash gas in the liquid due to the fact that the ammonia pressure is raised by the ammonia pumps after condensation rather than being condensed after pressurization as in conventional refrigeration systems.

A number of other factors contributed to the decision in favour of the selected refrigeration system including the flexibility of centrifugal compressors for capacity control permitting quick balance at each load condition, the higher efficiency of the centrifugal compressor at partial loads (variable speed control versus step unloading), lesser maintenance and the fewer shut-downs expected of centrifugal type machines.

It is apparent from the earlier reference to heat balance that the use of steam for power is also a factor in the compressor selection. Centrifugal compressors are very suited to turbine drive and, at relatively high operating speeds, they permit the application of a steam power-heating cycle without risk of oil being transferred to the steam lines and boiler.

However, before reviewing the economics of this application, a description will be given of the refrigeration equipment and its control.

The calculated maximum refrigeration load in the present plant is 400 tons, occurring in summer on days with extreme outside air temperature and humidity, when the river water temperatures come up to 75 deg. F. and when the brewery is in full production.

The refrigeration machinery consists of two centrifugal compressors, each with 200 tons nominal capacity.

The main line unit is driven by a back-pressure type steam turbine, while the second unit for stand-by and peak load duty has a variable-speed wound rotor electric motor drive.

The output of the compressors is adjusted automatically by means of an ammonia temperature recorder-controller with its sensing element in the ammonia receiver. This instrument controls both the steam turbine speed regulator and the suction damper of the motor driven compressor.

A second controller, sensing pressure and located in the medium pressure header, operates to limit the load on the turbine driven unit during cycles of low steam demand when both compressors are operating. As the steam demand in the brewery increases, the pressure starts to drop. The pressure instrument then overrides the ammonia temperature controller and calls for a higher turbine speed. The dropping ammonia temperature will, in turn, reset the suction damper on the electric motor driven compressor, thus decreasing the capacity of this to balance the increase in the alternate machine. In this manner, the loading of the steam turbine driven compressor is made to follow the cycling steam demand of the brewhouse, acting as a pressure reducing valve with an adiabatic power-producing pressure drop. (Fig. 5.)

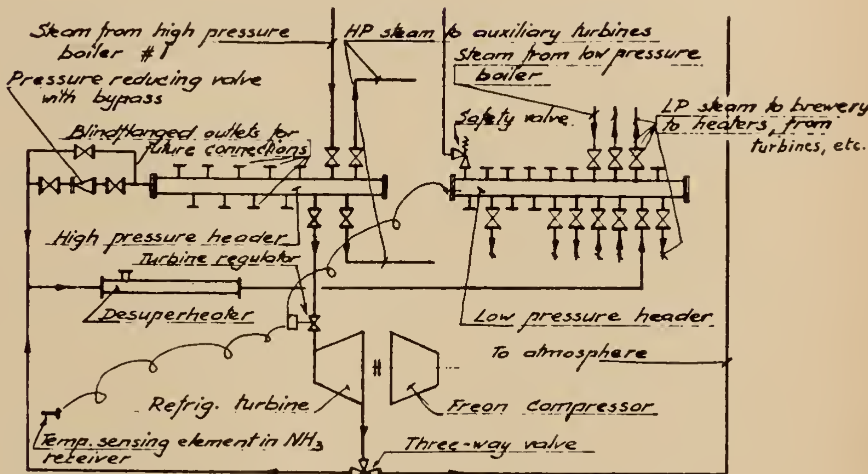


Fig. 5. Diagram showing the steam header and turbine hook-up.

If, during peak refrigeration demand, the steam requirement in the brewery should drop to such a low level that the refrigeration need cannot be met with the combined capacities of the electrical compressor and the steam driven unit, as limited by the steam requirement, a high limit thermostat sensing ammonia temperature will ring an alarm bell and switch the control of the turbine governor over to the ammonia temperature regulator.

On the opposite hand, there will be times, during winter, that heating and process steam demands far exceed the steam required to produce refrigeration.

The turbine in this case would be regulated only by the ammonia temperature. A pressure reducing valve is provided to supply the additional amount of steam from the high pressure header via spray type desuperheater.

Refrigeration capacity is therefore automatically controlled and balanced by refrigeration load. The only manual operation to be done by the operating engineer is decreasing the speed of the wound rotor motor or reducing the number of operating steam nozzles on turbine at decreasing capacities to improve the efficiencies of the units at partial load conditions.

Application of a combined power generating and heating system to get highest plant thermal efficiency requires a thorough study of time load characteristics and also of equipment for steam generation and utilization. It is seldom the case in smaller industrial developments that the process-heating steam demand has the characteristics to justify power generation. The ideal heat-balance situation where high pressure steam is used for power generation and exhaust low pressure steam for process purposes and heating becomes uneconomical in cases where the steam demand for power generation and process heating are poorly balanced and where electrical energy is cheap. In the case of this brewery, however, the steam requirement for power and process can be balanced rather ideally by proper choice of steam pressure and engine but, on the other hand, the hydro-electrical energy in this area is relatively inexpensive. With this background, a study was necessary.

Using a steam turbine as an energy generating reducing valve can be accomplished in several ways, of which the three principal solutions are listed below:

(1) Using bleeder type condensing turbine with steam extraction for process and heating, and separate condensation. With this system, the entire electricity requirement of the brewery could be generated by its own turbine generators. All process and heating requirements would be taken as back pressure steam from being condensed in a vacuum condenser.

(2) Using a back pressure turbine-generator. Only that much steam would be fed to the turbine as could be used for process and heating demands — the balance of the electric energy would be bought from the utility company.

(3) The major power consumer—the refrigeration compressor—would be direct-coupled with an individual steam turbine.

A quick analysis shows that alternatives (1) and (2) could give little, if any, economical advantage over alternative (3), but would require a much higher initial investment. Only by placing emphasis on the possibility and effect of shut down as a result of a national emergency could private power generation be justified.

Due to the size and characteristics of the steam, electricity and refrigeration requirements, and the circumstance that the biggest power consumer in this plant — the refrigeration compressor — would be located centrally in the mechanical services building, alternative (3) is clearly established as having the highest value and was therefore set aside for comparison with the all-electrical drive alternative.

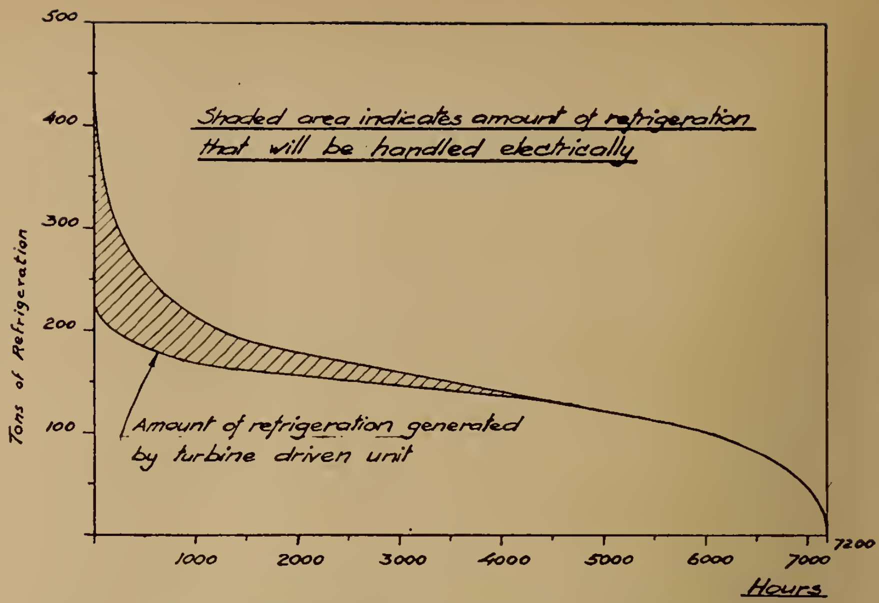


Fig. 6. Probability curve for refrigeration requirement.

Further study is needed to establish steam conditions before this final comparison can be made. Boiler design standards indicate that pressures of 600 p.s.i.g. and 300 p.s.i.g. would each provide the highest boiler value of the respective design ranges. The study of these two pressures as design inlet conditions for the power turbine indicates that:

(A) The refrigeration requirement could be completely covered with a back pressure turbine driven unit without steam loss to the atmosphere, if steam with at least 600 p.s.i.g. pressure and proper superheating is used in a high efficiency multi-stage turbine.

(B) A combination of 300 p.s.i.g. steam with moderate superheat and an inexpensive single-stage turbine could not cover the peak refrigeration requirement without producing too much low pressure steam.

However, when operated in conjunction with an electrically driven refrigeration compressor, the turbine in this latter alternative could give an overall economy very close to that of the higher pressure system and would have a number of distinct advantages, namely:

(i) Lower first cost.

(ii) Greater ease in the locating and securing of operators due to the relative scarcity of high pressure steam plants in Quebec.

(iii) Better economy on weekends in summer when the electric compressor could be used for the cellar refrigeration requirements at a time when steam would have to be discharged to atmosphere.

The difference in efficiency and operating economy between these two alternatives can perhaps be best illustrated by a review of the expected refrigeration load-hour curve. (Fig. 6.) This curve, when computed on an annual basis, is similar to many others which reflect seasonal load variations. From the graph, it can be seen that the 200-ton steam turbine driven unit will meet all but a small percentage of the loads. Consequently, the electric power that would be saved if steam were used to produce all the refrigeration is relatively small when compared to the amount saved by the back pressure turbine and would hardly be enough to justify the extra initial equipment cost.

Once the selection of the back pressure turbine-electric motor drive combination has been justified in this way, the final analysis between the steam-electric and all electric drive arrangements can be made. To simplify the recording of this initial owning and operating cost review, the former will be known as scheme S.E. and the latter as scheme El.

First cost comparison

It is estimated that the premium for boiler, piping and accessories for the steam electric arrangement would total $17,000. This would be reduced by $5,000, the estimated premium for wound rotor motor with its gear, controller, and primary power service costs over the steam turbine with its controls. Therefore, the net additional cost of scheme S.E. would be approximately $12,000 more than scheme El.

Operating cost comparison

The reduction of the annual electricity costs could be found by comparison of the monthly power consumption curves for the two alternatives, but can be more easily estimated by the following calculation.

For the calculation, we assume that, during every month when both compressors will have to be operated to meet the demand, the peak capacity of both units will be needed at least once and that, during the months when only one of the units is needed, again at least once, the unit will have to run at full load. This assumption comes very close to real conditions — in winter months the process cooling requirements come occasionally close to the nominal capacity of one unit, while in summer months the climatical conditions here in Montreal show a high probability for odd hot days even early and late in the summer season.

The contract for power calls for the following charges:

$1.30	Service charge per kw. of billing demand (monthly).
0.015	First 50 hours use of demand.
0.007	Next 100 hours use of demand.
0.003	Excess.

Now, when the operating assumption described above is applied, the annual saving in the electricity service charge for scheme S.E. would be:

350 x 1.3 x 12 = $5,460 where 350 is the motor size for one compressor unit.

The annual load probability curve (see Fig. 6) shows that nearly 1,000,000 tons of refrigeration would be produced with the steam turbine unit in scheme S.E. To produce this amount of refrigeration with an electrical unit would require at least 1,400,000 kwh., and more if an effective compressor speed regulation is not applied.

The calculation of the electricity saving in scheme S.E. can now be completed:

50 x 350 x 0.015 x 12	=	$ 3,150
100 x 350 x 0.007 x 12	=	2,940
(1,400,000 — 150 x 350 x 12) x 0.003	=	2,310
Service charge as calculated before	=	5,460
Total annual electrical saving		$ 13,860

In reality, it is likely that, during the off-season months when two units have to be operated, the loading of the compressors would not need to reach the maximum capacity. This is especially so when process peaks could be avoided by production planning. A decrease would therefore result in the estimated service charge for those months and also more power would be used at the least expensive 0.3 cent per kilowatt hour rate.

Reduced by as much as 20 per cent, the calculated annual saving of electricity in scheme S.E. would still be over $11,000. Conversely to this applied reduction, it should be mentioned here that the electricity costs estimated above are based on careful compressor speed adjustment to match the actual loads. In practice, this could only be achieved by utilizing an expensive automatic hydraulic drive. In cases such as the one under discussion where this expense cannot be justified, the human factor must be accounted for in the estimates and the electricity consumption will certainly be higher.

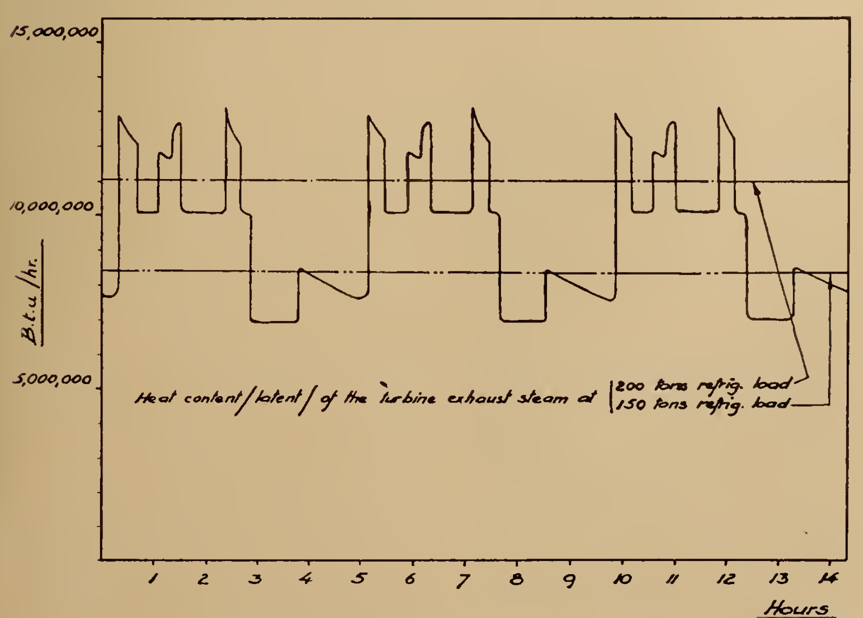
The electricity saving for scheme S.E. has to be reduced by the increased fuel cost for power generation.

To produce the power for the operation of the turbine-driven compressor, 4,000,000,000 B.t.u. per year will be required. Assuming a boiler efficiency of 80 per cent and the use of bunker "C" fuel oil with a heating value of 186,000 B.t.u. per gallon at a price of 9.3 cents per gallon, the annual fuel cost increase for scheme S.E. will be:

$$\frac{4,000,000,000 \times 0.093}{0.8 \times 186,000} = \$2,500$$

The net anticipated annual operating saving for scheme S.E. is therefore $11,000 minus $2,500 or $8,500. To estimate the cost of "owning" the additional $12,000 which would be invested in this scheme, an overall depreciation rate of 10 per cent is used, giving a cost of $1,200. The total "owning and operating" saving of the steam turbine-motor combination would therefore be $7,300.

Fig. 7. Calculated process heat requirement curve at summer operation.



Summary

We have found that first cost would be $12,000 higher and owning and operating costs $7,300 per year lower for scheme S.E.

Expressing this in another way, it is clear that the higher installation cost for scheme S.E. will be offset by the operating savings within two years.

It should be mentioned here that when, in the future, the brewery is extended, the process steam requirement will increase in proportion to the production increase but that the refrigeration load will increase to a much lower degree. This will result in a further improvement in the economy of the selected system.

Refrigeration Equipment in Brewery

The "in-house" side of the refrigeration system includes many interesting features. The loads which make up the design total for the system have been listed in Table III and a few of these will be discussed in some detail.

One of the largest process cooling requirements in the brewery is the cooling of hot wort after extraction from the kettle. Leaving the hot wort storage tank at a temperature of over 200 deg. F., the wort is cooled to 50 deg. F. in stainless steel plate type heat exchangers. These heat exchangers are designed for two-stage operation. The first stage makes use of river water from the water treatment plant to drop the wort to approximately 90 deg. F. in summer. Lower river water temperatures in other seasons will increase the cooling range of this stage. The second stage provides the final degree of cooling by means of chilled water. The cooling water from the first stage having been heated to temperatures of 155 deg. F. and higher, is discharged into hot water reservoirs for later use in brewing. This heat exchanger, therefore, works as a wort cooler, process water heater, and waste heat recovery unit simultaneously.

The chilled water is circulated through the second stage of the wort cooler from a sprayed pipe cooler, called a Baudelot cooler in the brewing industry. In this unit, the water is distributed through adjustable troughs over vertically mounted ammonia pipe coils and collected in an accumulating tank. The refrigeration storage capacity of the tank is considerably increased by allowing some of its contents to freeze to ice. This accumulating ability of the tank spreads the short cycle (1½ hours) wort cooling load over a period of five hours, thereby decreasing the required compressor capacity and improving the synchronization between the process steam and refrigeration requirements.

A second large process cooling load is caused by the exothermic process in the fermenting tanks. Each pound of sugar in the wort gives off approximately 250 B.t.u. during fermentation. Some of this fermentation heat is transferred from the tanks to the rooms by convection and radiation and, in the case of open tanks by evaporation from the surface. Each tank is equipped with brine cooled attemperator coils to keep the fermentation temperature at constant predetermined levels and later to cool the beer quickly to the desired discharge temperature. The brine for the attemperators is chilled in shell and tube type exchangers to 17 deg. F. for lager fermenting and 25 deg. F. for ale. These exchangers operate directly on the suction pressure of the ammonia condensers or at approximately 11 deg. F. The Baudelot cooler also operates without a back-pressure regulator. Other cooling appliances are equipped with regulators, which control the ammonia evaporation temperature in the respective coils to desired limits. Gate, plug, solenoid, and pressure relief valves complete the control equipment at each unit.

Turning to the air conditioning loads, it is recorded earlier that a number of the storage and processing rooms have controlled temperatures. These temperatures range from 32 deg. F. (storage cellars) to 50 deg. F. (ale fermenting room). The rooms are conditioned by individual fan driven units with prime surface type ammonia cooling coils. The refrigeration loads include transmission heat from the environment, heat from lighting, motors, occupants, ventilation heat, the part of the fermentation heat transferred into the rooms by transmission and evaporation, and latent load from the washing of the floors. This last item can be very high, particularly in summertime due to the high vapour pressure difference between 75 degree river water from the filtration plant and 32 degree room temperature, and the frequent or practically continuous washing with hoses in most of those rooms. In order to reduce this evaporation load from wet floors, a large number of floor drains are installed and the bulk of the washing water is carried away quickly, thereby reducing considerably the latent load which otherwise would be introduced to the room.

This effects a saving in both equipment and operating costs, and decreases the defrost requirements of the cooling coils.

The CO_2 generated by fermentation is collected from the closed lager tanks for re-use in beer carbonation. The ale fermenting tanks, being open. generate CO_2 gas which escapes to the room and creates a high ventilation requirement, adding considerably to the total refrigeration load. The standards of the Department of Health (Division of Industrial Hygiene) recommended a maximum concentration of 0.5 per cent CO_2. To keep this condition uniformly throughout the space, a total of 264,000 cubic feet of fresh air would have to be induced to the room every hour. To reduce this ventilation requirement and consequently the high refrigeration load it imposes, the tanks are provided with a direct CO_2 exhaust system, consisting of adjustable inlets above the beer surface connected into a separate piping system through which the gas is pumped to atmosphere. Due to the fact that the CO_2

(*Continued on page 1536*)

A general view of the modern high-speed bottling plant.

Canadian Design and Construction of High Voltage Overhead Transmission Lines

V. F. Crowley,
Manager, Transmission Division,
The Shawinigan Engineering Company Limited

Read at the Conférence Internationale des Grands Résaux Electriques à Haute Tension, Paris, France, May/June 1956

The design and construction of high voltage overhead transmission lines in Canada are being extensively modified and revised in order to produce economies consistent with acceptable operating efficiency. These changes are based on past operating experiences, combined with investigations, studies and experimental installations. While some of these changes are being adopted to a varying extent, both individually and in combination, others are still under consideration.

The rapidly expanding systems of the Canadian electrical power utilities are materially changing the conceptions of high voltage overhead transmission line design. Reduction in material and erection costs are being effected while maintaining an effective level of operating safety and efficiency.

FOR some time now various Canadian electric power utilities have been examining the possibilities of revising, or modifying, the presently accepted standards employed in the design and construction of high voltage overhead transmission lines. The primary incentive in making these studies is the rising cost of materials and labour.

Many Canadian lines show a very high degree of operating efficiency. Mechanical and electrical failures have been nil, or extremely rare. The question arises whether this condition indicates that the lines have been designed to an exact level of efficiency, or with safety or overload factors which are greater than necessary.

In the light of increased knowledge and experience obtained over many years of investigation and operation of high voltage overhead transmission lines under Canadian climatic and topographical conditions, it is felt that the commonly accepted standards and practices could be modified to produce more economical transmission lines and still maintain an acceptable level of operation and reliability, both mechanical and electrical.

These modifications are being incorporated in present designs to a varying degree and operating results to date appear to justify the trend in this direction.

Very little consideration is being given to the possible revision of the co-efficients involved in the various formulae used in the calculations, but rather in the results arising from the application of these formulae.

The major amount of investigation and revision is, of course, on the structures themselves, but other factors involved in the design and construction of high voltage lines are being considered. Field construction procedures are receiving attention, both as they affect the design and the labour costs of erection. The trends in the revisions of high voltage overhead transmission lines involve both wood and steel structures. However, the greatest emphasis is on steel towers, as the majority of high voltage lines are being constructed in steel. The trend towards extra high voltage overhead lines, with their much greater mechanical loadings, practically necessitates steel supporting structures.

This paper does not attempt to cover all the factors and design assumptions which may produce savings in high voltage transmission line costs, but presents in outline form only those receiving the primary attention of transmission engineers in Canada. It is recognized that the overall problem is extremely complex, as each factor requires an extensive study in itself as well as an intricate correlation. All this in turn must be applicable to the specific problems existing on each electric system.

Planning and Scheduling

Since the end of World War II an urgent demand for electrical power has required that many high voltage transmission lines be constructed according to extremely tight schedules. This acceleration, over the normal period of time required for designing and constructing a line, has drastically reduced the opportunities for incorporating economies.

There is a definite trend now under way to attempt to schedule all operations so as to obtain time for adequate study of the design and the planning of the construction program.

Substantial savings are being realized and following are some of the various items under study:

(*a*) Investigation into design and construction as outlined in this paper.

(*b*) Standardization of structures in a given classification of lines in order to reduce both labour and material costs.

(*c*) Purchasing of materials in large quantities.

(*d*) Reduction in construction delays by obtaining the complete right-of-way prior to commencing construction.

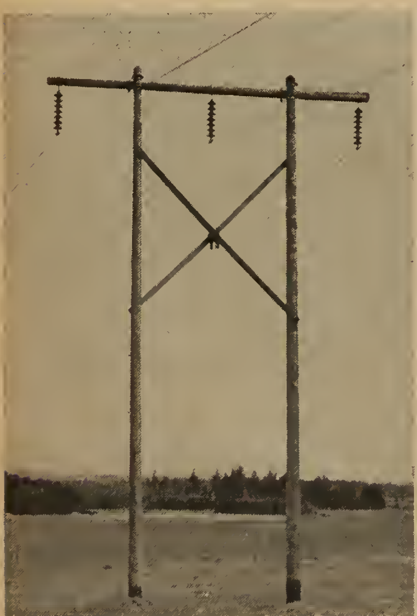
(e) Avoidance of costly construction delays due to lack of material, by assuring that all materials for small projects should be on hand before beginning construction. For longer lines, materials to be scheduled for delivery so as to allow distribution during the most advantageous season and ahead of the time required for actual erection purposes. Distribution of material on many of the transmission lines in Canada may be more economical during the winter than in other seasons of the year. In cultivated areas there is less damage to the farmer's crops and fields. In rough mountainous terrain and swamp sections, transportation is often more readily facilitated by the use of temporary winter roads. The transportation of men and materials to tower sites is faster and more economical over these roads as they permit the use of specialized vehicular equipment.

(f) Actual construction being scheduled so as to take advantage of seasonal conditions.

It is recognized that some operations in certain areas may be more economically carried out in winter than in summer and *vice versa*. Excavation work in swamp areas during the winter season has been facilitated as the frost inhibits the flow of fluid soils and water, and either eliminates or reduces to a minimum the use of crib-work or sheeting.

Thus with more efficient construction methods and specialized equipment, it has been found that transmission line work may be carried out during winter conditions as economically as during other periods of the year. This enables the construction organizations to carry a more balanced and experienced labour force, which is more efficient than engaging less experienced personnel for seasonal work only.

Fig. 1. 115 kv. single circuit, wood pole, H-frame spar arm construction. No overhead ground wires. (*The Shawinigan Water and Power Company*)



Classification of Transmission Lines

A useful method of evaluating the possibilities of reducing the costs of high voltage transmission lines is by classifying lines according to the various design assumption factors. This may assist in relating the electrical and structural performance of the line to the cost of construction and maintenance. This information will enable management and the operating staff to select a suitable type of construction, correlating the lowest overall cost with the required operating efficiency, thus assuming a "calculated risk" with a fair degree of assurance based on experience. The degree of such classification would depend upon the individual system and the localized problems.

However, general divisions for a system employing transmission line voltages up to 230 kv. have been suggested as follows:

(a) *Prime* electrical and structural classifications for radial lines which are the sole means of transmission to an important load terminal. This classification would incorporate all existing maximum design and construction factors.

(b) *Prime* structural classification but reduced electrical security: for lines where electrical interruptions are controlled by high speed reclosing.

(c) *Prime* electrical classification but reduced structural strength: for lines where expected loadings are not so severe and outages of a day or two could be handled by switching loads.

(d) Reduced electrical security and structural strength for lines where higher class parallel circuits exist.

(e) A further reduction in electrical and structural design factors: for tie lines of minor importance.

Some organizations are examining the past operating performance of their lines together with the existing and proposed future system connections in an endeavour to produce a reasonably practical and useful classification. While there is a general trend in this direction, some difficulties are encountered in evaluating the importance of the various transmission lines due to rapidly expanding systems.

Structure Loading Specifications

There appears to be a very definite feeling by most Canadian transmission engineers that substantial economies may be gained by an intelligent reappraisal of existing transmission structure loading specifications.

Tower loading specifications are generally set forth in a relatively arbitrary manner, e.g., a wind pressure of eight pounds per square foot, one-half inch radial thickness of ice with one broken conductor. Towers are designed on this basic consideration and steel detailers then produce a tower in which failure will theoretically occur at precisely the point set by these loading specifications. Designers, while recognizing the inconsistencies of this step, are the first to defend the loadings, maintaining that the extra strength incorporated into the towers by these loadings is essential to cover the multitude of possible stresses that may exist in erected towers. Such items as incorrect fabrication, improperly set footings, the unequal settlement of footings, all combine to add extra stresses in the towers after the line has been completed. Unbalanced forces might also be set up in the towers by the action of galloping conductors, unequal ice loads on conductors, stringing operations during construction, etc. While these stresses are indefinite and largely indeterminate, the towers must be able to withstand them.

These considerations may offer a sound argument for maintaining the conventional loadings, but, in the final analysis, the optimum in transmission line design is one in which the annual cost is the minimum. Hence, the annual costs of maintenance, emergency repair work, and value of power lost during outages. must be considered together with the capital cost charges.

It is possible to produce an almost impregnable line if enough money is spent on it. There is, however, a point of diminishing returns beyond which the extra steel built into a line does not supply a proportionate extra margin of safety. In view of the extremely small number of line outages due to the structural failure of towers, that have been reported over the last ten to fifteen years, it appears that this point of diminishing returns has been passed. The problem is essentially economic, that is, the charges on capital cost of extra steel versus money saved by fewer outages.

When consideration is given to the relative importance of each line, its load and location within the grid, it should be possible to accept a limited number of outages per year on certain circuits without detriment to the calculated performance of the overall system.

In an attempt to predict the performance of a line employing lighter towers, and recognizing that there are "intangible strengths" and "indefinite and indeterminate" stresses, it is difficult to arrive at a sound conclusion from a purely theoretical approach. Engineers are accordingly examining the performance records of existing lines in order to obtain data and information which will be of assistance in carrying out their studies.

(a) Design stresses and safety or overload factors.—It is possible to decrease the weight of transmission line towers by using higher design stresses or lower safety factors. The average basic steel stress has been for some time accepted at 24,000 pounds/sq. in. (1,687 kg./sq. cm.) on ordinary carbon steel members. (Canadian Standards Association Specification G 40.4-1950). There is a trend to increase this to approximately 28,000 pounds/sq. in. (1968 kg./sq.cm.). Several companies have already designed and constructed lines to this revision. The use of a higher stress is equivalent to reducing the loadings, i.e., raising the design stress from 24,000 pounds/sq. in. to 28,000 pounds/sq. in., is the same as reducing the tower loadings by 16 per cent. Although the consideration of this method is an indication that towers, in general, are felt to be stronger than necessary, the method does not permit emphasis to be placed upon any specific loading.

A general reduction in the overload or safety factor, which is normally 1.5 based on the yield point of the steel at 36,000 pounds/sq. in. (2,531 kg./sq.cm.), is effectively the same as increasing the design stress. In some areas the practice has developed of varying the safety factor for each of the different loading conditions. This is effectively the same as reducing the loadings, and has the advantage that it can be applied in a varying measure to each of the loading conditions in turn.

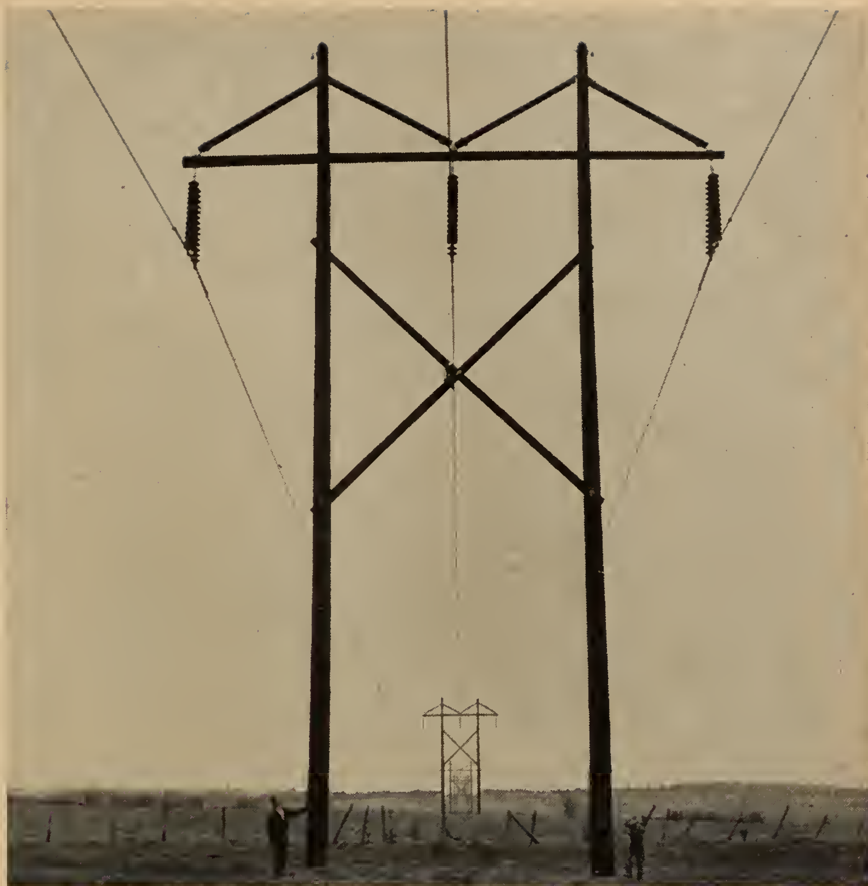


Fig. 2. 230 kv. single circuit, wood pole, H-frame construction with all spar members. Two overhead ground wires. ***(The Shawinigan Water and Power Company)***

There appears to be a trend towards the use of a higher yield strength steel, particularly in the larger tower members such as the leg angles and main compression members. This can result in a tower weight reduction of approximately 10 per cent, over an all carbon steel design, but this is largely offset by the premium price demanded for the Canadian high tensile steel. The net result is usually a very small saving in cost in favour of the combination of a carbon and high tensile steel tower over the all carbon steel tower.

(b) Conductor ice and wind loads.—The general Canadian practice is to use a conductor tension of approximately 40 to 50 per cent of the ultimate strength with an applied specified ice and wind load at 0 deg. F.

Many years of operating experience, together with extensive recordings on ice and wind conditions accumulated by the various government and private organizations, offer reasonable arguments for a modification of the present loading specifications for various areas. Although there appears to be justification for the specified individual ice and wind loads, there is substantial evidence that the maximum wind loads do not occur with maximum ice loads. Various combinations of ice and wind loads as indicated by the meteorological data are being carefully examined as to their effect on structure designs.

(c) Angle of suspension insulator swing. — To design a transmission line for a specific angle of suspension insulator swing is a fairly complex problem as there are several variables entering into its computation. While this may be calculated fairly accurately for a given set of conditions, at a specific tower, it will not necessarily apply to the entire line. The assumptions governing the variables have been fairly widely investigated and are now being modified in many instances so as to produce in the design a smaller angle of suspension insulator swing.

If the angle of swing is reduced, savings in structural weight are effected. For many years the angle of swing incorporated as a design factor in Canadian practice has been taken as 45 deg. from the vertical. This is now considered excessive and an angle somewhere in the order of 30 to 35 deg. may be more realistic. It is understood that in some European countries the swing has been reduced to under 30 deg. on certain lines.

The angle is dependent upon the wind velocity in the transverse direction, the diameter of the conductor, its weight, and the angle in the line for which the tower is designed. It is now generally recognized that the maximum velocity of the wind squall has a relatively narrow front and, while this may be applied to any individual tower, the mean velocity over the relatively long spans used on high voltage transmission lines is considerably less, thus resulting in a smaller angle of insulator swing. With the trend to the larger conductors, required with higher voltages, and the necessity to reduce corona loss as well as radio, television and radar intereference, an extremely high wind velocity is necessary to produce the standard 45 deg. insulator swing angle.

It has been estimated that tower weights may be reduced by approximately 5 per cent on a 230 kv. single circuit tower line if the angle of insulator swing is reduced from 45 deg. to 35 deg. Several Canadian high voltage transmission lines are now designed for an angle of insulator swing of 35 deg. and this reduction is gaining increased acceptance.

(*d*) *Electrical clearances.* — Electrical tests and studies show that the generally accepted clearances between the line conductors, or its hardware parts, and the supporting structures are larger than required. This is especially true regarding voltages greater than 110 kv. Presently accepted clearances assume that switching surge voltages or impulse voltages occur during gale or hurricane winds. This is felt to be rather drastic and that a more reasonable view may be assumed.

A reduction in this clearance factor results in closer phase and circuit spacing thus shortening the cross arm length and producing such advantages as a reduction in reactance, narrower right-of-way and a saving in structural weight. Some steps are being taken in this direction, although with caution, as the resultant savings are rather negligible.

(*e*) *Insulation.* — The transient voltages which influence the design and operation of a high voltage transmission line are being re-evaluated in regard to their effect on the line insulation. The usual practice has been to add extra units over the minimum number required to provide adequate insulation for the 60 cycle impressed voltage. This addition provides a margin for the lowering of the insulation value of the units due to contamination and also for abnormal electrical stresses. The lowering of switching surge voltages due to improvements in circuit breaker design, the increased knowledge of the isoceraunic levels, together with the extensive use of buried counterpoising and the protection against lightning strokes by means of overhead ground wires, all tend to a general acceptance of a smaller number of insulator units per string. The problem of contamination is usually studied on a local basis and the insulation increased to the estimated degree only on the structures affected. The economies ensuing from insulator reductions are mainly in the steel of the structures rather than a saving in actual insulator costs. It is generally agreed that shielding rings are not required on voltages of 230 kv., but are being used on voltages of 300 kv. and over.

(*f*) *Broken wire loading assumptions.* — In the search for further economies in line construction, serious consideration is being given to the effect of the longitudinal loads imposed on the towers by the so-called "broken wire loading" conditions. The general practice has been to assume the value of the "broken wire loading" to be the conductor tension produced under specified maximum ice and wind conditions. This loading is then combined with maximum vertical and transverse loadings in the designing of the structure. It is evident that a relaxation, or omission of this "broken wire load-

Fig. 3. 230 kv. single circuit V-strung suspension structure with 16 ft. 6 in. phase spacing. Two overhead ground wires. (*The Shawinigan Water and Power Company*)

ing assumption" would result in a appreciable reduction in the weight of structures. There appears to be little justification for retaining this full requirement in view of present experience on lines of modern construction. The improved technique of conductor jointing and careful stringing of the conductors have both combined to make the occurrence of a mechanical break an extremely rare event. Experience in Canada has been that modern high voltage line conductors do not break under heavy ice loads, as the safety factor incorporated in the stringing tensions is sufficient to resist the ice loads that are likely to occur. Where breaks have occurred in the past, these have generally been under ice-free conditions.

Consideration has been given in many ways to the loading imposed bv broken conductors, and some of the assumptions and proposed solutions are discussed as they relate to Canadian views.

The elimination of all longitudinal loading requirements results in a completely flexible line, with the suspension towers supported longitudinally under broken wire conditions by overhead ground wires attached at intervals to rigid dead end towers. Reports on unfortunate experiences with this type of line, in which a single tower failure has resulted in towers between the dead end structures collapsing progressively, make this solution appear somewhat less than ideal. It is therefore not being seriously considered for Canadian high-voltage steel-tower transmission lines.

Some attempts have been made in the past to use a quick release clamp that allows the conductor to pass through a tower when the insulator swings out beyond a certain angle. Tests on a clamp of this type indicate that the clamps may work effectively, protecting the tower from damage, but that there is a tendency for the clamps to act at several towers thereby dropping the conductor to the ground. The cost and duration of the resultant interruption can be as serious as if the structural damage were greater but confined to one tower.

The standard suspension clamp has an approximate slip strength value slightly greater than the normal conductor tensions, and tests have been made to determine the load applied to a tower crossarm when a conductor is suddenly broken. From an analysis of these tests, it was concluded that the full tension existing in the conductor prior to failure was transmitted as an impact load to the tower crossarm. It should be noted that this impact load could cause failure of the tower crossarm and, because of the energy absorbed in this failure, the damage may not progress further. The torque load applied to the tower would be reduced because the moment arm will be reduced by the swing of the crossarm and by the decreased tension in the span. It is also recognized that the impact strength of a structure, such as a transmission tower, is usually higher than the long time loading capacity.

Fig. 4. Three 230 kv. single circuit transmission lines. Two overhead ground wires. Seen from right to left, respectively, are lines constructed in 1934, 1950, and 1955. (*The Shawinigan Water and Power Company*)

These considerations assume that a broken crossarm would be an acceptable amount of damage. Where this condition is tolerated, the effect has been achieved by the use of a crossarm designed to fail at a specific loading. Similarly, some designs are based on a shear pin or link which would fail and permit the crossarm to swing and thus relieve the tension.

Regarding the relationship of the slip strength of a suspension clamp to the broken wire loading, it is necessary to consider the following variable factors. The suspension clamps must be able to hold a conductor against slipping on lines strung in hilly country when ice occurs on some spans and not on others; under dynamic loadings, such as those produced by "galloping" conductors. Judging by past experience, the standard clamp produces sufficient strength to meet this requirement.

There appears, then, to be some justification that the slip strength of the clamp can be considered as the maximum limit of the broken wire loading, and some Canadian high voltage transmission line structures are being designed to this factor, resulting in a considerable reduction in the weight of structures.

Some operating groups specify loadings equal to the maximum design tension of the conductor with no other major loads on the towers; others accept a lower factor of safety when designing for broken wire loading. These are all steps in the same direction and have apparently resulted in lines with satisfactory performance records.

V-Stringing of Insulators

A suspension insulator arrangement using two strings of insulators at each conductor support point, installed transversely to the line at 90 deg. to each other, is generally designated as V-stringing. Several high voltage lines, using this method of stringing, have been constructed in Canada primarily to reduce the phase spacing.

This method may offer some further possibilities of reducing the cost of transmission systems. The restriction of transverse swinging of conductors allows the lines to be installed on a narrower right-of-way. There is some saving in tower weight as the torsional load on the structure is reduced. The mechanical load imposed upon each individual insulator string is also reduced. A decrease in the line reactance, by permissible closer phase spacing, may result in equipment saving and operational economies. V-stringing has also been used, with advantage, to increase the horizontal offset distance of conductors erected in the vertical plane on double circuit towers.

The main disadvantage to V-stringing is that the cost of suspension insulators is doubled in addition to an increase in the hardware cost. There is also a greater possibility of an electrical flash-over due to defective, broken or contaminated insulators.

There are reports of severe galloping on lines with V-string single suspension clamp supported conductors during winds of gale force. A theory has been advanced that the galloping of conductors may be inhibited if each individual string of insulators supports the conductor by means of its own suspension clamp placed a short distance apart. Experimental installations of this type have been erected, results of which appear favourable, but are not considered conclusive.

Wood Structures

Experience has shown that there are very definite economies to be obtained in transmission line construction in Canada by the use of wood. Improved preservative solutions and treating methods have materially increased its life expectancy. The preservative solution preferred by most operators is pentachlorophenol in a vehicle of light oil, applied by the hot and cold immersion or pressure treating methods, depending upon the nature of the wood involved. Further economies are being achieved by the use of spar members for cross arms and braces. The previous objection to the use of spar members was the difficulty of developing adequate connections, but framing hardware is now available which will transmit the applied stresses, thus insuring the necessary overload safety factors. By the application of the various methods of reducing phase spacing, the length of cross arms and cross braces has been reduced, thus making wood pole H-frame cross-braced structures more economical and mechanically attractive. In addition, the rapid rise in the cost of steel has aided a swing towards a more extensive use of wood for transmission line construction. Many Canadian high voltage transmission lines (for all voltages up to and including 230 kv.) have been installed using wooden supporting structures. The application of wood becomes less economical as the higher voltages are reached but still offers substantial savings up to 230 kv. An increase in conductor size with a consequent greater conductor tension, increases the loadings on the structures. The size and lengths of poles are limited and eventually a balance point is reached in the number of structures per mile where overall costs dictate the use of steel structures.

All-Aluminum Conductors

It appears that considerably greater use might be made of all-aluminum conductors (AC) on medium and high voltage lines, than is at present the case. Some Canadian companies have used them to varying extents for heavy, medium and light loading conditions with excellent results.

Fig. 5. Three examples of double circuit lines. Left to right: 230 kv., two overhead ground wires; 230 kv., single overhead ground wire; 115 kv., single overhead ground wire. (*right background*) (*Hydro-Electric Power Commission of Ontario*)

On many early lines using all-aluminum conductors, conductor breakage was experienced resulting from what is now known as fatigue failure due to aeolian vibration. The cause of the trouble was not found at that time and the apparent weakness of aluminum was overcome by introducing a steel core to provide a conductor of greater strength. When vibration failure persisted, a satisfactory remedy was found in the use of vibration dampers, armour rods and improved hardware designs.

Possibly the most important problem in the use of all-aluminum conductors is that of determining the sagging tension which affects tower heights and spans and which governs the vibration life of the conductor. If an all-aluminum conductor and an equivalent cross-section area of aluminum conductor steel reinforced (ACSR) were sagged so that under a specific maximum loading they both reach tensions which are the same percentage of their ultimates, then the sag in the all-aluminum conductor will be greater than the sag in the ACSR. Thus, the structures must be higher, or the spans shorter, and this has been one of the major factors in the change-over to ACSR conductors.

Serious consideration is now being given in Canada to a possible re-orientation of thinking in regard to the almost universal use of steel reinforced aluminum conductors for high voltage transmission lines. Application of the advances in technique and improved fittings developed for ACSR to the design and construction of an all-aluminum conductor line is a good starting point. The following advantages and design features are being studied:

1. The cost of an all-aluminum conductor per unit length is much less than that of ACSR of equivalent area.
2. The weight of an all-aluminum conductor is less and the diameter smaller than that of ACSR; consequently, both the vertical and wind loads at a tower are less.
3. Where the ratio of maximum working tension to ultimate tensile strength for each type of conductor is the same, the tensions at dead end towers, and the transverse loads

at angle towers, are less for an all-aluminum conductor than for ACSR.

4. For spans of a predetermined length and for conductors of a specific cross-sectional area of aluminum, the sags, resulting from the use of an all-aluminum conductor may be less than for an ACSR conductor, if a limit is placed on the loaded tensions.

5. Compression splices and dead ends are much more readily made on an all-aluminum conductor, as it is possible to dispense with the steel sleeve required for ACSR.

Other factors involved in a change from ACSR to an all-aluminum conductor are receiving further study and may or may not prove to be a deterrent to the change.

1. The relatively light all-aluminum conductor may be more susceptible to galloping than the ACSR.

2. Wind, acting on the light all-aluminum conductor (with or without ice) will produce a greater angle of swing of the insulator string at a suspension tower. Longer arms may be required to maintain clearances, but, with the reduced tensions, the torque loads on the tower may still be less than the ACSR. It is possible that V-string suspension insulator assemblies or weights might be used to advantage in such a case.

3. On lines in rolling country, some form of hold-downs may be required on lightly loaded suspension towers.

Investigations into the stress distribution of ACSR have shown that the aluminum strands under normal conditions may be stressed to a higher percentage of their ultimate tensile strength than the percentage for the complete cable. In a homogeneous conductor, such as all-aluminum, this condition does not exist; therefore, it appears that all-aluminum conductors have a relatively higher resistance to fatigue than ACSR.

There may be, in addition, the problem of long term creep depending upon the normal loads applied to the all-aluminum conductor. Only a few of many aspects of the problem have been mentioned here and preliminary discussions on this subject have already led to investigations into some of the more obscure problems.

Fig. 6. 345 kv. single circuit suspension structure; bundled conductors. Wahleach to Vancouver transmission line. (*B.C. Electric Co. Ltd.*)

Bundled Conductors

The proposed development in Canada of hydro-electric sites more distant from the load centres is bringing to the fore the use of bundled conductors. From studies so far made, the opinion is that for lines requiring the transmission of 100 Mw. or greater, over a distance in excess of 250 miles at 60 cycles and voltages of 230 kv., or more, the use of bundled conductors should be considered. Another application arises on older transmission lines which were originally constructed on heavy loading assumptions, where it may be both economical and practicable to rebuild the conductor assembly with twin conductors of heavier total cross section. However, up to the present time very little practical experience has been developed in Canada with bundled conductors.

Double Circuit *vs.* Single Circuit Lines

There is a greater trend towards the use of double circuit transmission lines in Canada today. This trend is being accentuated by the rapid development of urban areas and the general rise in cost of land values in these areas as well as farming districts. Furthermore, the cost of clearing heavily wooded properties and the maintenance of these rights-of-way is becoming an increasing factor in the overall cost of transmission.

The basic reliability of a single circuit transmission tower line is an important factor on radial lines or on other services where security is a predominant requirement. Here, again, the growth of the high voltage network frequently affords duplicate facilities or possibilities of rerouting the supply of power.

Difficulties experienced in double circuit tower lines arise mainly from the local climatic conditions. Where the middle phase of a double circuit line is not well offset, the sudden release of ice or wet snow from a conductor may react sufficiently to make contact with the conductor above. Unequal sags are also caused by a conductor being loaded with ice or wet snow and raising the unloaded conductor in an adjacent span to the extent that clearance between phases is reduced to a dangerous degree.

Standard Conductor Loadings

The loading on conductors is assumed to be the resultant loading per foot equivalent to the vertical load per foot of the conductor, ice covered, combined with the transverse loading per foot due to a transverse horizontal wind pressure upon the projected area of the conductor, ice covered, to which resultant shall be added a constant. In the accompanying tabulation are the values for ice, wind, temperature and constants used to determine loading.

Values Used to Determine Conductor Loading

	Loading area	
	Heavy	Medium
Radial thickness of ice (inches)	0.50	0.25
Horizontal wind pressure in pounds per square foot	4	4
Temperature (deg. F)	0	+15
Constant to be added to the resultant in pounds per foot:		
For bare conductors of copper, steel, copper alloy, copper covered steel and combinations thereof	0.29	0.19
For bare conductors of aluminum (with or without reinforcement)	0.31	0.22
For weatherproof and covered wire	0.31	0.22

It has been noted that heavy ice does not usually form on conductors in a heavy wind, hence the transverse loading assumed is deemed to be sufficient for the purpose, but it is not sufficient to represent the vertical load which is imposed on the conductors by heavy deposits of ice which sometimes form in still air or with a light wind. In order to apply a total loading to conductors representing more clearly the conditions encountered in practice, constants have been added to the conductor loading. In applying loadings to bare stranded conductors, the coating of ice is considered as a hollow cylinder touching the outer strands.

It is also noted that in areas where extreme low temperatures are encountered the tension in the conductors resulting from such low temperatures may be greater than those for ice and wind loading.

Fig. 7. 345 kv. single circuit suspension structure; bundled conductors. Bridge River No. 2 transmission line. (*B.C. Electric Co. Ltd.*)

These loadings are specified by the Canadian Standards Association Electrical Code only for crossings over railways and communication circuits. They are generally applied however, to the lines located in the designated districts.

Appendix

Since compiling the information for the foregoing paper, certain interesting high voltage transmission line designs have been installed or are being seriously considered for early construction.

Probably the most unique project was the installation of a permanent arrangement of stranded steel cables across the Kildala Pass to support conductors on a section of the Kemano-Kitimat transmission line. These cables replace several towers which were carried away by snow slide. (*The Engineering Journal* — July 1956). The economy and effectiveness of this principle has led to further investigation into its application for high voltage transmission lines which are to be located through narrow valleys with high sides.

Further extra high voltage lines (300 kv. and over) are being contemplated employing two conductors per phase. This design results in economies for some utilities while others find that their system is best served by 230 kv. transmission.

Aluminum alloy conductors have been studied but are as yet not favourably received as it is generally felt that existing types of conductors are quite adequate. There is instead a trend to the use of A.C.S.R. conductors with special strandings. The size and number of aluminum and steel strands may be varied to produce an economical balance between the required electrical characteristics and the mechanical characteristics in order to meet certain conditions.

All this, in addition to further structural studies now being carried on, show that the electrical utilities are keeping abreast of the problems involved in transmitting the electrical power for Canada's expansion.

Hamilton River Survey - Labrador

G. V. Eckenfelder, W. P. Harland, and E. N. Webb, M.M.E.I.C.*

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Until recently Labrador has been largely unknown to man. In 1954 a survey was made to define the leading features for a hydro-electric development. The work covered three main divisions: the catchment, regulation, and storage area; the power development proper; and transportation, communication, and other administration. This paper describes the survey work that was done.

FROM EARLIEST times, Labrador has been regarded as a bleak, barren, uninhabitable area which, in consequence, has remained practically unknown and untouched by man. The curious and adventurous had, for many years, been drawn to the great chute known as Grand Falls below Jacopie Lake, but the flat and desolate plateau lands above were left unknown and untravelled save by a few Indians, missionaries, trappers and prospectors. In a high degree, it is still a virgin land, little changed since the last glacial age.

Investigation of power potential on the Hamilton River was provoked by the unceasing demand in Canada for ever more electricity which has approximately doubled each decade over the past 20 years. The major part of this paper describes the ensuing surveys and related enquiries.

A purely preliminary survey of the river up to Grand Falls and in the immediate vicinity had been carried out for Newfoundland Government in 1947-48 by Comdr. G. H. Desbarats[1] who estimated a potential around 3¼ million continuous horsepower. However, this conclusion was based on little more than an ascertained difference of river level and an estimate of run-off by analogy. The field work was restricted to that which could be done by ground parties dependent on canoe and pedestrian transport. In a total working season of less than four months with the effective working time sadly curtailed, the record left by this investigator with the means at his disposal and in the face of so many natural obstacles is a highly creditable one.

The objectives of the 1954 investigation† were essentially to define the leading features of the best discernable scheme for a hydro-electric development, and to establish the feasibility and economics by preparing preliminary designs and estimates. The survey proper resolved itself into: preliminary reconnaissance on which to identify the mode of eventual development and the operations ancillary to it, adequate topographical coverage of the essential areas, measurement and check of rainfall, river flows, and run-off, and collection of all possible information regarding engineering, materials, geological formations, climate, and so on.

Remoteness of the area and extreme shortness of the working season called for large survey forces and intensive organization to achieve conclusive results within one year—which subsequently was extended to two years, in order to check, elaborate and improve the engineering information up to the pre-design and pre-construction stage. Thus, the work was allocated to the three parties concerned in three main divisions: (1) the catchment, regulation and storage area; (2) the power development proper; and (3) transportation, catering, radio and general administration, access and transmission also being included here.

Historical

The Hamilton River was named in 1821 after Sir Charles Hamilton, Governor of Newfoundland. John McLean of the Hudson's Bay Company saw the falls in 1839, and is thought to have been the first white man to view the awe-inspiring cataract. Various other explorers visited the falls during the latter part of the 19th century; notable amongst them was A. P. Low, [2] a geologist of great energy and fortitude, who travelled far and wide over the Labrador tableland and whose report described the falls in detail.

The first reported enquiry into the power potential of Grand Falls area was in 1915 by W. Thibaudeau who made a reconnaissance of the power possibilities of Grand Falls, and he and his group may have been the first to visualize development of the site by the so-called "Channel Scheme" (Fig. 3). Their surveys provided a profile of the river from Jacopie Bay to the foot of Portage Creek showing that approximately 1,000 ft. of head existed in that reach. They also obtained a profile along the chain of lakes between these points.

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*The authors are associated, respectively, with Montreal Engineering Company Limited, Shawinigan Engineering Company Limited, and British Newfoundland Corporation Limited.

† by the British Newfoundland Corporation Limited.

Desbarats' survey[1] comprised levels from the foot of Muskrat Falls near sea level, to Jacopie Lake, and traversed the reach of the river adjacent to Grand Falls; incidentally, Thibaudeau's scheme for power development was shown to be practicable. Desbarats also made a preliminary reconnaissance of possible sites for utilizing the head between Grand Falls region and the sea. Moreover, he gave some attention to storage and drainage areas, as ascertainable from the Topographic Survey of Canada's small scale maps.

All of this information became available to the authors, and the elevation of Desbarats' bench mark at the crest of Grand Falls was used as the datum for the Corporation's 1954 and 1955 surveys.

Winter Reconnaissance

While results of previous investigations were helpful in a preliminary evaluation of the power site, they shed little light on the catchment area above Grand Falls. The photographs from which the uncontrolled maps of the Topographic Survey had been plotted were available, but gave little idea of ground elevations or of relative heights of lakes.

It was obvious that a ground reconnaissance must be made before any serious survey could commence. The general topography of the entire area had to be examined to determine: (a) elevations of lakes; (b) possibility of diverting the Naskaupi and of a diversion route; (c) feasibility of creating one large storage reservoir out of Sandgirt, Lobstick, and Michikamau Lakes; (d) locations of damsites for diversion and storage; (e) possibility of diverting the Unknown branch of the Atikonak; and, (f) locations of camp sites and aircraft landing areas.

On 3rd March, 1954, an expedition of ten men, under the leadership of engineers from the consulting firms, was based on the Menihek power station[3] about one hundred miles northwest of Grand Falls. Using two Beaver aircraft, the party made daily trips into the Grand Falls area over a period of three days during which the elevations of 12 stations were determined and a diversion route was reconnoitered. Still based on Menihek and using Beaver aircraft in sub-zero weather, two weeks were spent in the storage area, examining the country in order to become familiar with the topography and to find possible damsites. The required information hinged mainly on elevations which were obtained almost entirely by means of surveying altimeters. The Wallace and Tiernan instruments capable of detecting 1 ft. difference in elevation, were preferred.

Where it was important and feasible to obtain accurate levels, a spirit level was used.

The barometric levelling was done in two ways, the "single base" and the "leap frog" method. In the former, one barometer at a base station is read at prescribed intervals, while the other is carried by plane from lake to lake. Readings from the base barometer provide corrections to the elevations obtained by the other, the plane returning to base to compare instruments at the end of the day.

In the "leap frog" method, after readings have been taken simultaneously at the base and at the lake of which the elevation is required, the base instrument is brought forward in one plane and landed at this lake where the instruments are read side-by-side. Repeating the procedure, one plane (with barometer) remains in position until the other plane (with barometer) has landed at a new point when simultaneous readings are again taken. Radio communication is essential for this method.

All elevations were checked in the field by repetition, a minimum of six determinations being made for each lake. The "leap frog" method proved the more accurate of the two. In the "single base" method, the distance from base often became so great that local variations in air pressure produced inconsistent readings. In the "leap frog" method one is measuring differences and, virtually, the base moves along near the roving plane, which gave a closing accuracy of about plus or minus four feet on courses up to 120 miles long. During two weeks, the elevations of 76 lakes were obtained.

An overall picture of the ground to be surveyed emerged as a result of the winter reconnaissance. It was found that a flood channel existed through which the Naskaupi could be diverted into the Hamilton watershed, and that it was possible to divert the Unknown River branch of the Atikonak. Combining Sandgirt, Lobstick, and Michikamau Lakes presented no major obstacles, the reservoir thus created being contained by high ground, except at natural outlets where alternative sites for necessary dams were noted to exist. The elevations obtained, along with visual impressions of the topography, indicated no major obstacles to the Channel Scheme and two possible routes, one possessing natural advantages. A great many lakes were shallow and boulder filled, but lakes suitable for aircraft landings with related camp sites were found and noted. Lake ice was ascertained to be 40 in. thick, permitting the landing in winter of large aircraft with heavy loads.

All this information was of great importance, as it was now possible to determine within narrow limits the extent of the surveys required and to plan the summer's work accordingly.

The winter operation was not without hazards — low temperatures, blustery weather, unreliable visibility and radio — wherefore, safety precautions were essential. Aircraft carried emergency rations and camping equipment; flight plans were always filed, so that each pilot knew where the other was operating; and whenever men were left on the ground, even for a few hours, they were equipped to be self-sustaining.

Under severe winter conditions in a remote and totally wild region, a great deal of essential knowledge, far beyond expectations, was gained in less than three weeks and at a surprisingly low cost.

Control Surveys for Topography

The greater part, by far, of the ensuing field work consisted of establishing ground control for photogrammetric mapping. The type of information sought and the conditions prevailing in the storage area differed so widely from those in the power phase of the investigation that the methods used in each were necessarily different. However, the same principles applied in both areas.

Two types of control were required for photogrammetric mapping —horizontal and vertical. The firms engaged to carry out the photogrammetry indicated on prints of the aerial photographs the control which they would require, choosing small prominent objects that stood out well on the photographs as "H" or horizontal control points. The abundance of lakes and ponds provided the "V" or vertical control. Large lakes extending over the area of one or more photographs afforded natural vertical control and reduced appreciably the amount of levelling to be done.

(a) Storage Area — In the stor-

Fig. 1. Map showing general location of Grand Falls relative to important centres and physical features in Eastern Canada.

age area, great reaches of ground had to be contoured, and closed traverses were neither feasible nor essential. The country having little relief, maps with a close contour interval but on a relatively small scale were required. In the absence of closed traverses, azimuth checks were obtained by frequent sun observations — these in preference to star shots to avoid overnight vigils at stations far removed from the camps.

Since it was necessary to cover very elongated areas, the "H" points were tied to an open traverse which was run near the axis of the strip photographed. As a ground profile for making preliminary estimates was aimed at, so far as possible the line of traverse was selected along the high ground where visual reconnaissance indicated the containing dams might be located.

Vertical control along the main traverse was established by a double line of levels, elevations of the lakes chosen as "V" points being fixed by level loops from the main traverse. Permanent bench marks were set in rock at least every five miles along the main traverse.

(b) Power Area — In the power area, the ground surveys were divided into two broad categories; viz. control for photogrammetric mapping, and tentative location surveys for the proposed structures and installations. Effort was made to combine the two wherever possible.

After careful consideration, it was decided that closed traverses would be preferable to triangulation for horizontal control, if only for the additional information about the terrain that would be gained. Loop closure accuracy of 1 in 1,000 or better was maintained. As in *(a)*, a double line of levels provided the profiles along the traverses. Many miles of traverse round lakes were obviated by the chaining on ice accomplished by the 1954 advance party in May of that year. For orientation purposes, transit observations on Polaris were used for the basic azimuths.

A co-ordinate system was laid out, such that all of the power area would fall within one quadrant. All co-ordinate computations were referred to a selected base, to which line also convergency corrections were related. The Geodetic Survey of Canada station on Lookout Mountain was tied into this grid, so that the whole system can be readily converted to geographical co-ordinates when required.

"H" points were tied into the closed traverses, and the elevations of "V" points were fixed by level loops. Unlike the storage area, it was necessary to provide a small scale 20 ft. interval contour map of the whole area, as well as large scale 5 ft. contour maps of limited areas. To provide the vertical control for the 20 ft. contours, some elevations were determined barometrically, the "single base" method being used with not less than two sets of readings taken on different days.

No mention of control surveys would be complete without reference to an unusual role played by the helicopter. When beginning a traverse between two points in the bush, it is often difficult to determine in which direction to head. The helicopter assisted greatly by hovering over the point of destination at just sufficient altitude to be seen by the instrumentman at the start of the traverse. When the helicopter was on position, a red flag weighted by a stone was lowered some 15 ft. to 20 ft. as a signal for the instrumentman to take a sight, which device saved considerable time and unnecessary length of traversing.

Topographic Detail Survey

Compared with the area which was mapped from aerial photographs, the topographic coverage on the ground was quite small. In the vicinity of Grand Falls, some 9 square miles were mapped in 1954, principally in the eastern portion of the area where lighter bush and an old burn facilitated stadia work. The plane table was little used, owing to general inclemency of the weather in 1954.

No field topography was done in 1954 in the diversion area, the bush in the vicinity of the river being too dense. Time and effort were considered spent more profitably in taking underwater soundings, especially as maps from aerial photos could be produced from control already provided. In 1955, the sections mapped in the field were restricted to anticipated sites for some of the principal structures.

During the first winter's study of the Channel Scheme in the office, some of the contemplated works were defined to an extent that justified proceeding with detailed surface investigation and seismic profiles. Others were so indefinite that a larger area needed to be analyzed, for which purpose large scale maps already prepared from aerial photographs appeared adequate, thus requiring no additional field work in 1955.

In the case of the Naskaupi diversion and the Ossokmanuan damsites in the storage area, the height of land along which containing dams were needed was so well defined that an extensive band of topography had not been thought necessary. Much of the ground could be covered adequately by a single profile, with topography only at the main river crossings. The 1954-55 winter studies, using 5 ft. contours plotted from stadia and level data obtained in 1954, suggested an alternative scheme for the Ossokmanuan diversion, which made it advisable to obtain contours over a wider area. In 1955, this area was photographed and a new control survey made.

Traditional methods of ground topographic surveying played but a minor part in this investigation and only modern techniques could have provided the information in the short time allowed. It must be admitted, however, that detailed field surveys, where applied, afforded excellent opportunity to become familiar with the characteristics of the ground.

Photogrammetry

Aside from the obvious advantage of economy, the photogrammetric method of mapping was ideal for the prescribed purpose, in that actual field work could be reduced to a minimum.

The aerial photography and photogrammetric mapping were done by several firms. In the Grand Falls area, some 300 square miles were photographed at three different altitudes consistent with plotting at three different scales. In the event, only two scales were utilized: 800 ft. to 1 in. with a contour interval of 20 ft., and 200 ft. to 1 in. with 5 ft. contours. The entire Grand Falls site area, amounting to 228 square miles, was mapped at 800 ft. to 1 in.; while 30.5 square miles, including all localities for proposed structures, were covered at 200 ft. to 1 in. The smaller scale was considered adequate for general location of access roads and material deposits and for preliminary layouts, while the larger scale would suffice for setting out structures in detail.

Fig. 2. Map of the catchment and storage area, showing location of surveys.

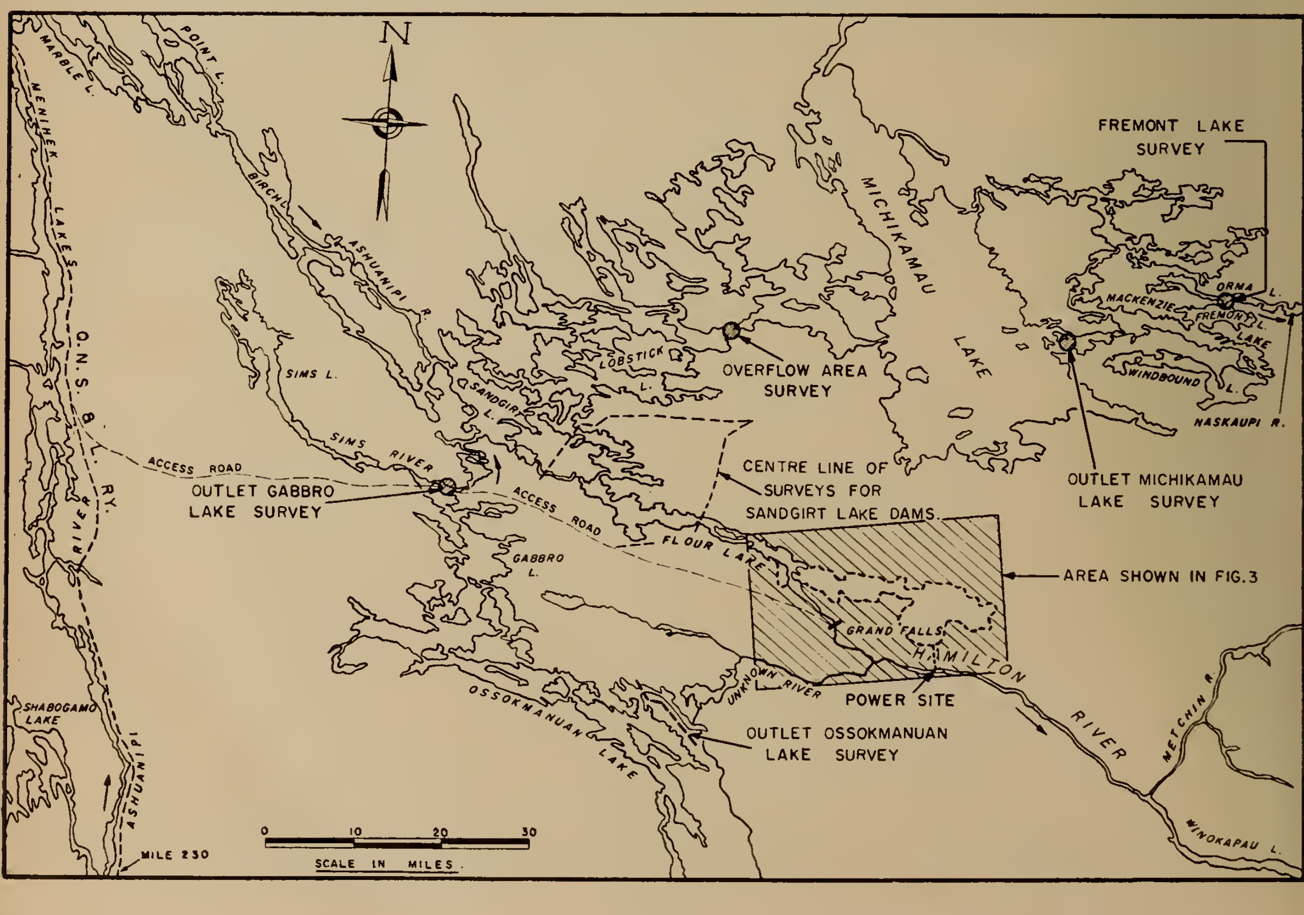


Fig. 3. Map of power development area, showing location of proposed engineering structures.

All storage areas were mapped to a scale of 400 ft. to 1 in. with a contour interval of 5 ft., which was adequate for the detail required and yet did not result in an excessive number of sheets; 145 square miles of ground were covered in this manner during 1954 and another 40 square miles in 1955.

Organization of the ground control generally followed the same pattern throughout, being varied according to individual circumstances. With minor exceptions, the firms undertaking the mapping sent their own photogrammetric experts into the field to define the control required and to supervise the survey work in progress. Where the parties concerned had mutual confidence based on prior experience, such specialist participation became a minimum. In all cases, the results were well up to the requisite standard.

In addition to being fast and comparatively inexpensive, photogrammetry produces very accurate maps. The recognized specification for contours is that they be correct within half a contour interval and, providing the vertical control is adequate, this stipulation is usually met without difficulty.

Where horizontal control is adequate, well-defined physical features can be plotted within 0.02 in. (hardly more than the thickness of a line) of their absolute positions. However, contours cannot be plotted with quite such accuracy, but their relative positions usually are very good.

Aerial photographs are invaluable in the field. Even the best of maps cannot provide the detail and information that is readily available from a pair of photographs and a pocket stereoscope.

Marine Soundings

In the diversion area, very extensive underwater soundings were required in order to provide basic information for the planning of various structures. In the storage area, the extent of cut necessary to divert the Naskaupi could be determined only by means of underwater topography. During the 1954 season and the early portion of the 1955 season, soundings were taken in the traditional manner by lead and line; but in the latter portion of last summer an echo sounder was introduced for this work. However, the Michikamau diversion soundings, being well advanced by this time, were completed by lead line and sounding pole.

Unfortunately, a great deal of the required underwater topography was in fast flowing water on the Hamilton River itself, which fact necessitated a rather elaborate organization for locating each sounding, whether taken by lead line or by echo sounder. In the usual procedure, two parties, each comprising a transitman and a notekeeper, were installed ashore on two stations of the river triangulation network, whence they could intersect the position of the boat as each sounding was made. These stations were so selected that the intersected angles lay between 30 deg. and 150 deg., and were close as possible to 90 deg.

After some experimenting, co-ordination between the instrument parties and the sounding party was systematized as follows. All parties synchronized watches before beginning a run, and soundings were then taken at pre-arranged intervals, every tenth sounding being indicated by a signal. With this system, up to 100 soundings could be made per hour using lead and line, and 360 per hour using the echo sounder.

The leads varied in weight between 4 lb. and 20 lb., depending upon the velocity of the water. After trial of various types of line, the most satisfactory was found to be "cod line" actually carrying the lead and having a metallic cloth tape loosely attached to show the depths.

At the Michikamau diversion, shallow water rendered it possible to sound with a pole. Soundings were fixed by two transits at shore stations but, as the distances were small, the angular fixes could be checked by stadia. Some 2,300 soundings were obtained in this way.

The echo equipment used, although inexpensive and intended primarily as a navigational aid for pleasure craft, exhibited an accuracy of 1 ft. for soundings between 0 and 60 ft. Electrical impulses at the rate of 30 per second are converted by a submerged "transducer" into mechanical waves which travel to the bottom and are reflected back to the transducer, there to be reconverted to electrical impulses. The time elapsed between the emission and return of the signal is indicated on a dial graduated in feet. Excellent results were obtained at any reasonable boat speed, even in the rapids. While river bottom conditions gave satisfactory operation of the echo sounder, at some places on the lakes a bottom of soft organic matter was found to absorb the mechanical waves and no reading resulted. This, however, did not affect the usefulness of the equipment to this survey as it was used entirely in the river.

Altogether, 6,900 soundings (2,300 at Michikamau) were taken during the two seasons over an area of approximately 600 acres.

Levelling and Water Transfers

It was important that the surveys of the widely separated areas comprising the Grand Falls power and storage scheme be related to a common datum. No geodetic bench marks or other datum existed above the head of Grand Falls, and the elevations obtained by barometer during the winter were of quite inadequate calibre for the contemplated surveys. In the event, Desbarats' bench mark at Grand Falls was adopted to relate the surveys to sea level, pending re-survey of the lower Hamilton. A line of levels was carried from this bench mark via Sandgirt to Ossokmanuan; also, up to and across Michikamau, over the height of land and on to the headwaters of the George River.

The map shows how much of the country is covered by water and full advantage was taken of this fact. Whenever possible, elevations were carried by water transfer across lakes, in order to reduce the amount of levelling work. This was only possible on lakes, or on streams with negligible gradient and during dead calm weather. Several readings of water level were taken simultaneously at each extremity of the lake or reach of river, and no elevations were accepted unless the successive

Fig. 4. Grand Falls and approach rapids.

readings agreed within 0.01 ft.

Where no suitable body of water existed, levels were run by instrument along the shortest route between lakes. All levelling was done using two rodmen, two sets of readings and two sets of notes, thereby providing a continous check.

One party was engaged during the 1954 summer solely in running these levels; and again, in 1955, a profile of the Hamilton River from Portage Creek to Muskrat Falls was obtained generally by the same method. To cover these great distances in so short a time, the party had to be highly mobile. The 1954 party comprised an instrumentman familiar with the method of water transfer, a rodman, and two axe-rod-canoe men, transported by two seventeen foot canoes each equipped with a ten horsepower outboard motor. Camping equipment was limited to essentials, and was selected for light weight and compactness, each man carrying an eiderdown sleeping robe. Four small Scotch silk tents and gasoline cooking stoves were used. Fuel caches were established along the line of travel by aircraft, and at least once each week weather permitting, an aircraft visited the party and left about a week's food, fuel, and other supplies. A portable radio kept the party in touch with Sandgirt base camp and provided fairly dependable contact at surprisingly long ranges.

In the 80 days campaign of 1954, this levelling party covered about 550 miles of land and water.

The men engaged in other phases of the investigation were housed in static camps where it was possible to provide a reasonable standard of comfort; but, for the level party, life was bared of all frills. Camp was pitched where nightfall found them, on rocky shore or edge of swamp; the course of the canoes often took them through wild rapids and across windswept lakes; they were more often wet than dry. Yet it was a happy camp, and the quality of the work was consistently high.

Seismic Sounding

As may be seen in Fig. 3, any development of the Channel Scheme would require structures covering a considerable expanse of territory. To divert and control the water from Jacopie Bay to an intake near Portage Creek, would involve some 3½ miles of excavated canal and 15 miles of earth-fill retaining dams. Evidently, investigation of depth and type of overburden along the lines of these canals and dams would be impracticable within the short season available, if attempted by test-pitting and borings alone. Geophysical exploration by seismic sounding appeared to be the answer.

The seismic refraction method used[4] is based on the principle that longitudinal seismic waves behave very similarly to sound waves, in that the velocity of the wave front varies with the density of the medium through which the wave passes. In operation, twelve special seismometers, known as geophones, are set out at regular intervals on a tangent which has already been profiled. The spacing between geophones may vary but usually is 15 ft., giving a set up length of 165 ft. which normally suffices to determine bedrock at depths up to 30 ft. or possibly more. If greater depth to bedrock is anticipated, the geophone spacing is increased accordingly.

The seismic impulse is produced by a dynamite charge, the size and location of which depends on the nature and anticipated depth of the overburden. These seismic waves travel through the earth to the geophones where the mechanical impulses are converted into electrical ones and recorded on a strip of moving film. The increments of time between the arrival of seismic waves after having passed through media of different densities provide the data for computations to determine the depth to bedrock.

There are, of course, various combinations of conditions which can complicate the interpretation of the seismic data. Therefore, it is necessary to conduct a geological surface examination of the area prior to the seismic work, and to sink a certain number of test pits or borings after. Correlation of the data thus obtained assures interpretation within the required limits of accuracy.

During the 1954 season, seismic investigations were confined to ascertaining depths of overburden along the lines of principal structures. However, during the following winter the additional possibilities inherent in the method prompted its wider application to procure fuller information regarding the nature of the overburden at the sites of structures, and the extent of available deposits of construction materials. In combination with adequate test-pitting, this application proved generally successful and effective. Determination of bedrock profiles along the centre lines of structures was continued in 1955 and, by locating the test pits strategically, the nature of the overlying material also was ascertained.

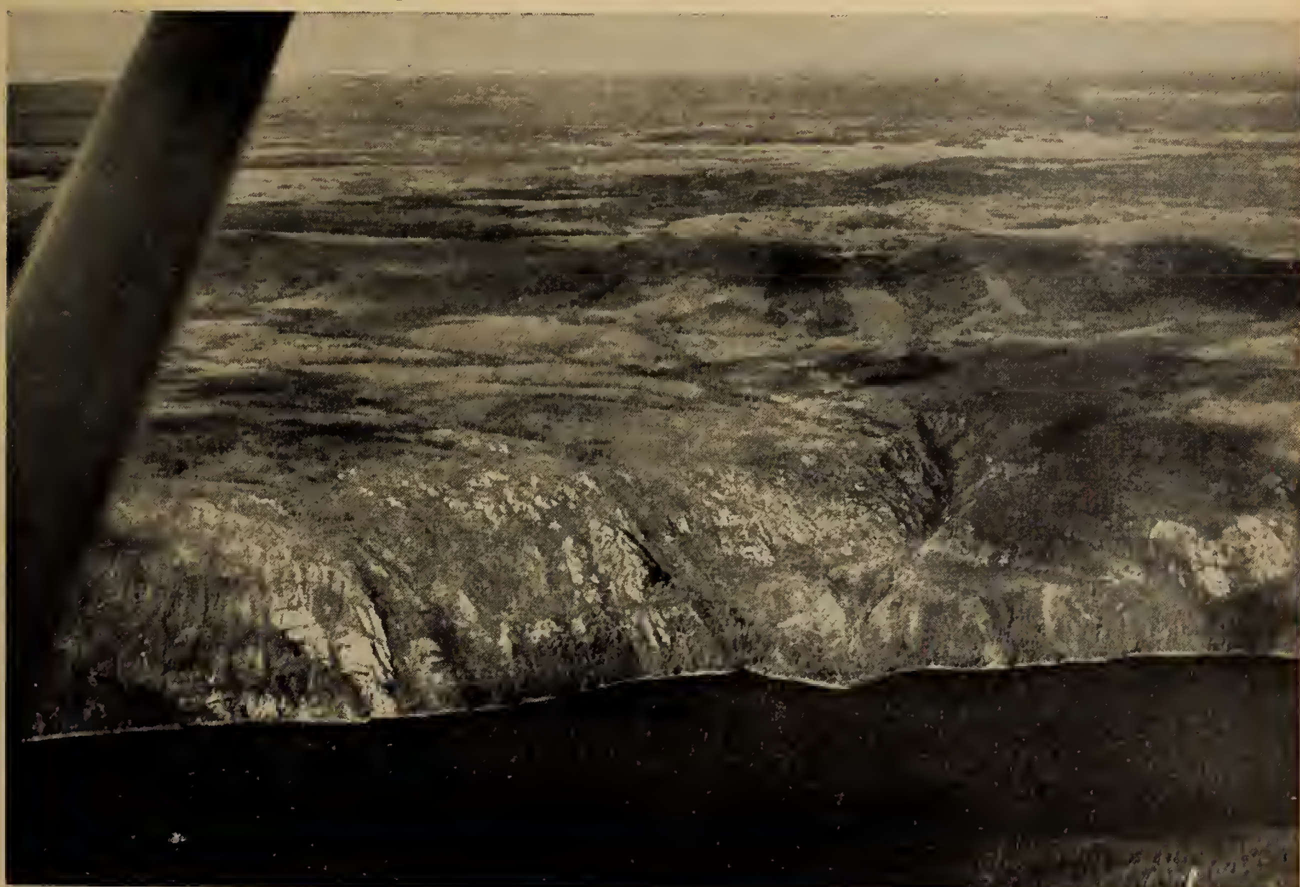
In addition, the depths of major deposits of pervious and impervious fill were defined by seismic sounding. A preliminary examination of a deposit selected by map and aerial photo was made by the geological party, who then dug shallow test pits to get a general "feeling" of the area and thereby to deduce the most suitable line for a seismic profile. After plotting the seismic results, the position for a deep test pit was chosen to afford the maximum of information from a minimum of excavation.* Such test pits elucidated the causes of "discontinuities" or changes in velocity and provided identification of the various materials represented by different velocities. The seismic profiles then enabled extrapolation laterally of the information obtained from the test pit.

Through the use of seismic methods, a continuous rock profile was obtained for the full length of all proposed dams and canals. Moreover, by combining other available data, the nature of the overburden at these sites was deduced with confidence. Depths of overburden investigated varied from 0 to over 200 ft. and averaged about 20 ft. The work done on natural deposits of pervious and impervious fill has made possible close estimates of the quantities actually available. No more than a small fraction of this diversified information could have been gained from surface examinations and test-pitting only.

A total of 79,635 ft. (15 miles) of seismic profile was produced by the

*See also under "Geology and Soils"

Fig. 5. Aerial view looking north across Hamilton River at Portage Creek below Grand Falls; Sona Lake in middle distance, with Lake Michikamau far distant in top left.



equivalent of one party working for seven months.

Rainfall and Run-Off

Scant knowledge of the Hamilton watershed run-off existed at the start of this investigation. Until a continuous stream flow record of several years duration existed, the energy potential of the river could not be assessed with any precision. Therefore, it was of the utmost importance that stream gaugings be started at the earliest possible moment. For the immediate appraisal of the size of development upon which to base preliminary design of structures, extended flow records being non-existent it was necessary to make a reasonable guess, using such fragments of knowledge as obtainable of the climate and of the characteristics of the watershed.

Discharge measurements had been started at Muskrat Falls in October 1953 and at Menihek Rapids in June 1952, but the latter were not continuous. The Department of Transport had established a weather station at Sandgirt Lake in 1943, where precipitation and temperature observations were made until April 1948; but, mining operations having begun at Knob Lake in 1949, the weather station was transferred there. In addition, continuous meteorological records have been kept at Goose Bay since May 1942. Goose Bay, however, is too distant for its records alone to be of much value in estimating run-off from the upper reaches of the watershed.

No evaporation observations had been made in the area, wherefore the proportion of the precipitation appearing as river discharges was not known. Nevertheless, by giving due consideration to climatic characteristics, terrain, meteorological conditions and the like, one could deduce the probable evaporation in Labrador. This, deducted from the minimum annual precipitation disclosed by the Sandgirt and Knob Lake records, gave a figure for run-off during the driest year in the period covered. The run-off thus derived was adjusted to allow for the probability of greater precipitation along the southern fringe of the watershed, and was then reduced to compensate for the effect of a drought cycle. Thus, an appraisal was made of the water available for a power development.

Having thus estimated the dependable annual run-off, there yet remained to define how this run-off was distributed throughout the year, in order to determine the extent of storage necessary for regulation. The twelve months of continuous records at Muskrat Falls gave the shape of the hydrograph at that point and, for the time being, the characteristics of the hydrograph above Grand Falls were assumed the same.

Stream-Flow Gauging Stations

The extreme paucity and sketchiness of the data available for computing a run-off figure will underline the urgent need for much more information. As soon as the survey parties reached the field in the summer of 1954, a temporary recording gauge was installed on the Hamilton below Portage Creek, and two discharge measurements were made at this point during the summer. Four permanent gauging stations were planned, one on the Hamilton above Jacopie Lake, one at each of the two outlets of the Atikonak, and one on the Naskaupi at Fremont Lake; considerable preparatory work was done at these sites before freeze-up.

During the fall and early winter, cable car installations at each of these sites were designed and material was ordered. In January 1955 a crew of men proceeded to the field and the material was air-lifted to the sites. The heaviest single package weighing nearly two tons was the cable for the Flour Lake crossing (1126 ft. span), which required a DC-3 on skis to carry it and more than 20 men on snowshoes to drag it the remaining 2½ miles to site. In all, about 20 tons of material were brought in, while large quantities of local wood, stone, etc. also were used in the various structures.

By spring, all four cables had been installed in time for the engineers of the Dominion Water Resources Bureau to measure the discharge at the spring flood. During the summer, safety guys and backstays were added, and settings were built for the recording gauges. Calibration meterings are now being made at regular intervals.

Fig. 6. Typical survey camp, showing usual transport facilities.

Geology and Soils

Investigation of the surface geology and into the occurrence of "soils" proceeded during the whole field seasons of 1954 and 1955. The earlier work by two geologists and two assistants which aimed at providing the general geologic background at the proposed engineering sites, was expanded in 1955 to obtaining detailed surface and subsurface information at locally important sites and, with the addition of an engineering 'soils specialist' graduate, to comprehensive investigation of "soils" deposits.

The 1954 reconnaissance followed on pre-season study and interpretation of aerial photographs, during which an impression had been gained of topography, outcrop distribution, soil cover, types and location of construction materials and other surface features of possible engineering significance. These features were assessed more fully during the field season, using a helicopter for spot-checking, and final detail was obtained by ground traverses and shallow test pits.

Outcrops in the vicinity of proposed sites were mapped geologically by ground traverses, special note being taken of possible major bedrock features which might affect future engineering structures. This work prepared the way for diamond drilling and further seismic investigations in 1955. On these traverses, shallow pits were dug and the soil sampled to determine the nature of the overburden.

In the course of investigating sources of construction materials, some 120 test pits were dug with pick and shovel to depths between 5 ft. and 15 ft. About 170 mechanical analyses were made of material in the range from ¾ in. to 200 mesh; material below 200 mesh was not sub-divided, while that above ¾ in. was only estimated by eye. Construction material was thus classified as to grain size and also according to geologic origin which information, compiled in report form incorporating test pit logs, grading curves and 7 geologic soils maps, covered the 150 square miles reconnoitered.

During the 1955 season, the work developed into two separate related phases, surface and sub-surface investigations. The soils enquiry required more detailed assessment of suitability and quantities of deposits at locally important sites. Briefly, this involved test pit digging, sampling and testing, interpretation, and determination of quantities. Also, the search was extended into other areas, where numerous shallow exploratory test pits were dug. Six test pits were dug to depths between 20 ft. and 41 ft., using a winch with bucket and shoring the pit sides with local black spruce — this under engineering supervision.

Field tests of soil samples included: (a) mechanical analysis of material between 200 mesh and ¾ in. size; (b) colour tests for organic contamination; (c) visual estimates of material above ¾ in.; (d) in-place density tests; (e) moisture content determinations. For more detailed tests, 50 lb. samples were sent to Montreal.

Surface and sub-surface investigations of the bedrock consisted of detailed surface geologic mapping and diamond drilling. For the latter, two

Fig. 7. The deepest test pit, 41 feet, dug in two weeks.

drills operated in two ten-hour shifts through most of a three months period. Six thousand feet of core provided a satisfactory picture of subsurface conditions, and further drilling at this stage was not considered necessary. Results of surface mapping and of drilling were combined to produce a plan and profile of local rock structure.

Access Route

A programme of reconnaissance during the summer of 1954 aimed at defining the most feasible and economical mode of access to Grand Falls. Air transport was not contemplated seriously and access by water was deemed unpractical as the open season is only 4½ months a year; therefore, investigation was confined to land routes.

The Quebec North Shore & Labrador Railway passing within 100 miles of Grand Falls is the obvious artery for heavy traffic into the Hamilton basin and thus, also, is the logical starting point for the access route. A road was envisaged in preference to a railroad, because of its lower cost and greater flexibility.

Possible routes were first selected by study of the three available sources of information: (a) the 8 miles to 1 in. map, showing the general geographic features of the area; (b) the R.C.A.F. aerial photographs covering the area at ½ mile to 1 in.; (c) existing Q.N.S. & L. Rly. facilities, such as railroad sidings, airstrips and tracks.

Five alternative routes were picked out, and then examined from the air in order to discern the more promising one; which, in turn, were investigated by on-the-ground reconnaissance to ascertain how best such obstacles as river crossings, swamp areas and solid rock outcrops might be overcome. Results proved conclusively that a road along the most northerly route would best serve the overall development plans. Although the short field season permitted only a cursory examination of this route, it yielded ground data which, with supplemental studies of the aerial photos, enabled the compilation of a ½ mile to 1 in. map showing tentative location line, type of terrain, swamp areas, river crossings, etc. This information proved invaluable for planning the engineering survey undertaken in 1955.

Starting from a siding at Mile 286 on the Q.N.S. & L. Rly., the route goes almost due east for 100 miles to the major crossing of the Hamilton River above the falls; thence, generally north and east to the power site. The preliminary survey in the summer of 1955 had as objectives: (a) to mark out and survey the actual road alignment; (b) to procure adequate information regarding quantities for reliable estimates; (c) to obtain full engineering details of all major obstacles;

and, (d) to establish the economic merits of the chosen route.

A field engineer party of eight men, assisted part time by specialists, carried out the survey in some 4 months. The main survey camps were established and serviced by Beaver aircraft, while the placing of subsidiary camps and daily transport of men were effected by helicopter.

Altogether, 100 miles of road were traced, surveyed by compass and chain, pegged at 500 ft. intervals, and flagged every 2,000 ft. for 80 miles. Gradients and lateral slopes were determined, along with sufficient information regarding clearing, nature of ground, etc., to provide reliable cost data; particular attention was paid to lengths and depths of swamps. Complete pre-design data were obtained for four major water crossings.

In addition to this general location survey, the first 12 miles from the railroad siding were set out in detail, full information for precise estimating being recorded.

Suitable soil materials were identified in some convenient areas, but a wider occurrence of gravel and sand deposits would be advantageous; however, the investigation was not conclusive. Construction of a road presents no major difficulty; while costs would be high, they can be anticipated to compare not unfavourably with projects of a similar kind.

Electrical Transmission

Disposal of power from so remote a place inevitably is a major problem to which long distance transmission affords one solution. The amount of power and the distances involved call for the highest practicable voltage, and modern developments require that direct current be not overlooked.

Various considerations suggest the north shore of the St. Lawrence as a potential scene for industrial development and application of such a block of power, while technical and commercial attractions point to Seven Islands. Accepting this as a typical case, a transmission route to Seven Islands was selected — mainly from 'paper reconnaissance' — in 1954, as a basis for estimating. This was elaborated in 1955 to reconnaissance by air and on the ground, combined with intensive study of aerial photos and collation of much pertinent information from other sources.

In this way, a highly practicable transmission route has been defined, adequate information for reliable preliminary estimates has been secured, an. detailed plans with costs for final survey of the line have been formulated.

Logistics

Decision in February 1954 to investigate the Grand Falls power potential during the ensuing four-month summer season posed exceptional targets of field work and of finality within one year, all despite very little knowledge of the conditions likely to be experienced. The winter reconnaissance confirmed the broad outlines of the field programme and emphasized the factors involved in maintaining camps, scattered over 2500 square miles and 250 miles from the nearest supply centre. These factors were crucial in the organization of such a field survey contemplated for completion in one season only.

Of necessity, the survey was directed from Montreal, with principal line of communication and transport to the field via Seven Islands, whence the Corporation's base camp between Mile 224 and Ross Bay on the Ashuanipi River was reached by a twice-weekly freight and passenger service on the newly completed Q.N.S. & L. Rly. This left 65 miles to the nearest survey camp, or 105 miles to the proposed power house site, to be covered by air.

To save both time and money, bulk stores for the field force of 180 men were flown into the area from Mile 224 base and landed on the ice during April. This eased the pressure on transport in early June, when the ice went out and prompt movement of men and fresh foods was essential to commencement of field work.

Although adequate landing facilities for heavy aircraft were not numerous during the ice-free period, all bulk transport was by heavy plane as far as possible before transferring to lighter and more versatile aircraft. Once camps had been established, two Beaver aircraft and two Bell helicopters provided nearly all transport services. Scheduled flights were found impracticable due to weather, the number and diversity of the camp sites, and the flexible nature of the survey; constant supervision and adjustment were necessary to prevent wasteful use of aircraft, or hindering the work.

Total flying time for all aircraft in the 1954 summer season was 2,578 hours of which one-half was attributable to camp service. The other half comprised: 23 per cent for survey work, 16 per cent for moving personnel, and 11 per cent ferry flights. During 1955, with 150 men in the field, the same number of aircraft was used but total flying time was 2,202 hours; ratios remained almost unchanged.

In order to expedite the survey work, to control and co-ordinate aircraft movements, and to supply all camps, a good radio net was essential. Voice radios of 80 and 85 watts output operating in the 3 to 5 megacycle band were installed in the major camps and provided contact with aircraft also. Effectiveness of communication depended on conditions and was generally good between all parts of Labrador, Northern Newfoundland and Seven Islands, but erratic with Montreal. Smaller camps and vehicles operated on the same frequency with portable sets of 3 to 15 watts output. Radio maintenance required a full-time technician during the summer.

Once communications had been established, camp supply, administration and catering followed routine patterns. Camps (with one exception where an abandoned meteorological station was used) were under canvas, both summer and winter; lighting was by gas lamps, cooking and heating by wood stoves. During the first summer, the blankets and camp beds issued to all personnel proved inadequate for cool Labrador nights. Sleeping bags were found to be essential and had the added advantage of making all personnel mobile and independent — a necessity under the uncertain travelling and living conditions.

Catering was done by contract, and the highest level practicable was maintained. Although most food kept well in the cool Labrador summer, a refrigerator was installed at Mile 224 base. One difficulty experienced was the deterioration of food during shipment from Montreal which was overcome in 1955 when bulk supplies of fresh foods became available in Seven Islands. Approximately 7 lb. of food per man-day were supplied.

Whenever possible, mechanical aids were used — canoes fitted with outboards, and power saws for line and fire-wood cutting. Most machines,

(*Continued on page 1536*)

Project Vanguard—
The IGY Earth Satellite

F. R. Furth

Vice-President, Farnsworth Electronics Company, Fort Wayne, Indiana.

Read at the 70th Annual General and Professional Meeting of The Engineering Institute of Canada, Montreal, May 1956

PROJECT VANGUARD represents a practical progression in the techniques of very-high altitude research. It is the first step beyond balloons, which cannot go above the earth's atmosphere, and rockets, which cannot stay aloft for an extended time. While essentially an extension of these proven research techniques, the Vanguard satellite program is the beginning step of a new phase, which presumably will be susceptible of continued improvement to permit longer and higher flights and more advanced instrumentation.

Vanguard is also significant because of the magnitude of the project. It could not be accomplished without the cooperation of many different organizations with experience in various scientific and technical fields, and extensive logistic support, to establish and maintain a suitable launching facility and tracking stations. Successful construction and launching of the satellite will demand going to the present limits — or beyond — of our engineering knowledge in many fields.

Project Vanguard is a three-year project. Many of the broad and most of the detailed engineering decisions concerning the first satellite and its launching have yet to be made. Because of the Navy's prior experience in upper-atmosphere research, it has been possible to move ahead rapidly in sketching in the broad outlines they intend to follow.

The National Academy of Sciences is sponsoring the satellite program as part of the United States' International Geophysical Year effort. The Department of Defense has been charged with responsibility for designing, constructing, testing, and launching a scientific vehicle. Their purpose is to implement the Presidental announcement of July 29, 1955, regarding an earth satellite, and to accomplish all the work in time to lauch the satellite during the International Geophysical Year.

Before his retirement in January 1956, Rear Admiral Furth was Chief of Naval Research, U.S. Navy, and therefore is well qualified to write of the earth satellite that is to be launched as part of the International Geophysical Year program. The paper was presented at the annual meeting of the Institute under the auspices of the American Rocket Society, Inc.

Within the Department of Defense, the Navy has been selected to manage the technical program. The Army and the Air Force will participate primarily in the field of logistics. The Chief of Naval Research will manage the program for the Navy, and coordinate the efforts of the other military departments and Government agencies. The Naval Research Laboratory will be the primary organization within the Navy to implement the program.

It is important to remember that both the Office of Naval Research and its Naval Research Laboratory are scientific agencies, although their ultimate purpose is to support military preparedness. They have been supporting, and conducting basic research for many years. As a result, they have the organizational structure, the personnel and the close day-to-day contacts with the scientific world that are necessary to carry on the Vanguard program.

Both ONR and NRL are very much at home in the field of upper atmosphere research, in which they have carried on much of the pioneering work. The Office of Naval Research and its predecessor, the Office of Research and Inventions, have supported high altitude research since 1945. They realized the necessity for a stable platform from which scientific observations could be made, to gather information of value in upper-atmosphere physics, cosmic radiation and future high-altitude flight. Then, as now, the basic problem was to devise a vehicle capable of carrying a payload to sufficient altitude and remaining there long enough to make the desired observations.

Inherent limits of aircraft and rubber balloons used in high altitude studies precluded their use for carrying scientific instruments above 100,000 feet. The development of plastic balloons permitted some advances. (Rockets could go higher but could stay aloft only a very short time. The total flight time for a Viking, for example, never exceeded ten minutes.) Instruments can be taken to 100,000 feet for periods ranging from a few hours to a day or more with balloons. More than 1000 such flights have been made under ONR sponsorship, and newer techniques that employ balloon-rocket combinations have also been devised. Rockets fired from plastic Skyhook-type ballons at 70,-

000 feet have telemetered scientific information from altitudes of more than 250,000 feet.

The purpose of these ballon and balloon-rocket flights has been to obtain cosmic ray, meteorological and other geophysical data. The cosmic ray studies have been jointly supported by the Atomic Energy Commission and ONR. The Air Force has also adopted these techniques for high-altitude studies.

The Naval Research Laboratory has been using large, high altitude research rockets since 1946. It has fired twelve Viking rockets and many of the smaller Aerobee rockets. They are instrumented research vehicles that have yielded much scientific information. It is also a matter of interest that the highest photographs ever taken of the earth's surface were taken with a camera mounted in a Viking rocket, from 158 miles up.

The Naval Research Laboratory as a whole has been doing original work in the physical sciences since its founding in 1923. It is well known for its work in radio and radar, among other things, and for the research carried on in connection with the Viking-rocket project. Several of its thirteen research divisions are particularly well fitted by experience to contribute to the project. They include atmosphere and astrophysics, optics and nucleonics. These divisions are well-staffed with scientists who are recognized in their fields and who have been prolific contributors to the scientific literature of upper atmosphere research.

Normal Procedure

Project Vanguard is being approached as the Navy would approach any other large-scale scientific venture. Since both ONR and NRL have employed, as contractors or consultants, nearly all of the nation's leading scientific authorities in geophysics, astrophysics and rocket research, and have actively participated in these fields, there is no problem of establishing contacts with key people outside the Navy. For the NRL scientists, Vanguard essentially means accelerated work of the same type which they have been performing in the past.

Since the earth-satellite problem does differ in several respects from the bulk of NRL's work, however, it will be prosecuted outside the division structure of the Laboratory. A separate project office reporting directly to the Laboratory director of research has been established. It will be neither necessary nor desirable to set up a large, complex organization to coordinate the project. Much of the necessary coordination of the technical program is carried out on a day-to-day basis by scientists and engineers at the working level in the Navy, other services, and industry.

Working-Level Communication

The Army and the Air Force have designated Project-Vanguard liaison officers who have official responsibility for keeping their services abreast of the status of the project, and who keep ONR and NRL workers informed of their services' potential for participation in any given phase of the work. In addition, the day-to-day coordination at the working level goes on among the services. Army, Navy and Air Force military and civilian personnel involved in rocketry and other aspects of upper-atmosphere research have used formal machinery and informal contacts for threshing out mutual problems for many years. This same working-level communication network is being used to attack problems that must be solved before the satellite can be launched.

The primary difference between Vanguard and the previous upper-atmosphere research projects is introduced by the time element. The Vanguard satellite will be launched during International Geophysical Year, which ends in December 1958. It is not possible to proceed with separate component development, building up the rocket and satellite design on the basis of continuing developments in each field, and making modifications as component advances permit. The project director and the technical director have had to decide at the outset what the total design is going to be, then go ahead and build it. They will try to develop a complete definition of the specifications before major work begins. Feeding into this are the results of about two dozen design studies now in progress. They represent an attempt to define the launching system.

This does not mean that actual work is being held up pending a complete set of specifications. In certain technical areas they do not have a choice. These are areas where components already developed must be used to the greatest extent possible, and in these areas certain hardware is now being built. The first-stage rocket motor is one example.

The Navy's approach to the management of Project Vanguard has been shaped by the project's mission. Their technical responsibilities can be discharged only with assistance from the Army, Air Force and American science and industry. They have already turned to industry for construction of the three-stage rocket vehicle that will carry the satellite to its orbit.

The Glenn L. Martin Company of Baltimore, Maryland, has been awarded the prime contract for construction of the rocket. This company built the Viking research-rockets for the Navy. The first-stage rocket will be of cylindrical monocoque construction, consisting of skin, frames and longitudinal members, using integral propellent tanks.

Martin has awarded a sub-contract for construction of the first-stage rocket motor to the General Electric Company of Schenectady, New York. This engine will be more efficient than the present Viking engine, and therefore more powerful. It will have a thrust of 27,000 pounds at sea level, and an operating time of about 140 seconds. The engine consists of a regeneratively-cooled thrust chamber, gimballed mounting, propellant valves, turbopump, and high-pressure lines. The propellants will be liquid oxygen and a mixture of ethyl alcohol, gasoline, and silicone oil, which will be forced into the thrust chamber by turbine-driven pumps. The turbine will be powered by the decomposition products of hydrogen peroxide. In this type of turbine liquid peroxide is converted in a steam generator into hot steam, which is directed against the turbine blades.

Finless Rocket

This first-stage rocket will be essentially similar to a Viking rocket, but improved in two principal ways. The first is the more efficient engine. The second basic improvement over the Viking phase of research rockets is the removal of fins, to produce a rocket that is completely stabilized by the thrust of the motor. This is possible through mounting the motor in a gimbal, which permits controlling the direction of the thrust in any direction by actual movement of the rocket motor. The Vanguard gimbal mounting will be designed to permit angular deflection of the motor-thrust vector by $\pm 5^0$ from the centre line of the vehicle. A gyroscope controls the direction of the motor. For years many rocket experts have felt that this was the direction in which the development of large rockets

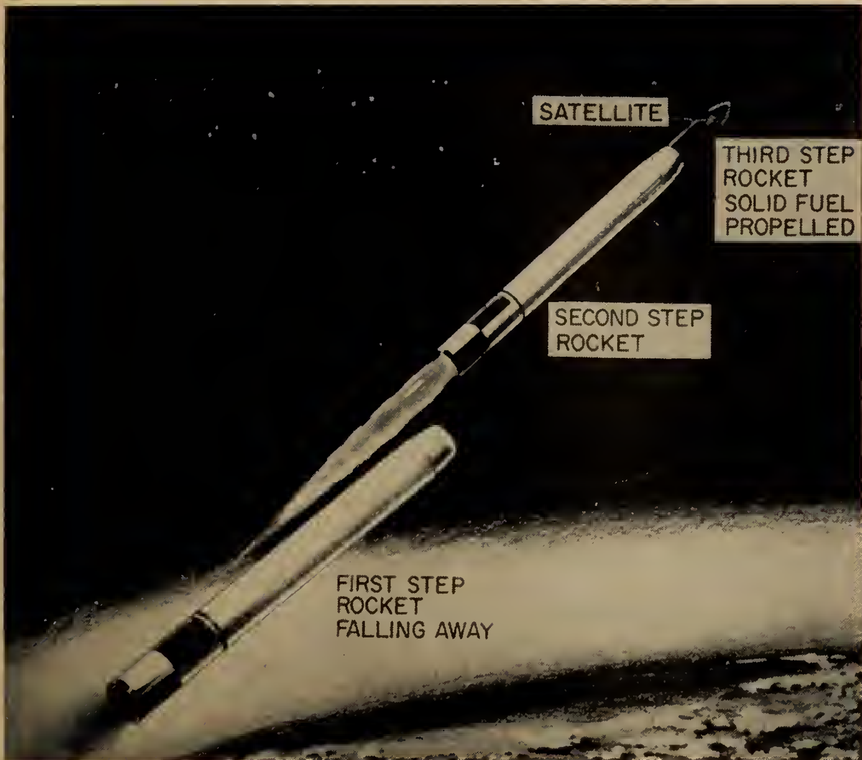


Fig. 1. An artist's conception of the Vanguard rocket at the end of the first stage.

should go. The gimbal structure was built into the first Viking, and into all the subsequent ones, although they also had fins to assist in stabilization.

The move to a finless rocket illustrates one way in which ten years of research with the Vikings is valuable background for the present project. It was known in 1946 that the use of fins for longitudinal rocket stabilization produced unwanted moments in roll and added weight to the rocket's structure. Furthermore, they give no assistance to the rocket's course at the moment of launching, when its forward speed is low and near the end of its powered flight when it is above the earth's atmosphere.

The finless rocket has been under study for about five years and a few small rockets have been fired experimentally. The Martin Company has performed much analysis that has proven the finless type theoretically workable and has sufficient confidence to go ahead with a large finless rocket for Vanguard.

The second-stage rocket will also be a finless cylindrical airframe of monocoque construction. A sub-contract for construction of the second stage has been awarded to Aerojet-General of Azusa, California. This power plant will also consist of a regeneratively cooled, thrust-chamber, and will be mounted in a gimbal. Nitric acid will be the oxidizer and unsymmetrical dimethyl-hydrazine the fuel. Flow of these propellants to the thrust chamber will be effected by helium pressure in the propellant tanks, rather than by a steam turbine, as in the first-stage motor.

The third stage of the Vanguard rocket will be powered by a solid-propellant motor, and will consist of the motor, a structure for attaching it to and for imparting spin to the air frame, and the satellite package and mounting structure. Several contractors are now bidding on the third-stage rocket motor.

One of the first programs begun when Vanguard was initiated was a set of studies to determine the optimum weight for each stage of the rocket. Preliminary estimates had to be made for weight, propulsion, and aerodynamic parameters. The optimum stage-weights are functions of these parameters and will vary as the parameters are changed. A change in the thrust of one of the engines, change in weight of the payload, or shape of the missile would change the way in which total weight should be distributed among the three stages. The stage weight itself must be considered as a variable, since it consists of fixed weights, such as the power plant, and variable weights, such as the propellant. The final determination of many design details for the rocket and the satellite will depend on the results of these optimization studies.

At the time this paper was written, the gross weight had not been decided upon, but it will probably be between 20,000 and 25,000 pounds.

In general appearance, the Vanguard rocket can be expected to have the outline of a thirty or fifty calibre bullet, but much more slender. (Figure 1 shows an artist's conception of Vanguard.)

When the Navy scientists come to the satellite vehicle itself, they enter an area necessarily characterized by compromise. Many conflicting requirements must somehow be reconciled. The satellite should be as large as possible, in order that it can be easily tracked by optical means. The bigger the object, the greater will be its visibility. On the other hand, weight considerations demand that the satellite be as small as possible. The scientists and engineers who design and build the Vanguard satellite will not be worrying in terms of pounds; they will be trying to shave ounces off the weight of the object which ultimately goes into the rocket. So a compromise must be reached in order to build a vehicle small enough to be successfully placed in the orbit yet large enough to be useful scientifically. It must be small enough to fit into the nose of the third-stage rocket. The most desirable configuration for the satellite itself now appears to be a sphere in the neighborhood of 20 inches in diameter, weighing about 21½ pounds. One obvious advantage to a spherical shape is that it would make it easier to convert the data on air drag into figures for the density of the upper atmosphere.

Other considerations in designing the satellite and determining its payload stem from the physical stresses to which it will be subjected. It must be transported to altitude in a rocket that has high acceleration and intense vibration. It must be strong enough to withstand the G-stress imposed upon it by each of three stages of rocket firing, but strength must be gained without use of excessive weight.

The problem of aerodynamic heating during ascent has been investigated. If the satellite package were to be the nose of the vehicle, it could become too hot, probably in excess of 1000 deg. F. The satellite will be protected in the early parts of the flight by a disposable nose cone. Since the heating would occur during the last part of the first-stage flight and the first part of the second-stage flight — i.e., after high speed has been reached and before the denser portion of the atmosphere is left behind — the conical nose could be jettisoned near or at the end of the second stage. The use of such a cone would provide a weight penalty for the second stage flight, and this is one of the many factors that is being considered in the weight studies being made in connection with arriving at design specifications for the Vanguard rockets.

The satellite must survive for a certain length of time after it has been placed in its orbit. While circling the earth it will face danger from two main sources, temperature extremes and meteoric dust. Solar radiation will tend to heat the satellite and its payload to very high temperatures, perhaps of the order of 300 to 400 deg. F. While in the earth's shadow its temperature may drop to well below 0 deg. F. The instruments required for a successful scientific experiment cannot stand wide temperature variations. The temperature range through which certain electronic components, such as transistors, will survive is roughly 40 deg. F. to 120 deg. F. — this presents a problem of satellite design to stabilize its inside temperature satisfactorily.

It is known that meteoric dust at the altitudes to be traversed by the satellite will eventually cause some deterioration. The rate and extent of the harm is not known; in fact, one of the objects of these experiments is to find out the density of meteoric dust in space. One possible method for measuring density of meteoric dust would be to have the satellite shell coated with a conductive material to form an electrical circuit. As dust wore the shell thinner, electrical resistance would change proportionately. This dust might score the surface of the satellite, and thus affect its ability to reflect light, with a consequent effect of the inside temperature and upon optical tracking. The assumptions that have been made here on the surface of the earth, in order to arrive at design specifications, might be changed when the satellite gets beyond the atmosphere and is acted upon by meteoric dust. It will not be known until the first one is fired.

It has not been decided what material is to be used for the satellite shell. Every material that held promise of being practicable has been studied and the choice has been narrowed down to a few. Some of the necessary considerations in choosing the material are rigidity, fabrication difficulties, weight, and reflectivity. Different fabrication techniques are also being explored.

The problems of the amount and kind of instrumentation in the first satellite must be solved and compromises agreed upon. Subject to weight and space restrictions, it must send aloft enough instruments to do some scientific work. The Navy's job is to put into an orbit an object capable of doing work of importance to the scientists and the fields they represent. The first satellite cannot completely satisfy the men in each field — it cannot do all the things they would like to see done. If they tried to build a satellite capable of yielding large amounts of diverse scientific data, they could not get it up into its orbit, and would wind up with nothing. The Vanguard technical program must result in a satellite that will be workable, yet scientifically useful. On the technical side, this means sacrifices in terms of accepting larger size and greater weight, with resultant engineering problems. On the scientific side, it means sacrifice in terms of the useful payload which the first satellite will carry. A reasonable fraction of its weight — perhaps one-fourth or one-third — will consist of scientific research instrumentation and its power supply. The remainder will be devoted to structure, a tracking transmitter, turn-on equipment and power supply.

More Than One Rocket

Several Vanguard rockets will be built in connection with the program because, to be reasonably certain of successfully putting a satellite into an orbit, there must be more than one rocket available.

Technically, the chances of failure of a single shot would affect the attitude of everyone connected with building the rocket and its cargo. They are working in a field that places great demands upon everyone's knowledge and calculations of probable performance. Much money is involved. If all of this money and all of this effort were risked on one shot, the project officers and technical workers would be always confronted with the desire to make one more calculation, one more adjustment or one more test flight before firing, in order to be more certain of success. Yet, to complete the job on time, every step of the program must be marked by bold, confident engineering in which the Navy must be prepared to take the consequences of falling short of perfection.

Attendant Programs

The determination of specifications for the launching rocket and the satellite, and their construction, represent the major phase of the technical program for Project Vanguard. The project director must be equally concerned, however, with all of the attendant programs required to make it succeed. A launching site has been tentatively selected. The Vanguard satellite will probably be fired into its orbit from Patrick Air Force Base, Cocoa, Florida. This base meets the operational requirements for large rocket launching and appears suitable to the scientific needs of the program. As soon as the project was established, Navy scientists and scientific and facilities officers began a series of continuing consultations with their Army and Air Force counterparts to determine the best launching site, the requirements for logistic support and how they will be met by the three services, and how problems of establishing and manning tracking stations will be handled.

Several tracking stations will be set up. Each station must have communications circuits linking one another and linking each to a central collecting and computing agency. Each station must have a complement of technicians, observers and operators, although a minimum of construction will be required. Perhaps one quonset type structure for an operations building, trailers tracking antennas, and communications antennas would constitute a typical tracking site.

Scientists are now working to determine the primary orbit of the satellite and the specific tracking methods. Both optical and radio tracking will be used. Time, speed and position information from many separate sightings at different tracking stations must be fed rapidly into a central electronic computor which will determine the orbit on the basis of this information. Data on the orbit must then be broadcast quickly throughout the world to enable scientists of the IGY to pick up the satellite with little difficulty.

A tracking system known as "Minitrack", which uses radio devices, is under development at the Naval Re-

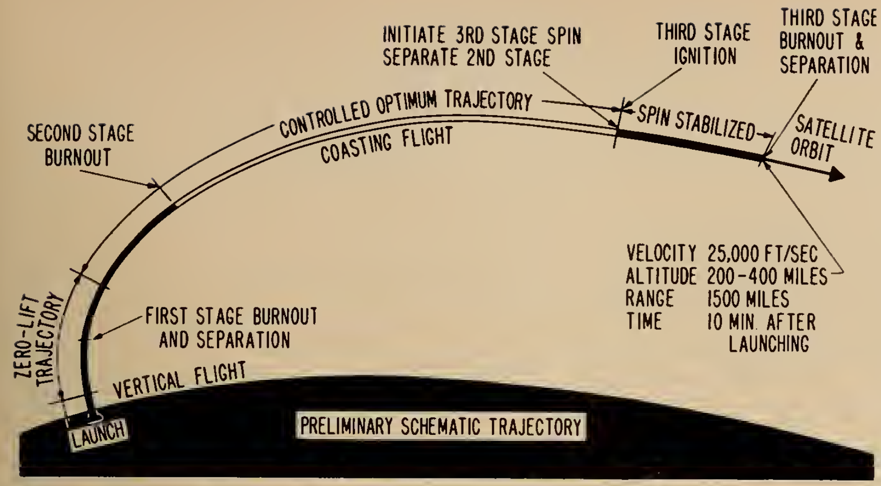


Fig. 2. Schematic diagram of the stages in the trajectory of the Vanguard satellite.

search Laboratory. This method uses a miniature radio transmitter in the satellite. It radiates a continuous signal to receiving equipment on the ground. Employment of this method would also aid optical tracking by furnishing estimated satellite position predictions but would require placing a line of observing stations — probably in the Western Hemisphere — to intercept the satellite on its orbit.

A major consideration in the telemetering system is to select the best —for the purpose — of the components now available, perhaps modify them for this specific task, and make as many improvements as possible before installation and testing. For example, the designers want to require as little power as possible from the transmitter in the satellite; therefore, they would want to improve the ground antenna system as much as they can. Improvements to the antenna would, of course, also permit better coverage of portions of the trajectory.

(Previous theoretical research is now proving of considerable assistance in working out optical tracking problems. For the past several years, scientists in the optics division of the Naval Research Laboratory have been conducting studies on the visibility of stars at night and during the day. In connection with this work, calculations were made on the conditions under which small earth satellites might be seen. For purposes of this study, the scientists assumed a satellite that was a 21-inch sphere travelling in an equatorial orbit at an altitude of from 200 to 1000 miles. As a result of these studies, " . . . it has been concluded that if one knows exactly where and when to look, a satellite when nearly directly overhead and at 200 miles altitude would first be visible through 7 x 50 binoculars when the sun is 2° below the horizon, and would be visible to the naked eye for solar depression angles greater than 9. To see such a satellite earily, however, and to be sure of observing it when its position is not known exactly, some telescopic magnification, such as 7 x 50 binoculars would almost be a necessity and observations of the satellite should not be attempted until the sun is 5 below the horizon.")

When the rocket and its satellite payload are ready to launch, and all of the launching facilities and tracking equipment and stations are in readiness, the Project Vanguard satellite will be fired up into its orbit. Only a general summary of the procedure is possible at this time, using figures that stem from preliminary design thinking. More precise data must await extensive detailed planning and engineering. (Figure 2.)

The first-stage rocket will start the entire assembly vertically on the first part of its flight, and when it is a few miles off the ground, its guidance system will begin to steer it gradually toward a near horizontal trajectory. When its fuel is exhausted, the first stage will drop off and fall into the sea. This will take place at 30 to 40 miles up, and the rocket will have reached a velocity between 3000 and 4000 miles per hour. The second rocket, deflected from the vertical, will continue the satellite upward. It will burn out at about 130 miles up, and the rocket then will be travelling at about 11,000 miles per hour. It will then coast into the satellite trajectory, with only very slight deceleration. At an altitude of about 300 miles, the second stage will separate, fall free and the third rocket motor will ignite and accelerate the satellite vehicle to a velocity of about 18,000 miles per hour. It may then separate from the satellite proper. (How to separate the satellite from the rest of the third stage presents something of a problem. In the Viking rocket firings, for example, it was decided to slow down the rocket's fall to lessen impact damage to the instruments. This was done by destroying the rocket's aerodynamic shape through use of an explosive charge that blew the nose free of the rest of the rocket.) The satellite will then be headed almost horizontally into its orbit, at orbital speed. A portion of the total velocity will be gained by launching the rocket toward the east, to take advantage of the earth's rotation. Thus, before the rocket is even launched, it will have a substantial horizontal velocity due to the rotation of the earth.

The satellite will start into its orbit with a spin imparted prior to ignition of the third stage rocket. However, eddy currents generated in the metallic skin of the satellite by the earth's magnetic field will soon reduce the spin to the vanishing point.

The satellite's orbit will be elliptical, rather than circular. Perigee, the point of nearest approach, will be about 200 miles from the earth, and apogee, the most distant point in the orbit, will be about 800 miles out.

The problem of guidance, to ensure that the satellite is projected almost horizontally into its orbit, is especially difficult. If the angle of entry is either too high or too low, perigee will be too close to the earth, and the satellite will dip into the denser portons of the atmosphere and disintegrate before it has made enough revolutions to complete its mission. It has been determined that on the basis of theoretical calculations, the angle of projection should not deviate by more than a few degrees from the horizontal for a launching altitude of 300 miles. If it misses by more than this, the perigee altitude, will be roughly half of the launching height, which would cause the satellite to dip well into the denser parts of the atmosphere and cut short its life. The guidance system must therefore be designed to ensure an error of no more than a few degrees in the angle of projection into the orbit.

The consequences of missing the planned orbit are not so serious in terms of the satellite's lifetime, but would pose problems of tracking. The satellite will transit different areas of the earth on each revolution. If a revolution is completed in 90 minutes, as is now contemplated, the earth will have completed roughly one-sixteenth of its daily rotation during this time, so that the satellite will appear at a different longitude for the same latitude on its next trip.

Although the portion of the atmosphere through which the orbit will pass is extremely thin (just how thin is one of the facts that the satellite may establish) the cumulative effect of the drag of this thin air will be sufficient to bring the satellite gradualy closer to the earth. As the satellite enters the denser atmosphere, it is expected to disintegrate harmlessly in the same manner as a meteorite, because of intense heat and probable mechanical collapse. The lifetime of the satellite is being estimated on the basis of a number of assumptions concerning the composition and density of the upper atmosphere. It may be several days or several weeks or even months, depending upon what is up there.

Water, Steam, and Refrigeration for a Modern Brewery

R. E. J. Layton, M.E.I.C. *(Continued from page 1512)*

gas is much heavier than air, it rests on the beer surface and can easily be removed without the complicated hood systems normal for exhaust applications. A secondary exhaust system includes grilles placed at low levels for additional protection against gas concentration. The temperatures in the cellars and process areas are controlled by room thermostats, operating the fans and liquid line solenoid valves. The suction temperatures of the different coils are set between + 30 and + 14 deg. F. and are selected with consideration to latent and sensible heat ratios and desired room humidity conditions. Changing the setting of the modulating back-pressure valves in the suction lines will give an adjustment of humidity conditions if necessary.

The units are defrosted automatically by individual timers with water at 60 deg. F. A separate circulation system is also provided for heating and reheat purposes. The ventilation air for the process cellars is filtered and cooled or heated in a separate fresh air unit with sprayed cooling coil, working at a suction temperature just above the point where frost formation begins.

The temperatures in the conditioned rooms, together with the brine and chilled water temperatures, can readily be checked by the operating engineer from the 16 point temperature recorder-indicator provided in the mechanical services building.

Other Brewery Services

To complete this review of the design of mechanical services in the brewery, a brief description will be given of those systems not yet considered.

Waste products from the brewhouse, the yeast rooms and fermenting cellars and from the beer filters and bottling shop all impose special conditions on the brewery drains. Two separate underground systems are provided; one for process and a second for storm and sanitary requirements. These are combined just before being run into the municipal sewer — an arrangement which will permit processing of wastes if such an operation becomes justifiable. To improve operation, the water, which has been used for condensing in the refrigeration machines, is collected and pumped to points in the brewhouse and the "carbonating" room. Here it is used for flushing out the drains when waste grains and process materials are being disposed of.

To produce the air used as counter pressure when the beer tanks are being unloaded and also to meet the other compressed air requirements of the brewery, two oil-free type reciprocating air compressors are provided in the mechanical services building. To reduce the "sun effect" and thereby the temperatures or the cooling loads of the space covered, roof flooding systems are provided on both divisions 4 and 5. These divisions of the brewery contain the warehouse, bottling shop and office areas. Not discussed, but also part of the design, are the ventilation systems which are applied as required throughout the building.

In this paper, an attempt has been made, not only to describe an installation, but also a basis for design. It is evident that modern breweries such as the one considered here provide many interesting fields for mechanical design.

The valuable assistance of Mr. Harald Tamm, a member of our staff who contributed largely both to the design and to the preparation of this paper, is gratefully acknowledged.

Hamilton River Survey — Labrador *(Cont. from p. 1530)*

and in particular the gas-driven generators for the radios, operated satisfactorily until the second summer, when it became clear that complete replacement would be more economical than on-the-spot maintenance.

Two first-aid men were in the field continuously through both summers. Accidents were relatively minor, most of these being axe cuts.

Conclusion

That conclusive results of the order indicated were achieved in the time and under the conditions prevailing in Labrador is a glowing tribute to the enthusiasm, skill and team spirit of all personnel on the one hand, and on the other to the use of the most modern appliances and techniques. Photogrammetry and seismic sounding played a major part, made possible only by aircraft in the versatile fixed and rotating wing forms flown by Canada's well-known "bush pilots". Aircraft alone could have provided the necessary transportation for all purposes over the final hundred miles into the work area. However, the ultimate objective, real knowledge of the ground surface and composition, could have been attained only by men on foot who, individually, covered hundreds of miles of Labrador wastes in this manner.

While the actual field survey and general services were performed by many different concerns, the general direction and co-ordination were provided throughout by the Corporation to which the authors wish to express warm thanks for permission to present this paper.

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DISCUSSION

of Technical Papers

WATER, STEAM, AND REFRIGERATION FOR A MODERN BREWERY

R. E. J. Layton, M.E.I.C.

The Engineering Journal, 1956, November, p. 1504

R. E. Crossey, M.E.I.C.[1]

Mr. Layton has presented an excellent treatise on the factors involved in the design of the new Labatt's Brewery. The subject is extremely broad and therefore he had to omit some of the more interesting design problems which were encountered.

In the design of the refrigerant piping for the ammonia condensing system, the designer is given the opportunity of effecting large savings in pipe and installation cost. He is no longer bound to conservative pipe sizing charts by the necessity of minimizing the production of flash gas. The liquid lines for this system may be designed by selecting for each branch a pipe size which will give a pressure drop equal to the differential in the pump discharge pressure and the evaporating pressure. The lines with the lowest evaporating temperature and pressure can therefore be sized for a greater pressure drop than the lines with the higher evaporating pressures. In all cases, these pipe sizes are considerably smaller than those obtained in the design of the conventional direct compression system. In an installation the size of Labatt's, this represents a considerable saving.

In a brewery, the relative humidity is an important factor along with the dry bulb temperature. In the hop storage area, the vapour pressures in the air and the hops must be close to equilibrium to prevent a moisture exchange which would harm the quality of the hops. This condition is obtained at 34 deg. F. at approximately 65 per cent relative humidity. In other areas a low relative humidity is desirable to reduce the maintenance on steel tanks and the production of stray yeast and moulds.

The relative humidity is controlled most readily by a brine chilling system which permits the use of a modulating valve on the brine line. When the ammonia condensing system is used, it is not as convenient to alter the dewpoint to give the desired relative humidity. To accomplish this, it is necessary to use a relatively expensive temperature-compensated back-pressure regulator. However, in a brewery the change in latent loads is very gradual and the required relative humidity can be achieved by a careful selection of coil surface area and surface temperature, combined with manual adjustment to compensate for seasonal change in latent loads. As the brine chilling system is more expensive than the ammonia condensing system, the advantages obtained in ease of control do not warrant its use in the design of this brewery.

[1]Jas. P. Keith & Associates, Consulting Engineers, Montreal.

G. N. Martin, M.E.I.C.[2]

The author treated his subject in a thorough manner, acquainting his readers with his clients' design requirements. This writer had the opportunity to visit the plant in operation and see the application of the principles set in this article. He was also engaged in the supply of the steam power plant equipment.

Before the selection of an economizer was made as heat recovery equipment, the use of an air preheater was investigated. For the conditions obtaining at this plant the choice of the former proved more economical and satisfactory.

The boiler is fired with bunker "C" oil and provision is made for the possible conversion to solid fuel firing at a later date, if required. Continuity of service is ensured by the use of a "package" boiler installed on a temporary basis and to be used until the plant expansion calls for the addition of a twin water tube steam generator.

Advantage was taken of using medium and low pressure steam circuits thereby establishing an interesting heat balance without having to complicate the system of auxiliaries.

[2]Dominion Bridge Company, Limited, Montreal.

HAMILTON RIVER SURVEY, LABRADOR

G. V. Eckenfelder, W. P. Harland, and E. N. Webb, MM.E.I.C.

The Engineering Journal, 1956, November, p. 1521

Howard J. McLean, M.E.I.C.[3]

The paper on the Hamilton River Survey gives an excellent outline of the planning and the field methods used in appraising one of the world's great power sites (the Grand Falls of the Hamilton River) which includes the creation of storage and regulation of the river flow.

Obviously, a great deal more time, effort and money would have been spent in acquiring the necessary essential field information for a project of this magnitude if aerial photographic surveying and seismic methods had not been available.

The field work by ground forces was confined to establishing the elevations of lakes, doing the control surveys, check traverses and levelling, and the minimum test pitting and drilling which was necessary to supplement and aid the accuracy of the aerial photography for photogrammetric mapping and seis-

[3]Construction superintendent, Montreal Engineering Co. Ltd., Montreal.

mic work. Large mapped areas were required, but topography was needed only at selected portions including the sites for dams and diversion structures.

The preliminary general appraisal of the surface topography was done in mid winter to determine the lake elevations and the locations of the ordinary and the flood channels. This work reduced the chaos of wilderness, dotted with lakes, to definite drainage patterns and permitted the general planning of the work to be done and the selection of the areas to be mapped by aerial photographic surveys. The necessary ground control for photogrammetric mapping was aided by the abundance of lakes for vertical control, and traverses were run, where possible, along ridges and connecting prominent points for the horizontal control.

The results obtained from the aerial photographic mapping confirmed that this was the best method for obtaining the necessary information for such a large area.

As described by Mr. Harland, helicopters were used to advantage in the work and one of the interesting points mentioned was signalling from the helicopter to indicate the direction of a traverse. A helicopter is a most economical time saver to trained reconnaissance engineers in difficult areas when working on a carefully planned programme.

Those of us who have taken soundings in rivers, a laborious painstaking job, will appreciate the description of the echo equipment used, which does accurate work in a fraction of the time required by the lead and line method.

As stated in the paper, seismic soundings, when preceded by a geological surface examination of the area and supported by sufficient test pits and borings, can be used to yield a large amount of most useful information regarding the depth and type of overburden overlying the bed rock, the rock profile at each dam site, and the extent of deposits of construction materials. This information combined with the sub-surface investigations by geologists and soil specialists (based upon test pit and boring) have proved the locations and quantities of construction materials.

This latter, the locating and testing of materials available for construction of earth-fill dams and dykes, and finding good supplies of concrete aggregates, is most important. Use of suitable materials convenient to the selected locations of structures to be built, will save millions of dollars.

In remote areas, the use of suitable local construction materials, when available, usually favours earth fill construction for dams and dykes for their lower capital cost, low maintenance, and lack of troubles from frost action in northern latitudes. The earth fill structures are practically indestructible if well designed, and properly built and maintained. The more costly concrete (with long haul of cement) must of course be used for diversions, sluice dams and control works, powerhouse foundations and substructures, etc., but in the interest of economy, can be kept to the minimum amount necessary.

The access road from Mile 286 on the Quebec North Shore & Labrador Railway to the crossing of the Hamilton River near Grand Falls (mentioned in the paper) will become the first step towards construction of the great power development. I understand that construction of this road will be started in early June of this year.

The authors of the paper on the Hamilton River survey are to be commended for their good description of the methods used in obtaining the field information. These methods would apply equally well for investigations of other large projects in remote areas where the essential information is required quickly and economically.

The Authors

The comments by Mr. McLean are appreciated and do not appear to call for any reply.

AIR POLLUTION CONTROL PROBLEMS

E. A. Allcut, M.E.I.C.

The Engineering Journal, 1956, April, p. 387

Walter C. Wagner[1]

Mr. Allcut has left but little to be added, and such additions would be quite secondary in importance.

I would recommend that his name be added to that of John B. R. Neilson, director of smoke abatement, of Toronto, as a member of Air Pollution Control Association, the Canadian-U.S. organization that has served both nations so effectively over the years. I agree with Mr. Allcut in his thought that definitions for example, adopted in different areas are not comparable. As he states, "This is a very undesirable situation, which can only be rectified by agreement on an international basis." While this activity must necessarily be on a less tangible basis than that relating to the international steam tables, nevertheless something in the way of active collaboration must be faced, to the mutual advantage of all nations substantially concerned.

Convinced that an international interchange of research and developments should be initiated the board of directors of the Air Pollution Control Association recently approved the proposal to form a committee of the Association to sponsor the creation of an "International Commission on Air Pollution".

[1]Consulting Engineer, Chamber of Commerce of Greater Philadelphia, Philadelphia, Pa.

Letters were then sent to representatives of the foreign nations understood to be substantially concerned. A part of the letter reads:

"We are now convinced that all nations which are increasingly concerned with this subject can individually and collectively make greater technical progress if their air pollution control organization are members of an international organization. In this way, each of the important technical subjects constantly arising which are of common interest to many countries could be given more direct and collective attention by special commission committees of representatives of those countries. Greater progress, through a wider distribution of related information, such as the results of pure and applied research and of applications, would in this way be made continuingly available to all members of the International Commission."

The replies received to date uniformly indicate great interest and a willingness to participate actively in the program.

As a result, a "task force", consisting of past presidents of the A.P.-C.A., including past president Louis James Cudbird of Toronto, is now developing an outline of the Commission organization and its scope of activities. The "task force" includes members who are on other technical international commissions and who have some knowledge of related activities of many of the European and other nations.

The outline, when completed, will be submitted for review and comment to all such organizations, including of course those organizations concerned in our two countries.

Referring again to Mr. Allcut's extremely valuable and timely technical and administrative contribution, I join with many others in the hope that a way will be found to make it generally available not only to regulatory authorities, but also to industrial and commercial interests substantially concerned.

The Author

I am glad to know that Mr. Wagner and his associates are taking some steps toward the co-ordination of work in the field of air pollution control. This matter is being studied by the committee recently appointed by the Canadian Standards Association and I hope that some liaison will be possible with our colleagues in the U.S.A. During my recent visit to England I also discussed the matter with some of the British authorities in this field and they expressed interest in the project. As a result of these activities I hope that some international body will be set up. The principal question at the moment is "who is to bell the cat" — and how, and when?

INDUSTRIAL POWER DISTRIBUTION

J. R. Auld, M.E.I.C.

The Engineering Journal, 1956, April, p. 405

R. C. Short,[1] JR. E.I.C.

It is with a great deal of pleasure that I compliment Mr.. Auld on a splendid paper. As he pointed out, the design of industrial power distribution systems has evolved into a most important engineering project. Flexibility to facilitate future load growth is one of the most salient factors to be considered in this design. Capacity to meet future needs must, of course, be balanced against initial capital investment, and transformers with provision for forced air cooling can be applied very nicely to these circumstances.

Provision for forced air cooling to be added later involves the following transformer design features:—

(1) The transformer is designed from the beginning on the basis of the forced air cooled rating which is usually 33⅓ per cent greater than the self-cooled rating.

(2) All conductors, including coils, cable connections and bushings, are specified with adequate capacity for the forced air cooled rating.

(3) A well is provided in the cover of the transformer to receive the controller element for the fans.

(4) All conduit for control wiring is provided, and provision is made for mounting the control cabinet.

This provision only, for future addition of forced air cooling, costs approximately 2½ per cent of the price of the straight self-cooled transformers.

When the load climbs to the point where the forced air cooled capacity is required, the control element, wiring and fans are purchased and installed. The fans can be operated from either top oil temperature or winding temperature, and will turn on and off automatically, depending on the loading of the transformer.

I note with interest that in this case, provision has been made for four times the present load by purchasing transformers larger than necessary and also making provision for addition of fans. The fans we will supply will be propeller type, blowing the air horizontally over the radiators and individual thermal overload protection will be provided. In the event of a failure of one fan the others will carry practically all of the load and the loss of one fan is not serious.

In this case, the fans will be controlled from winding temperature and will only run when needed.

The winding temperature equipment is responsive to a current in the high voltage winding, but the calibration is set on the hottest temperature in any of the three windings at full load fan cooled conditions. This means that proper division of load between the two windings must be watched, but actually this is not too critical, unless the transformer is running at maximum load.

When the transformer is underloaded, division of load between the two windings is not critical because the oil temperature is less than normal and, consequently, the overload capabilities of either of the secondary windings is increased.

[1]Packard Electric Co. Ltd., Tramways Building, Montreal.

N. E. Hudak[2]

As Mr. Auld points out electric power is the life blood of industry. Without electrical power, industry could never have progressed in such gigantic strides. It is therefore essential in our present age of electrification, that considerable thought and effort should be made by every industrial concern to weigh the merits of its power distribution system. Too often, much too often, the power system in a plant is taken for granted. It is not until failure occurs and plant shut-down takes place that the importance of a power distribution system is realized.

Now is a good time to study more closely the basic industrial power distribution systems. Mr. Auld has reviewed six of the approximately eleven basic industrial power systems. He has used simplified, single line diagrams to illustrate each of the basic systems and has reviewed each system particularly well from the maintenance and economic standpoint.

For those who are interested in pursuing further any of the basic systems discussed, or other basic systems, particularly from the standpoint of flexibility, continuity of service, future expansion, interrupting capacity, protection and control, much can be found in the AIEE Committee Report entitled "Electrical Power Distribution for Industrial Plants", AIEE papers, reference books and many other recent papers and reports.

After discussing each of the six basic systems, Mr. Auld proceeded to show with illustrations, the electrical distribution system of the Maitland nylon works of the DuPont Company of Canada Limited. He has discussed factors such as cost, choice of voltage, type of system, future load, location and size of substations; factors which arise each time a plant distribution system is being planned. He has appropriately concluded by outlining a formula for the selection of a satisfactory power distribution system.

The Author

I appreciate the interest shown by Messrs. Short and Hudak in the subject, and I am in agreement with the ideas they have expressed.

[2]Amalgamated Electric Corp. Ltd., Toronto, Ontario.

ABSTRACTS

BASED ON CURRENT LITERATURE AND EVENTS

A BRIEF ON THE NATIONAL BUILDING CODE OF CANADA

Presented to the Royal Commission on Canada's Economic Prospects

The National Building Code of Canada is essentially a set of minimum regulations respecting the safety of buildings with reference to public health, fire protection, and structural sufficiency. The code is not intended for use with specialized civil engineering structures. Its essential purpose is the promotion of public safety, through the use of desirable building standards throughout Canada.

It is an advisory document only, having no local standing until and unless it is adopted for specific use by a provincial government or municipal administration. It may seem strange, at first sight, to find an agency of the Federal Government issuing a document which is essentially a local municipal ordinance.

The fact that the National Building Code is actually printed in the form of a by-law is evidence of its unusual character. Under the terms of the British North America Act regulation of such essentially local matters as building operations was made the responsibility of the provincial governments. They have, in turn, delegated this responsibility for urban areas to local municipal governments, through their Municipal Acts. Building regulations throughout Canda are therefore essentially local municipal ordinances, commonly called "building by-laws".

Municipal building regulations are, however, directly responsible for the control of the design and erection of all buildings in their respective municipal areas. Local building by-laws are therefore municipal ordinances of some importance. In almost all cases they have been developed locally through the years and follow no general pattern. The result has been a collection of local ordinances which vary greatly throughout the land, not only in arrangement, but also in technical content.

It was in the mid-thirties that the seriousness of this problem, and its full complexity, appears first to have been recognized. The introduction of the first National Housing Act led the Administrator of the Act, to consult with municipalities as to the local regulations then available for the control of house building under the terms of this Act. It was then that the difficulties of the municipalities in this connection first became generally evident. No municipality had the necessary financial resources for work on the revision of its building by-law, or for the preparation of a building by-law where none existed.

No Solution at Municipal Level

It was clear that no solution could be expected at the municipal level. Appeal was made to the then president of the National Research Council, General A. G. L. McNaughton. Jointly with the Department of Finance (then administering the National Housing Act), the National Research Council thereupon apppointed a representative committee to investigate the problem; a secretariat was formed; building codes of other countries were examined; and it was finally decided to prepare a National Building Code for Canada.

This was envisaged as an advisory document which would be prepared by representative national committees. If and when it was legally adopted by any municipality for this purpose it could be used as its own building regulation. Work was commenced in 1937. In 1941 the first National Building Code of Canada was published by the National Research Council — a volume of over 400 pages — and sold for one dollar a copy to all who wished to have it.

The years of war naturally interfered greatly with the use and general recognition of this pioneer document. It is now in use, either directly as the local building regulation, or indirectly as a reference document for use in association with the local by-law, in over two hundred municipalities. Its acceptance by provincial and municipal authorities throughout Canada showed that the idea of such a national service was locally acceptable.

Soon after 1945, it became obvious to Council authorities that the National Building Code should be reviewed, if it was to fulfil its intended national purpose. At about the same time, Central Mortgage and Housing Corporation was established by the Federal Government, being charged with the administration of the revised National Housing Act. The original intention to associate work on the code with research in the building field was revived. For this, and other associated reasons, the Council established in 1947 its Division of Building Research. By agreement, the Council undertook this responsibility, setting up an Associate Committee on the National Building Code.

Terms of Reference

The terms of reference of the Committee are to promote uniformity of building regulations throughout Canada and to maintain the National Building Code of Canada as an up-to-date and progressive document. After full deliberation, the Committee decided to achieve its first objective by concentrating on the second. A year's work resulted in a completely new scheme of arrangement which appeared to meet all objections, ever though it was regarded by many experts in the field as unpractical. It was adopted; it has proved completely successful in use. Under the guidance of the Associate Committee, the 1941 Code was then completely revised in accordance with the new arrangement.

The Code is now published in the form of a by-law, ready for adoption by any municipality merely by the insertion of the appropriate name, provided the contents are found to be locally acceptable. Its unique feature, derived from the new arrangement, is that the entire document is arranged in a number of completely independent parts. In consequence, it is really only necessary to change this part to permit of the adoption of the Code anywhere in Canada, all technical provisions being independent of purely local requirements. Local climate will come immediately to mind as an inevitable variable. This is covered in a special climate part of the Code so that peculiar local climatic features may be obtained for any municipality for appropriate use with the design parts of the Code.

Canada has therefore today a national advisory building code, so flexible in arrangement that it can be kept in close accord with all major advances in building practice, its servicing based upon more than a decade of experience with municipal use of the 1941 Code. With every local adoption of the Code one more step is taken in the elimination of senseless, and usually minor, variations in building practice between municipalities. This can have an immediate, even though minor, effect upon building costs and especially upon the costs of housing.

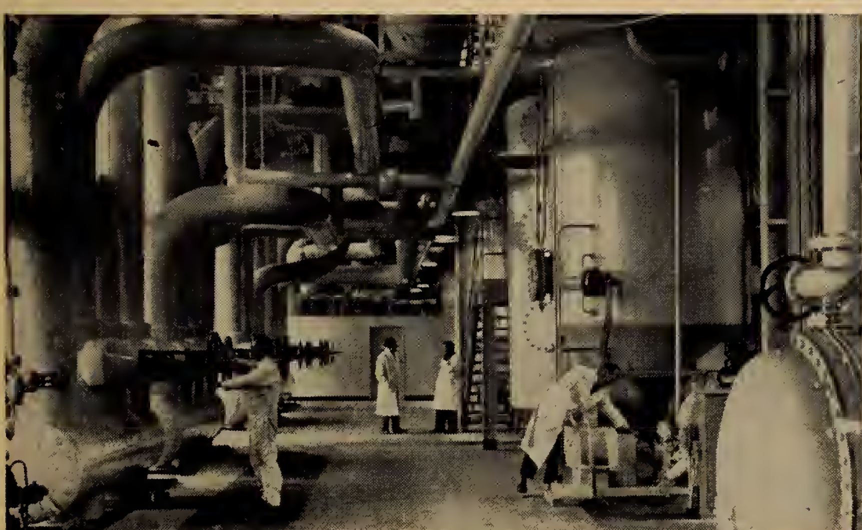
During the last quarter of a century house building has changed from being the erection of a relatively simple type of shelter with a minimum of special features to the construction of buildings which are technically complex. This technological advance is now in full swing. The next quarter of a century may be expected to see a continuation of this change but eventually some levelling off as house design approaches a state of technological saturation. It is therefore apparent that the best and most flexible controls possible should be available for use in connection with all such modern building in Canada. It is the firm belief of the Associate Committee on the National Building Code that the widespread use throughout this country of the National Building Code can achieve these ends.

FIRST LARGE-SCALE NUCLEAR POWER PLANT OPENED

On October 17 Her Majesty Queen Elizabeth II officially opened the U.K. Electricity Authority's nuclear power plant at Calder Hall, Cumberland, England. This is the first nuclear plant in the world to supply significant amounts of economically-produced electrical power into a country's commercial power distribution system, though nuclear-electrical energy has previously been generated and used on a small scale in Britain, the United States, and the U.S.S.R. A second station, Calder Hall "B" is well on the way to completion and is due to go into service in 1958.

For each generating station there are two reactor buildings, based on concrete rafts, 11 feet deep, each containing some 5600 cu. yd. of concrete. Reinforced concrete walls, 7 feet thick, rise 90 feet above the rafts to form an octagonal biological shield. The walls of the shield were built to plus or minus 1/10 in. on vertical and plan true dimensions; and a concrete density of 162 lb./sq. ft. was obtained.

Each reactor is contained in a pressure vessel, and 500 slabs of 6-in. steel plate, each weighing three tons, are placed between the vessel and the concrete shield. Cylindrical steel heat exchangers, 17 ft. diameter and 80 ft. high, are sited at



General view of the Calder Hall nuclear power plant shows two 300 ft. high cooling towers, one of the two reactor buildings, centre, and administrative and turbine buildings (behind the transmission tower). The view of the basement of the turbine room (left) shows part of the steam feed system between the reactors and heat exchangers.

corners of the reactor buildings.

A more conventional group of buildings houses the four 23,000 kw. turbo-alternators, the control block, administration, and workshops.

Three of the main contractors involved, the Taylor Woodrow Group, English Electric, and Babcock and Wilcox, have formed a group prepared to build similar nuclear power stations anywhere in the world.

CAN MAN'S POWER DEMANDS BE MET?

Times Review of Industry, Aug. 1956

In this article two important conferences are discussed. The Tidal Power Conference, held in Paris and St. Malo, was largely devoted to schemes projected for the Brittany coast and the pioneer work of French engineers on the design of water turbines and the use of temperature differences in tropical seas.

Members of the conference on tidal power visited a model established at St. Malo, where tidal cycles are reproduced, which is fully described in the article. The great economic deficiency of a tidal power scheme is that it does not provide "firm" power. It only saves fuel and cannot help peak problems. This apparently insuperable difficulty has been largely overcome by the "bulb turbine generator", the action of which is discussed. Possibilities of extracting power from wave action and from temperature differences between top and bottom of tropical oceans, were also considered.

The fifth World Power Conference, held in Vienna, surveyed progress throughout the world, a valuable feature being that, for the first time, Russian engineers gave extensive data on the existing and potential hydro resources of the U.S.S.R.

The aim of this conference was to explore and open up powers which 'must not be misused for destruction but harnessed only for universal joint progress'. Atomic power, though discussed for a full day, did not dominate the conference. Papers presented clearly indicated that world demand for power continued unabated. There was a tendency, particularly in Europe, to try to coordinate the energy needs of neighbouring countries. Long distance transmission of extra-high voltage a.c. power was discussed. An urgent need was revealed for more uniform statistical data concerning energy reserves of all kinds.

Energy used in the form of electricity, it was stated, only accounted for about 9 per cent of the world's total usage of energy in any form. Demand for electricity was growing so rapidly that by 1957 perhaps as much as half of the intake of energy would be distributed electrically.

Russian engineers reported that the U.S.S.R.'s total theoretical gross water-power potential was 3680 billion kwh. annually. There are 50 rivers with a potential power production of more than 10 billion kwh. About half the potential was theoretically exploitable. In 1950, 1850 stations with total generation of 586 billion kwh. utilized sections of rivers with total theoretical potential of about 1000 billion kwh. More than 2,250,000 kw. of water power had been installed during the last five years.

Other sources of energy, such as the fuel cell, wind power, geothermal power, power from sea temperature differences and solar energy were also dealt with, as well as the heat pump. Though nuclear power was not regarded as the sole answer to energy problems of the future, the session on the subject was one of the most important of the whole conference.

It was clear that no country other than the U.S.S.R., the U.S.A., and Britain could hope to find in atomic power a solution to its power problems within the next two or three decades; nevertheless, uranium deposits already known leave no doubt that mankind will be able to satisfy its needs for energy for a practically unlimited time.

HOUSE WILL STORE HEAT FROM SUN

United Kingdom Information Service, *Trade Topics*, July 1956

A solar-heated house has been invented by a Bristol, England, man. The designer claims that cooking and heating will be at about one-tenth of the normal electricity cost.

The equipment will be capable of storing heat for at least 18 months.

Ventilation is provided by moving the windows, which are fixed on rollers in specially built frames. Interior walls are twice as thick as normal inside walls and ceilings are made of concrete. Heavy steel girders are placed around the base of each interior wall.

Production models of the new house will cost approximately the same as conventional dwellings.

REVIEW OF I.C.A.O. POLICY AND PROGRAM

Presented at the I.C.A.O. Assembly, Venezuela, July 1956

I.C.A.O. policy with regard to the planning of air navigation facilities and services includes objectives of airways, airports, and navigation facilities for international civil aviation and the promotion of safety of flight.

In this review (Agenda item 20) policy is found to be adequate in scope. The I.C.A.O. program is briefly described and its adequacy discussed in relation to fulfilling existing requirements, concluding that lack of funds is the greatest remaining barrier to satisfactory implementation. Possible methods of providing for new finance and technical assistance are suggested.

Conclusions drawn in part IV of the paper include the following.

(1) Provision of air navigation facilities and services in many areas falls short of requirements. Consequences of shortcomings in implementation will grow more serious as new flying equipment comes in service and density of traffic increases. It is imperative that new financial resources be made available from the States themselves or from users of air transport through the airlines.

(2) Importance of having earliest possible information on new equipment and projected operations to permit long-range advance planning is evident.

(3) States should study the problem in broadest terms and consider alternative means for solving the financial problem.

(4) Provision of finance will not of itself solve the manning problem but will simplify it. With expectation that money for real estate and equipment will be forthcoming, intensified attention to training personnel and development of technical assistance under I.C.A.O. control would be indicated.

Appendix B reviews statistical indications of future expansion of world air transport.

Appendix C reviews the trend of civil transport aircraft development over the next ten or twenty years.

Copies of Agenda item 20: A10-WP/13, EX/11 are obtainable from Public Information, International Civil Aviation Organization, International Aviation Building, Montreal, Que.

PENSIONS FOR PROFESSIONAL ENGINEERS

Engineering, 1956, v. 182, n. 4714, July 13.

The Engineers' Guild is to launch a pension scheme for professional engineers in the autumn. The object is to provide cover for the professional man throughout his career. The scheme is to be open to all members of the Guild and to other members of the Institutions of Civil, of Mechanical, and of Electrical Engineers who are eligible to become members of the Guild. The Guild points out that it had been preparing a scheme of this sort for some time before the concessions on pensions for the self-employed were announced in the last Budget.

How far this scheme when published will offer attractions beyond those available under other group schemes remains to be seen. Two basic issues are apparent at this stage. If the terms offered are attractive and the scheme is well supported in consequence, as it will deserve to be, the Guild will have built a bridge in its own right between the professional institutions — an object it has had in mind for some time and which has not been easy so far to accomplish. Another point is this. If this move is successful it will draw the attention of engineers, especially those engaged in professional work, to the possibilities of using insurance arrangements and annuity devices as a means of perpetuating partnerships on terms attractive to the younger men who need security, and who often do not have capital to buy their way into an organization.

BRISTOL BRITANNIA AIRCRAFT IN CANADA

The Britannia turboprop airliner recently made an extensive tour of the North American continent, including stops at Montreal on its arrival and final departure. The aircraft has been ordered, in various versions, by several operators, including Canadian Pacific Airlines.

The Britannia types include the prototype series 100 and the series 300, with longer bodies and more powerful engines, both of which are flying. The series 310 is a long-range version, destined for the North Atlantic run; this can make a non-stop crossing in either direction at all times of the year. Other series include the 320, a 133-passenger medium range development of the 310; and a cargo/passenger version.

The 300 and 310 series will be powered by the Proteus 755 free-turbine engine, a development of the earlier 705; the 755 engine produces 4,120 e.h.p. and each of the four engines drives a de Havilland four-blade 16-ft. airscrew of hollow steel blade construction. Maximum take-off weight of the 310 Britannia is 175,000 lb.; the range in still air, with a 28,000 lb. payload, under standard conditions, is 4758 st. miles; and mean cruising speed is 391 m.p.h. The Royal Canadian Air Force has chosen a version of the Britannia, known as the CL28, for maritime reconnaissance work, and these aircraft are being built for the R.C.A.F. by Canadair Limited, in Montreal. As service involves extreme range patrol at very low altitude, the CL28 will be powered by compound piston engines, which are economical in fuel consumption at low altitude.

The Bristol Britannia turboprop airliner is scheduled for London—New York service in 1957. It will carry 132 passengers at 400 m.p.h. Range is some 6,000 miles.

CONTRACTS FOR KARIBA DAM

Italian Business, Sep. 5, 1956

Italian firms have been granted a $98,000,000 contract to dam the waters of the Zambesi river in the Kariba gorge. (The project was reported in the October issue of *The Engineering Journal*, p. 1376.)

The "Impresit" group of companies bid for the dam construction at $70,-778,400, beating the next lowest offer by over $4 million.

The second contract was granted to Societa Anonima Elettrificazione, of Milan, for electrical work including construction of lines and cables extending over 900 miles. The bid was $26,203,362.

The success of the Italian firms caused some controversy, including suggestions that government favours were involved — which was publicly denied. It is stated that technicians and other Italian workers will be paid at the same rates as the British bidders would pay their European labour; the total American bid was lower than the British, although American pay rates were much higher.

THE DOMESTIC HEAT PUMP

Engineering, 1956, Aug. 24.

The heat pump is not a new idea. Its principle was proposed by Lord Kelvin about 100 years ago. Recently considerable attention has been given to it in the U.S.A., Switzerland and Germany. Main advantage is low operating cost, since two to five heat units are given out for each heat unit of electricity.

A possibly more efficient use of electrical energy is by employing the heat pump cycle. The overall efficiency for electrical heating can be raised from 28 per cent to over 100 per cent and all advantages of electric heating maintained. The principles of a heat pump are similar to those of the refrigerator.

Before assessing the economy of using a heat pump, a theoretical analysis must first be made. Then consideration must be given to the possibilities of adopting the heat pump in the home for space and water heating. The latter presents the more difficult case.

Economic circumstances alone make the heat pump a "must" and no doubt the traditional way of heating (in Britain) is on its way out. Heat pumps will initially become the conventional means of water heating; later they will provide central heating and air conditioning. The Beaver Report on Air Pollution has indicated the need for ending smog. Furthermore at least one third of Britain's coal, 63 million tons a year, is used for domestic heating. This is clearly a justification for the industry to develop heat pumps.

This article is accompanied by numerous graphs, tables, diagrams and formulae, and explains how to determine the economy of using the pump, how to design the installation and how to adapt it for the home.

COSMIC RADIATION RESEARCH ON THE JUNGFRAUJOCH

H. Wäffler, Professor of Experimental Physics, University of Zurich

In a deep notch between the Jungfrau and the Monch, in the Bernese Oberland, there is a narrow ridge of rock some 330 ft. high and 200 yards wide at the edge of a glacier depression. The Sphinx, as it is called, rises to a height of 11,700 ft. and contains the highest railway station in Europe, a very comfortable hotel, and a research centre with the most modern equipment, in the heart of the mountain. For 25 years research workers differing widely in nationality and outlook, have worked here on problems of medicine, physiology, astronomy, physics, etc., forming a big international family which has come together for the sole purpose of adding to the common stock of human knowledge.

Of the various branches of physics studied at this centre, the most important is cosmic radiation—one of the most fascinating natural phenomena known to modern science. The earth's surface is continuously bombarded by a hail of electrically charged particles which far exceed in energy anything we can produce in our laboratories. The problem of the origin of this radiation and the nature of the particles composing it has been of greatest interest for science for years. Although its origin remains a mystery, scientists now know a great deal about the particles of which this radiation is composed. Experimental research conducted on the Jungfraujoch and at other elevated centres has enabled us to form a picture which may be described in broad outline as follows.

Each square centimetre of the topmost layer of the atmosphere receives particles from outer space at a rate of about 30 per minute. Some ninety per cent of them are protons. The proton and the electrically uncharged neutron form the material of which all atomic nuclei are composed. Of the other 10 per cent some nine tenths are the nuclei of helium atoms, the second lightest element, while heavy nuclei of lithium, boron and carbon account for the remaining tenth. The speed of these primary cosmic particles is enormous, being only a fraction of 0.1 per cent less than the velocity of light (300,000 km./sec.). The kinetic energy of the particles is correspondingly high. If we take as a measure of this energy, as is common practice in atomic physics, the difference of potential through which these charged particles would have to pass in order to be accelerated to such speed, we find that we must reckon with potentials of 10^{12} volts. While penetrating the atmosphere, these primary particles collide with the atomic nuclei of the air (nitrogen, oxygen). As a result of these high-energy collisions, the kinetic energy of the particles involved is materialized and new particles are formed known as mesons. All mesons—about ten different kinds are known today—are characterized by great instability. They decay spontaneously in less than two microseconds into other kinds of mesons, which in turn decay until finally we have left high-energy electrons and photons as the last experimentally demonstrable products of decay.

On their journey through the atmosphere the various kinds of particles successively radiated achieve equilibrium. In the uppermost layers of the atmosphere the primary particles and the mesons produced as the result of nuclear collisions predominate, together with secondary protons and neutrons which are also released by the nuclear collisions. At sea-level, on the other hand, nearly all these particles have completely "died out". It is the process involved in the nuclear collision that is of particular importance to modern research. It throws light on the nature of the interactions between the "bricks" forming the atomic nucleus, i.e. the protons and neutrons. The still unknown laws of this interaction determine the structure of the nuclei, and thus the structure of the whole material world. Nature's laboratory provides us, so to speak, with experimental material all ready for use. All we have to do is to avail ourselves of it in the proper place, namely, at the highest possible attitude.

The Wilson Cloud Chamber

The apparatus giving us the most useful information in this research is the Wilson cloud chamber. By rapidly expanding a super-saturated vapour mixture in the cloud chamber it is possible to render visible the tracks of the particles causing the collisions, making them appear like the condensation trails sometimes left by the exhaust gases of high-flying aircraft. By placing the cloud chamber in a strong magnetic field, the nature of the charge and the momentum of the particles passing through it can be determined. By placing plates of suitable material in the chamber, the principles governing the nuclear collisions in that material can be studied together with the properties of the mesons thereby produced.

An efficient cloud chamber with a strong magnetic field weighs several tons. It occupies a lot of space and consumes several kilowatts of electric power. For this reason such an apparatus can only function satisfactorily in well-equipped laboratories with an abundant supply of current. The research centre on the Jungfraujoch is particularly well placed in this respect. It is accessible by rail throughout the year, it can take current from the supply line of the Jungfrau railway, and it possesses large laboratories equipped with every technical refinement. Switzerland can count itself fortunate to possess such an effective research centre.

Canadian Developments

NEWS OF MAJOR ENGINEERING DEVELOPMENTS IN CANADA

St. Lawrence Seaway and Power Project

Weather conditions during September hindered construction operations generally. A total of 4,300 persons were employed on the Ontario Hydro section of the project during the month.

Progress by Ontario Hydro

At the end of September all subgrade work had been completed for the 40-mile relocation of the main line of the C.N.R. between Iroquois and Cornwall. More than half the double track was laid and ballasted. Preparatory work had begun for the grade separations. The sites had been prepared for the four new stations to be constructed.

Sub-grading was practically completed on five of the six sections to replace No. 2 highway between Iroquois and Cornwall. Surfacing work should commence next month.

At the power-house site, earth excavation was completed and 90 per cent of rock removed. Concrete placement had proceeded to unit 8. The draught tube form used for unit No. 1 had been erected in unit No. 3 and was ready to receive concrete. A total of 260,000 cubic yards of concrete had been placed in the Ontario Hydro section of the powerhouse structure, with intakes poured for six units. Outstanding progress had been made on the construction of the Cornwall dike closure structure for diversion of Cornwall canal. About 85 per cent of the concrete had been placed in the structure and half the backfill required was placed.

Wet weather had hampered Cornwall dike construction work. However, the contractor moved more than 20,000 cubic yards of material per day during favourable conditions.

All equipment for the 1956 stage of the St. Lawrence transformer station was in service. Work is proceeding ahead of schedule on the 1957 stage.

Channel improvement work progressed favourably during September. At Galop Island, the large cofferdam at the north end had been dewatered. A total of 6,000,000 cubic yards of earth had been excavated and approximately 275,000 cubic yards of rock had been excavated. Dredging was progressing favourablv in the Chimnev Island contract with a total of 720,000 cubic yards of material removed. Work had begun on the Iroquois Point contract. Clearing operations were well underway.

A total of 66 houses was moved by the end of September into new town No. 2. Construction of basements continues to be well ahead of house moving. In new town No. 1 work was concentrated on the completion of water and sewer services, as well as roads in the eastern half of the town. A temporary water pumping station was placed in operation to provide fire protection. Meanwhile, the permanent water pumping station, sewage pumping station, and sewage treatment plant were nearing completion.

At Morrisburg, good progress was made in the construction of sewers and water mains for the new subdivision. Construction of footings for the new shopping centre had begun. Similarly at Iroquois, activity was centered around construction of the new shopping centre. Considerable street paving and landscaping work was in progress at Iroquois. Construction of the new public school and the superstructure for the new high school was underway.

Long Sault dam. Stage 1 piers have been completed and construction of the roadway is in progress.

Progress By NYSPA

During September construction moved steadily ahead as work continued on an around the clock basis. Concrete placement in all project structures exceeded 780,000 cubic yards, excavation for all features exceeded 26 million cubic yards and employment averaged 5,200 for the month.

Concrete placement for the stage 1 construction of Long Sault dam was complete except for the parapet walls. With excavation of cut "F" approximately 88 per cent complete, its downstream plug was breached and water was admitted into the cut area, as removal of the plug continued. Grading for the westerly section of Barnhart Island road had been completed and work on the north dike was progressing. Cofferdams "A" and "B" were being removed and construction of stage 2 cofferdams was progressing. The contractor's access bridge to stage 2 cofferdam was completed. Placement of rock material in stage 3 cofferdam "E" was started on September 13.

Concrete placement in Barnhart power-house continued with a total of 313,000 cubic yards to September 30. Concrete placement for the switchyard tunnel was started. Excavation for the switchyard continued and placement of embankment in the south forebay dike exceeded 430,000 cubic yards.

At Iroquois dam, stage 1 concrete placement was completed, and all 15 control gates placed in position. Excavation within the stage 1 cofferdam area was completed and thirteen cells of the stage 2 cofferdam were in place.

At Massena intake, placing of concrete was continued with 123,000 cubic yards placed to date. Back-filling around the wing walls and dike embankment placement continued. Construction of the Massena-Alcoa water facilities was essentially completed.

Excavation under the five channel improvement contracts was 43 per cent completed as work at the Galop Island south channel progressed to 94 per cent of completion.

Contracts were awarded for the relocation of New York State highways 37 and 37B. Bids were opened for seeding and topsoiling of channel improvement spoil areas in the vicinity of Galop Island, south channel and reservoir clearing between Waddington and Barnhart Island power plant.

Approximately 95 per cent of survey work for the Barnhart-Plattsburgh transmission line had been completed. Production of construction drawings and specifications continued at rapid pace. Expediting of major items of equipment was pressed to insure delivery of manufactured components at the project in time to meet the tight schedule.

A start was made in September on stilling the turbulent Long Sault rapids. Rock and earth fill is being dropped into the water some eight miles west of Cornwall from an aerial cableway strung between steel towers, linking Long Sault Island with the Canadian mainland.

Some time in December, when the spillway in the first stage of construction on Long Sault dam is completed, first stage cofferdam removed and second stage cofferdam in place, the upstream earth 'plug' presently blocking the river flow through "cut F" will be removed by blasting, which will divert the flow of the river to the south channel and through openings in the Long Sault dam spillway.

Progress by SLSA

The mile and a quarter long Iroquois lock, due for completion by November 1957 at a cost of $6½ million, requires excavation of 4½ million yards of glacial till. More than half of this quantity had been removed by the end of September, leaving a gaping hole 100 feet wide, 90 feet deep and several thousand feet in length. Most of it came from around the 1300 foot lock structure and upper guide walls. Little earth had been dug for the lower guide-walls of lower approach channel.

A few base blocks had been poured for the walls of the lock structure, but most of the 80,000 cubic yards of concrete placed to date had gone into the upstream guide wall, which was 75 per cent completed. For half of the 1300 foot length it had been built to a height of 47 feet. It is 34 feet wide at the base and will be six feet wide on top. One of its functions is to serve for mooring ships waiting to pass downstream through the lock.

Contracts were awarded in mid-June for the upper and lower Beauharnois lock structures at prices of $14.44 million and $11.2 million respectively. Designed wide enough to ultimately permit ships to pass one another, the lock structures will at present be built wide enough for one ship except at the entrances and for a short two-lane section at the downstream end of the lower lock.

The contractor for the upper lock had set up his camp and plant, and was crushing and stock-piling aggregates. His contract includes excavation. About 15 per cent of the earth excavation and 10 per cent of the rock had been moved up to the end of September.

For the lower lock a separate contract had been awarded last March at a price of $3,480,000 for rock excavation for the lock structure and guide walls, for full width and length to a depth of some 40 feet. This contract also included more than half a mile of four lane highway approach road at each end of a 200 ft. long lined highway tunnel 26 feet in height under the lock structure. This excavation, all of it in tough sandstone, was practically completed at end of September.

The contractor for the lower lock structure had also built his camp and was setting up the mixing plant and stock piling concrete aggregates.

In the Lachine section, a contract for the Côte St. Catherine lock was awarded in August 1955 at a price of some $7.1 million, for completion in July 1958. The work here extends a distance of two miles and includes a turning basin below the lock, regulating works for controlling the canal water level above it and a reservoir pool upstream. The lift will be 30 feet, overcoming the major fall of water in Lachine rapids.

In addition to much excavation, the contractor had placed concrete for a number of monoliths upon which the walls of the lock structure will be based.

Also in the Lachine section opposite Montreal at the south shore end of Victoria bridge is the 2 mile long St. Lambert lock, overcoming the 15 foot drop between the Laprairie channel and the Seaway entrance channel in the harbour of Montreal. A contract was awarded in 1955 for this lock at a price of some $7.4 million, and work commenced last January. Completion is called for in August 1958.

Here most of the 2½ million yards of excavation had been completed. On the south or land side of the lock structure above the Victoria bridge, alternate blocks of the concrete wall were poured almost to bridge-floor level with the remaining sections following close behind. The downstream guide wall on the land side was taking definite shape below Victoria bridge.

Many miles of channel in the shallow riverside and overland in the Lachine section have still to be excavated. Dredging of the seaway entrance at Montreal harbour and of channel reaches in Lakes St. Louis and St. Francis and elsewhere will continue for two more years.

Miles of these channels have been dug or dredged already. Several minor contracts and one major one are completed in the Lachine section. One of the three dredging contracts in Lake St. Francis is completed. Of the three contracts for enlarging the Welland ship canal to a depth of 27 feet, one is completed.

Three more contracts were signed at Montreal on September 14th by the St. Lawrence Seaway Authority, totalling some seven million dollars, as follows:

(1) Dominion Bridge Co. Ltd., for construction of superstructures for two vertical lift bridges on the Canadian Pacific Railway's double track bridge near Caughnawaga, $3,031,097.

(2) Atlas Winston, Ltd., Montreal, for excavation of channel and construction of dike, embankments and CPR substructure, $3,259,525, at Caughnawaga.

(3) Timberland Machines Ltd., Woodstock, Ont., for supply and erection of 10 stiffleg derricks with winches at five SLSA locks, $649,000.

Award of these contracts brought the value of SLSA contracts awarded to date to over $156 million.

The cornerstone for the Seaway Authority's Cornwall headquarters building was laid on September 11 by president Lionel Chevrier of SLSA. Speakers at the ceremony included the Hon. George C. Marler, Minister of Transport, Mayor Aaron Horovitz of Cornwall, and Albert Lavigne, M.P. for Stormont. To be the tallest building in the city, it is already built to its full height of seven storeys, and is due for completion next summer.

Progress by SLSDC

At end of September excavation at the Eisenhower lock was completed for the upstream approach channel and for the lock structure and upstream guide walls, but not for the lower guide walls and downstream approach channel. Rock was excavated for the lock itself.

Some 120,000 yards of concrete had been placed in the lock proper, out of an estimated total of half a million yards for the whole job, bringing the lock walls up to about one third of their final height. Excavation was under way for the approaches to the highway tunnel under the lock.

At the Grasse River lock, cost of which will be $26.8 million, excavation for the lock structure was complete but little excavation had been done for the guide walls and channel approaches. Concrete had been poured for the walls of the lock throughout its length to approximately half the final height. No work had been started on the highway approaches.

Placing of concrete on these two American locks will be discontinued during the winter months, in contrast to the five Canadian locks where concrete work will be continuous.

Earth for the Long Sault main dike and for the Richard's Landing dike on the American side is obtained by dredging from the navigation channel, but is paid for by NYSPA. The main dike was about 40 per cent completed while the Richard's Landing dike was some 33 per cent completed, at the end of September.

The 14 cubic yard dragline named 'The Gentleman' had been moved to an island in the forebay for recasting fill. About 25 per cent of the 12 million yards of excavation for the Long Sault navigation channel had been completed.

Most of this channel can be done 'in the dry' and will be continued well into the cold weather. On a three mile stretch between the two American locks across swampy land a pool was formed by pumping, and a dredge is pumping material from the pond to the spoil area, at a considerable saving below the cost of shovel excavation.

Clearing was completed on Long Sault Island and partly completed on Delaney Island, and was proceeding on other wooded areas within the St. Lawrence Park limits.

The St. Lawrence Seaway Development Corporation will ask Congress next session for authority to borrow further money. Rising costs for labour and materials are blamed by the agency for an additional $5 million on the original estimate of $105 million. Actually $17 million of additonal borrowing power will be asked, but $12 million is for contingencies and will not likely be needed. Redesign of the bridge at Cornwall, making it a suspension structure, will save $2 million and mean no delay in final completion of the project. As of September 1, 1956 the project was claimed to be on schedule.

Dredging at Cornwall Island

SLSA president Lionel Chevrier, addressing members of the Cornwall Board of Trade on September 20, explained that a channel 450 feet

Iroquois dam. Stage 1 construction is nearing completion as one gantry crane is in position and runway beams are being completed.

in width and 27 feet in depth must be dredged on the south side of Cornwall Island to provide navigation from the upper end of Lake St. Francis to the entrance to the Grasse River lock.

The Cornwall Island south channel must also be deepened, widened and straightened so that the velocity in the navigation channel will not exceed 4 feet per second. This will reduce the flow in the north channel, he pointed out, and therefore it becomes necessary to do compensatory dredging in the north channel to maintain the flow distribution under natural conditions.

The Cornwall Island dredging, amounting to approximately $35 million, will be shared by all four entities now working on the development of the river. However, the actual dredging will be carried out by the St. Lawrence Seaway Authority and the Saint Lawrence Seaway Development Corporation.

"The matter of the north channel dredging," remarked Mr. Chevrier, "is under discussion between the two governments of the United States and Canada, and no final statement can be made until the matter has been determined on that level."

Plans Revised for Ogdensburg Cornwall Bridge

A major change in Seaway plans for the International area near Cornwall was announced on September 20. One high level suspension bridge will be built instead of four smaller structures called for in earlier plans. In addition, the New York Central will abandon its line into Canada when the south channel bridge is replaced by the high level span.

Cost of the new bridge will be $6 million, or some $2 million less than the earlier plan to build connecting bridges across the Polley's Gut area. It will be located about 1000 feet west of the existing Roosevelt rail-highway bridge between the U.S. mainland and Cornwall Island. For the present no announcement is made on plans for alteration or removal of the second bridge from Cornwall Island across the north channel to the Canadian mainland.

The new span will be an international project. Canada will build the substructure and the U.S. will build the superstructure. The bridge will be completed by July 1958 and the old structure over the Seaway channel will be torn up. The question of tolls will be taken up at a later date. Tolls are charged on the existing bridge. NYCRR shareholders have approved sale of the 70 mile line from Helena, N.Y. to Ottawa to the St. Lawrence Seaway Authority.

Harbour Improvements Authorized

Over the next three years the National Harbours Board will spend about $50 million on eight big federal harbours, to catch up on postponed harbour remodelling and the need to provide for fast efficient handling of ships' cargoes; $20.5 million will be spent this year, about $15 million in each of the years 1957 and 1958.

Of this, ports along the Seaway will have some $16 million in improvements this year. Quebec will get $1.7 million for a new oil wharf and for rebuilding berth 8 at Pointe-a-Carcy. Another $5 million will be spent for a two-million bushel elevator and berthing for large lakers.

Montreal will get $6 million for new wharves to provide 3100 linear feet of berthing, for raising of Sutherland and Laurier piers, for extension of oil wharves, and for a new grain jetty, as well as $1 million for further dredging and $2.4 million for grain conveyor galleries. A possible further $7 million will be spent for grain storage elevators.

Short Cut to Upper Lakes

A short-cut system to link Georgian Bay with major southern Ontario markets and lower sections of the seaway is being reviewed. This was a major political issue half a century ago but was abandoned when the Welland canal was improved. A connecting waterway through Lake Simcoe to some point between Toronto and Oshawa is under study. The channel would start from Collingwood or Midland and follow the Nottawasaga valley or some reaches of the Trent canal, which at present carries 250 tons of freight yearly.

Cost of the original 440 mile schemes from Georgian Bay to Montreal was estimated at $100 million early in the century and would take 10 years to build. The 100 mile route now under review would take a more direct line to Lake Ontario. Costs, of course, could not be compared.

Rocket Launching Site

The Arctic launching site for rockets at Fort Churchill was ready in October for its part in the International Geophysical Year (IGY) to begin officially next July. This was announced recently by Dr. Joseph Kaplan and Mr. F. T. Davies, chairmen respectively of the United States and the Canadian national committees of the IGY.

The program of rocket launchings in the Arctic is part of the intensive international study of the earth, the atmosphere and the sun, to be conducted over the entire world from July 1957 to December 1958. From this program scientists of all nations hope to gain a better understanding of the earth's structure and various effects in the atmosphere such as aurora and airglow, cosmic rays and solar activity.

Mr. Davies, assistant chief scientist of the Defense Board of Canada, is also a member of a co-ordinating committee for the IGY appointed by the president of the National Research Council. Other members are Dr. C. S. Beals, Dominion Astronomer; Dr. D. W. R. McKinley, Radio and Electrical Engineering Division, N.R.C.; Dr. D. C. Rose, Pure Physics Division, N.R.C. Mr. Rose is chairman of this committee.

Rocket experts chose Fort Churchill for its accessibilty and because it lies within the "Arctic auroral belt" where Northern Lights are most easily observed. The rocket launchings are part of the scientific effort of the United States to explore the atmosphere in the Arctic to a height of 180 miles. Aerobee rockets will be used for high altitudes and smaller two-stage rockets for lower altitudes.

Preliminary rocket flights were to begin in late October or November under the direction of the U.S. scientists. Canadian scientists co-operating in the tests at Fort Churchill will make observations on the ground which will tie in closely with measurements taken by the rockets.

The Fort Churchill rocket site is a multimillion dollar establishment financed by the U.S. Many branches of the U.S. Defence Services are lending their support to this scientific venture.

Scientific instruments carried by the rockets will measure density temperature, pressure and wind velocities in the Arctic atmosphere at heights never before studied. They will also take measurements of the ionosphere — the upper region of rarified, ionized gas between 50 and 250 miles above the earth's surface — which reflects radio waves in long - distance communication. The rockets will record effects of the sun's light at high altitudes, and such phenomena as Northern Lights, cosmic rays, and the earth's magnetism.

Canadian Pipeline Projects

In a progress report at mid-September, Westcoast Transmission disclosed that some 2000 men were at work, 1964 on pipeline construction and the balance on the absorption plant and compressor stations. More than a third of the pipe had been laid for the main 30-inch pipeline from the Peace River area to the International Boundary.

Westcoast Transmission

220 miles of pipe had been covered, 254 miles had been welded and pipe had been delivered for 448 miles. One of the contractors, Canadian Bechtel Ltd., claimed a record in pipelaying of 1,200 feet in one day, while four spreads laid 30 miles in one week or an average of over one mile each per day. A contract had been awarded for two 18,000-h.p. compressor stations to Dutton Williams Ltd., at Australian and Fort McLeod, with initial capacity each of three 4,500-h.p. units.

Pacific Petroleums has purchased a major interest in XL Refineries of Dawson Creek, and is building an $18-million gasoline processing plant at Tavlor Flats, to be integrated with XL Refinery operation to serve a substantial market along the Alaska highway and in the Peace River valley.

Gas reserves in the Peace River area are estimated at close to 4 trillion cubic feet. Some 2¾ trillion of this is controlled by Pacific Petroleums. Well-head prices are set tentatively at 6 cents till January 1958 and 10 cents for the next five years, increasing to 12½ cents the eighteenth, nineteenth, and twentieth years. Westcoast plans to move 3 million c.f.d. during 1957 and 400 million c.f.d. in 1958, out of an ultimate 650 million c.f.d.

Dr. George S. Hume, one of North America's outstanding geologists who has been director general of scientific services, department of Mines Ottawa, is joining Westcoast Transmission Company Limited, as vice-president and chief geologist.

Dr. Hume, who has been with the federal government since 1920, has been acting deputy minister of mines for the past year and a half. He has also taken a leading role in the development of Canada's natural gas reserves and in the establishment of natural gas pipelines for services to all parts of Canada.

Inland Natural Gas

Dutton-Williams Bros. Ltd., has been awarded a $9 million contract for general construction on the new distribution system of Inland Natural Gas Co. The project involves some 360 miles of trunk lines from Savona east through Kamloops to Oliver, and east to Nelson. Fifty miles east of Kamloops a spur will serve Salmon Arm. The line will supply gas to some 25 communities. Pipe is ordered from Canadian Western Pipe Mills at Port Moody and Alberta Phoenix Mills, at Edmonton, in 12, 10, 8, 6, and 4-inch sizes at a cost of $6½ million. The company will spend $22 million during the next 12 months and a total of $28 million by 1960.

Inland has been confirmed as supplier of gas to the City of Nelson B.C. Ratepayers approved the sale of its municipally owned propane-air gas system to Inland and the granting of a franchise to Inland to provide natural gas. Inland plans to maintain the plant to provide service until gas becomes available and to act as a standby plant thereafter.

Two additional northern communities have also been added to the list of those to be served by Inland; Little Prairie, east of Dawson Creek, and Hundred Mile House, will be served by stub lines from the Westcoast Transmission pipeline. Apart from subsidiaries, Little Prairie becomes Inland's most northerly B.C. customer, though Dawson Creek and Grand Prairie in Alberta are also customers.

Inland has incurred commitments worth almost $7 million during the current year to date. Pipe has been ordered at a cost of $6½ million. In the near future the company will commence laying some 360 miles of pipeline and the entire system involves 875 miles of pipe including local mains and services. During 1956, Inland has become a certified gas utility, and within a few months the company will finance the major operation of building its pipelines. Cost of the entire project is estimated at $25 million.

J. R. White, president of Imperial Oil, warned recently of too much optimism regarding possible petrochemical developments around Edmonton and the Peace River area. Any major industry using Peace River gas was more likely to be established near Vancouver, he predicted. Such plants must be convenient to large population centres with easily reached markets. High freight rates out of Peace River and even Edmonton were a handicap to building there.

Trans Canada Pipelines

Arrival of the first trainload of 34-inch pipe at Cabri, Sask., on September 20, with almost continuous shipments promised to follow, has resulted in a return to all-out pipelaying operations on Trans Canada's western leg to Winnipeg. Two more spreads have started work. Up to mid-September less than a fifth of the 575-mile line had been laid, due to interruption of pipe deliveries since the steel strike and to a critical shortage of welders.

Final pipe shipments may not be made until February, however, according to suppliers; thus prospects are that the entire line may not be completed before midsummer of 1957. Possibly only half of the western leg will be laid before winter weather calls a halt to pipelaying.

Trans Canada has been harder hit by the steel strike than any other pipeline. Long term future for pipe deliveries is difficult to forecast because of the increase in pipe orders over recent months, it is difficult now to arrange for pipe delivery for a major project before 1959.

Majestic Contractors Ltd., had been temporarily shut down on the first spread from Burstall to Leinen, due to lack of pipe, with 52 miles of pipe in the ground. Canadian Bechtel Ltd., on spread 2 will soon have enough pipe to complete its 110-mile section. This contract includes the only river crossing in Saskatchewan, over Swift Current creek.

Intercity Gas Ltd., a wholly owned Manitoba enterprise incorporated in 1954 to distribute gas to towns and villages in the province, has obtained exclusive franchises for Portage la Prairie, Neepawa, Rivers, and Hamiota. Further franchises are being sought. Initial expenditures for the network of mains to connect with Trans Canada pipelines are set at $1.1 million, plus a further $500.000 if new franchises are allowed. Mains are nearing completion for the four towns under franchise. Financing is now being carried out.

A build-up of gas sales in the Montreal area had been planned to commence as soon as a further supply of Texas gas was available. Import of this gas depends upon F.P.C. action on an application which is consolidated with the application for export of Canadian gas at Emerson.

The Quebec Natural Gas Corporation was incorporated in 1954 by interests allied with Trans Canada to distribute gas in the Montreal area and to negotiate with Hydro-Quebec for purchase of the Montreal Coke Company. Pipe for the line from Toronto to Montreal is on order, but according to pipe delivery schedules the earliest date gas could be made available to Montreal would be 1958-59, even if no hitch occurred in financing. The import of Texas gas may be authorized even later than that by F.P.C.

Gas Treaty Proposal Gets Cool Reception

Proposals for a natural gas treaty between Canada and the U.S. made on October 1 before the Federal Federal Power Commission met cool reception in diplomatic circles of both nations. In formulation of a national energy policy, a firm and definite line is already set on electricity;—that since it can never be recovered it should never be exported. A parallel was suggested which would put natural gas in the same category. That would, however, cut across the Trans Canada pipeline program under which gas would be exchanged.

It is Canada's policy to be most particular about export of natural resources, considering each case as it arises. This policy runs counter to blanket agreements on exchange of natural gas.

FPC Hearings

Early in October during FPC hearings, Examiner Francis Hall recommended a disregard, for the time being at least, of objections by competitors and the coal industry to the Tennessee Gas Transmission Company's pipeline from Emerson, Manitoba to Portland, Tennessee, to be built by Midwestern Gas Company. To reject the plan now would not be in keeping with the public interest or past practices, he observed. But, he warned, his recommendation for further study must not be taken as an indication of future approval. This was considered by observers as a victory for the proposed pipeline, even though a final ruling is up to the full F.P.C.

Financing

A third advance, in the amount of $4,183,000 was made on September 27 by the Crown Corporation to Trans Canada Pipelines. This brought the amount advanced to finance the western section of the pipeline to $15.083,000.

Financing plans for the entire project, exclusive of the Northern Ontario section to be built by the Crown Company, are now almost completed. Financing is now imminent and should be carried out within a few weeks. The first mortgage bonds for at least half the total issue will be placed privately with investing institutions. Debentures and common shares will be offered exclusively in Canada. No decision is yet made as to interest rates on debt securities, nor on the issue price for the common shares.

Export to U.S. Still Needed

Trans Canada officials and gas producers generally regret the Hon. C. D. Howe's statement in a speech at Toronto on September 18, that "gas committed to Trans Canada has been sold in Canada, and export to the United States is no longer necessary." This, they feel, may influence the Federal Power Commission against giving a permit to export Canadian gas to the U.S. via Emerson, Man. They give two reasons why Trans Canada must seek all possible export markets; first, the slow build-up of markets versus the faster growth of reserves, and secondly, pipelines do not want any limitations set on their growth.

Millionth House

A million houses have been built in Canada since the end of World War II. Completion of the "millionth house", in Scarborough, in September called for some comment on the past and the future of housing in Canada, by Robert Winters, M.E.I.C., Minister of Public Works.

Approximately 1½ billion man-hours of work have been done on construction sites alone—one facet, only, of the economic effect. The construction labour force now numbers nearly 400,000 workers. Land and building have involved the expenditure of $9 billion.

Canadians are now building more than enough dwellings to take care of the annual increase in the number of families, of population movement. and to replace dwellings destroyed. They are cutting into the backlog of need. It is possible, therefore, to move in the direction of replacing substandard housing.

More Iron Ore from Ungava

Four iron ore companies are spending an estimated $1 million this year in development and engineering studies of the low-grade iron ore deposits around Ungava Bay. They plan to market several billion tons of beneficiated ores in European countries.

Consolidated Fenimore Iron Mines Ltd. has already spent some $2 millions in development and studies over the past three years. Two Cyrus Eaton companies, Atlantic Iron Ore Co. and International Iron Ore Co. have also been investigating the area for three years.

A harbour would likely be established on Ungava Bay, which is open to navigation for only two or three months of the year. Present plans call for transhipment of ore by shuttle service in two months of open navigation to a port in Greenland on Rype Island one mile from Gothaab. From this port, where storage of 3 million tons of ore would be set up, ships of up to 45,000 tons could transport the ore all the year round to European mills.

Hydro-Quebec is looking over the area for a possible hydro-power site. Ottawa's hydrographic surveys branch is studying Ungava Bay for a harbour site. Transportation routes to tidewater, metallurgical and mill methods for concentrating the ores are also under study. Estimated capital cost of developing the Fenimore property for production of a million tons of concentrates yearly, using magnetic separation, is about $16 million.

Month to Month

News of the Institute and the Profession

COMMENT AND CORRESPONDENCE ELECTIONS AND TRANSFERS

Technical Manpower Conference

It was bound to happen sometime. All the talk about shortages and education, could be resolved only by some sort of get-together of people who were interested.

Under the auspices of A. V. Roe Canada Limited, the interested people met at St. Andrews, N. B. on September 9-10-11. Much credit must go to the company for its courage in tackling the problem about which so many were talking and so few doing anything. The company handled the complete job including the organizing and the financing, and did it all well. It must have been particularly gratifying to have everything go so well, including the acceptance of two previously prepared resolutions which point the way for the future.

The resolutions proposed the establishment of an Industrial Foundation on Education, and the appointment of a committee to explore the feasibility of establishing a National Advisory Committee on the Advancement of Education.

To the conference were invited many leaders in industry, education, government, professional societies and labour. The roll call showed about a hundred there. It was a notable assemblage for a notable purpose.

The two reports which were approved without a dissenting voice read as follows:

First Recommendation

A proposal to establish an Industrial Foundation on Education as a permanent factfinding and executive organization, to be financed entirely by industry and to perform broad functions on behalf of industry in the field of education, as related specifically to needs and acknowledged responsibilities of industry.

Basis For the Recommendation

This Conference would fail in its larger purpose if its deliberations did not culminate in some positive action.

Since the Conference is predominantly industrial in representation it therefore devolves upon industry to seek a course of constructive action toward solution of the truly appalling problems we face in the supply of professional and skilled manpower and the educational problems related thereto.

But industry can only do so much without encroaching upon responsibility and authority in other areas of this many-sided problem in which it can only plead, advise and offer opinion and support.

What, therefore, can industry do?

We of the Advisory Committee to this conference, believe that the immediate contribution of industry in the step-by-step solution should take the form of an Industrial Foundation on Education.

This Foundation would be a fact-finding and executive organization, permanent in nature. It would be the voice of industry in the field of education, the

Among those attending the Technical Manpower Conference were, left to right: Dr. L. Austin Wright, E.I.C. general secretary, Dr. C. B. Purves, president, Chemical Institute of Canada, V. A. McKillop, president of the Engineering Institute.

Cover Picture

Pipe in the Alberta-Winnipeg section of Trans-Canada Pipe Lines' 2,250-mile natural gas transmission line is 34 inches in diameter, weighs more than 355 tons per mile.

Sideboom tractor, shown raising a string of pipe for cleaning and coating, is probably the busiest piece of equipment on the job. Next step is to lower the heavy pipe into the six-foot deep trench.

vehicle by which individual components of industry would state and expound upon their aims, and support all necessary steps to greater efficiency in the educational system as related to the needs and future of the national economy.

Such an organization could have many functions.

A rapid enumeration suggests these examples:

1. Sponsorship and organization of in-plant training programs.

2. Adminstration of industrial contributions to educational advancement whether for individuals by way of scholarships, institutions by way of grants and fund-raising campaigns, or the cause of education generally by contribution of influence and promotional talent and/or funds.

3. Continuing study on educational problems specific to industry and commerce with periodic recommendations toward solution of these problems.

4. Public information programs designed toward motivation of career decisions, attracting more people to teaching careers, providing more technical training facilities, more and better university facilities and buildings.

5. Assistance in career counselling.

6. Guidance in effective utilization of professional and technical skills.

7. Influencing the training of many more women as scientists, engineers and science and engineering teachers.

8. A continuing program to influence scientists, engineers and technicians to remain in the fields for which they were trained.

9. Cooperation with the professional societies on matters of status and recognition whether for practicing engineers and scientists or those teaching.

Many more likely and necessary functions could be added to the list — the foregoing are but examples of necessary objectives which we believe can only be attained through an industry-wide organization.

Such an organization can be established and put to work for relatively little money.

Members of the Advisory Committee can serve as a Board of Directors, while initial staff requirements are as follows: Executive Director, Research Analyst, Secretary, Clerk Typist, and possibly one Illustrator.

Annual operating expenses are estimated at $50,000. Initial capital costs for furniture and equipment would be in the region of $3,000. These funds, for the first year of operation, have already been pledged.

Second Recommendation

A proposal to appoint a Committee to Explore the Feasibility of establishing a National Advisory Committee on the Advancement of Education as a permanent and national fact-finding and policy making organization having a broad responsibility in the entire field of education and to have representation from government, industry, education, the professional societies and organized labour.

Basis For the Recommendation

The Advisory Committee is convinced that the problems we face in education generally, and especially as related to the urgent needs of today and for the future in technological skills, can only be solved in total by attack on a broad, national front. While the proposed Industrial Foundation can accomplish much, its function and likely achievements can only constitute one piece of a much larger fabric.

The Committee believes that it has been clearly established by research and through discussion at this Conference that these problems constitute a national emergency which so far has not been comprehended on any national scale.

We are therefore recommending that an investigation be undertaken on a national scale whereby the main segments of our organized society may be brought together in an attempt of broad dimensions to find a vehicle by which the educational problem may be kept under close scrutiny continually and in centralized and closely coordinated manner.

The initial step, we propose, should be the appointment by this Conference of a Committee of Five, representing education, industry, professional societies and organized labour, under a Chairman, and with necessary staff, to explore the feasibility of establishing a permanent national advisory body on education, representing government at appropriate levels together with the other entities mentioned above. This national advisory body would be charged with the responsibility of studying trends and improving levels of efficiency across the broad field of education in the interests of national well-being in all aspects.

We propose that this Committee should be empowered by this Conference to start its work immediately and to report its findings within the next three months. Funds will be required and the need is estimated at some $50,000 for a thorough-going study.

As a basis for consideration — and in no sense a set goal — the kind of national body we visualize might be called the National Advisory Committee on the Advancement of Education.

This organization, by present concepts, could emerge as shown in the illustration.

Here we would have a fully representative body which, through its various committees, would be in constant and timely communication with people at the many grass roots of the problem.

What would be some of the principal functions of such an organization?

1. Development of plans for expansion of educational facilities.

2. Assessing costs and formulating financing plans for such expansions.

3. Constant review of curriculum content.

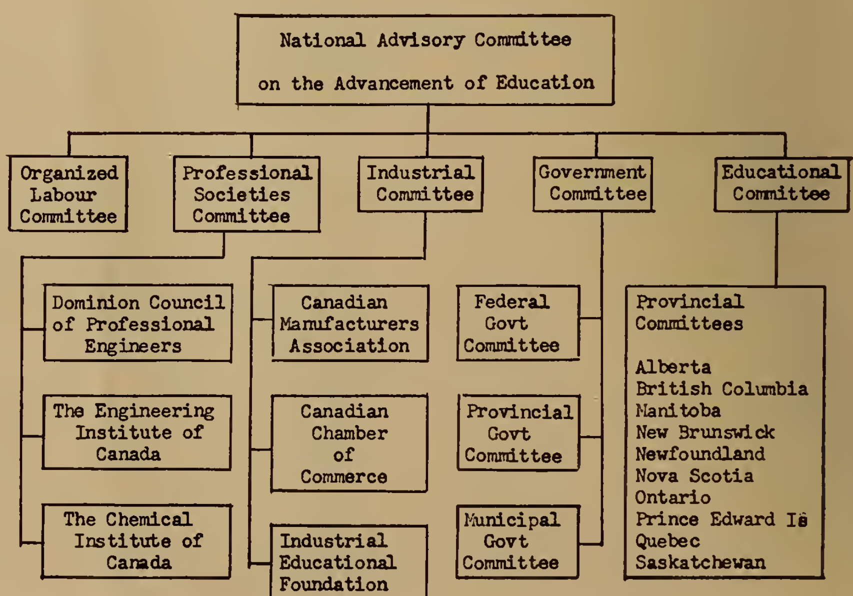
4. Investigation of teacher problems and formulation of plans to overcome them.

5. Motivation of students toward acceptance of responsibilities and essential roles in our complex industrial society.

6. Investigation and development of teaching methods and training aids.

7. Public information programs on education problems, financial needs and public responsibilities in education.

8. Investigation into scholarships, grants, loan plans for students and other



financial aids to worthy but needy students.

9. Investigation into programs and proposals for further education leading to professional or technician status outside established institutions and methods (for example, cooperative educational institutions for engineers, in-plant training programs).

These are but some of the functions a fully-representative national organization on education could undertake and constitute but a glimpse of the highlights of the many aspects of the entire problem where action is required.

We believe they indicate quite clearly the need now to investigate and work toward early establishment of such a national organization.

The Foundation will be financed entirely by industry. Its chairman will be Crawford Gordon, Jr., president of A. V. Roe Canada Ltd., Toronto. Executive director will be S. H. Deeks, Toronto, who prepared the brief which served as the general theme of the Conference. Cost of maintaining the Foundation and the exploratory committee for its first year will be $100,000 pledged by the industrialists.

The proposed National Advisory Committee on the Advancement of Education would be a permanent and national fact-finding and policy-making organization with a broad responsibility in the entire field of education. It would have representation from government, industry, education, the professional societies and organized labour.

Its chairman is James S. Duncan, Toronto. Other executive members will include Dr. G. Edward Hall, president of the University of Western Ontario, London; D. W. Ambridge, Toronto, president of Abitibi Power & Paper Co. Ltd.

Speaking on behalf of the educators gathered at the Conference, Dr. Hall endorsed the two "cornerstones" laid, as being "satisfactory to the universities in principle."

The general conference chairman was James S. Duncan. Leader and special speakers were Dr. O. M. Solandt, Hon. M.E.I.C., A. H. Frampton, J. D. Barrington, P. R. Woodfield, D. W. Ambridge and A. F. B. Stannard.

The speaker for the closing dinner was the Rt. Hon. C. D. Howe, Hon. M.E.I.C. Mr. Howe agreed there was a shortage of engineers and that every effort should be made to overcome it, but he did not think there was any reason for hysteria. A shortage of engineers was a clear indication that the country's economy was sound. He said he would really begin to worry when there was no such shortage.

The Engineering Institute of Canada was represented by its president, V. A. McKillop. The Chemical Institute of Canada had its president Dr. C. B. Purves there, and the Dominion Council was represented by its president E. J. Durnin of Regina who is also chairman of the Saskatchewan Branch of the Institute.

The Conference was a success. If the support offered in the future in carrying out the proposals equals that of the Conference, they too will be successful. They are far reaching, sound and well thought out. They merit wide support from all parts of Canada and all groups of people.

Hamilton Branch Expands

Recently the chairman of the Hamilton Branch has announced that a technical division has been formed within the branch membership.

An elaborate canvass was made of the membership several months ago which showed clearly that there was a demand for more technical papers. The strongest demands were in the fields of electrical and mechanical engineering and accordingly the branch has undertaken to start out with a joint mechanical, electrical division.

It is proposed for the first season there will be six sessions of the division each held on a Monday evening. The subject will be the same throughout the series, namely nuclear energy. Arrangements have already been made for speakers for the entire series and it appears as if the attendance would be very encouraging.

Other branches also are studying the advisability of creating technical divisions. It is expected there will be further developments along this line in many branches within the coming season.

Transatlantic Telephone Cable

Service on the transatlantic submarine telephone cable was inaugurated with due ceremony on September 25. To observe the historic occasion, groups gathered in London, New York and Ottawa to witness the first use of the new telephone system connecting London with North America.

Representing the Engineering Institute at the International ceremonies was B. G. Ballard, past vice-president of the Institute. His report is herewith.

On January 24, 1957, the cable will be put to use in a very apt way to connect London and New York with Montreal for a joint meeting arranged to discuss the technical features of the system. Participating societies will be the Institution of Electrical Engineers, the American Institute of Electrical Engineers and the Engineering Institute of Canada.

Report of Ottawa Ceremonies

As agreed, I represented the E.I.C. at the official opening of the first transatlantic telephone cable between Canada, the United Kingdom, and the United States, on Tuesday, September 25, 1956.

It was an impressive event at Ottawa. Similar groups were assembled in both London and New York, and with the time differential between England and this continent, the ceremony became a pre-dinner event in England and a pre-luncheon event in North America.

Each guest was provided with a telephone which, not surprisingly, handled one-way traffic only.

Promptly at 10.30 a.m. the ceremony began, with a short talk by Mr. Bowie, the president of the Canadian Overseas Telecommunications Company, describing the general plan of the system and expressing appreciation for the complex and cooperative effort which the completed installation had entailed. Mr. Bowie was followed by Mr. Thomas Eadie, M.E.I.C., president of the Bell Telephone Company of Canada, Mr. Merchant, the United States ambassador to Canada, Mr. Pritchard, the acting high commissioner for the United Kingdom, and Mr. Marler, minister of the Department of Transport.

At this point, guests were requested to put the telephones to their ears, and at exactly 11.00 a.m. C. R. Craig, chairman of the board of the

American Telephone and Telegraph Company came on the line, speaking from New York. He sent his greetings to Dr. Charles Hill, postmaster general of England, who reciprocated cordially. It is difficult to describe adequately one's impressions of such an outstanding event. To have the opportunity of listening to the first exchange of conversation over a transatlantic cable is a privilege which cannot be held lightly. Even in an age of scientific miracles, I found the clarity of speech and the absence of background noise almost startling. Despite the rather abnormally low sensitivity of my ears, I did not, at any time, experience difficulty in hearing distinctly every word and every syllable.

Perhaps I should have devoted more attention to the actual messages which were exchanged, but I fear that I was more preoccupied with the marvel of this achievement, and I could not dismiss from my mind contemplation of the delicate electronic equipment and the relatively innocent-looking cable buried miles deep in the Atlantic, exposed to thousands of pounds of pressure per square inch and capricious sea currents, performing so perfectly in obedience to the brilliant minds who had conceived them. I envied those who had contributed to the success, and I acquired a renewed pride in the engineering profession.

There followed further conversations between Mr. Marler, Mr. Craig, and Dr. Hill, and at 11.06 a.m., eastern daylight time, the system was declared open for service.

At the conclusion of the ceremony, free transatlantic service was made available to guests, and I endeavoured to send the greetings of E.I.C. to Sir George Nelson and W. K. Brasher, both of whom I expected to be present at the London function, and who were the only senior officials of our sister institutions in Great Britain whom I know personally.

Subsequently, a reception was held, and then a most delectable luncheon at which Mr. Eadie of the Bell Telephone Company of Canada spoke briefly and Mr. Marler was presented with the telephone through which he had made the first telephone call by transatlantic cable from Canada to the United Kingdom. It was a rather magnificent instrument, trimmed with gold.

It was a memorable event, and I am very glad that it should have been my privilege to represent the E.I.C.

B. G. BALLARD

Civil Defence Forum

Late in September, for the first time in Canada, civil defence authorities met with engineers to discuss mutual problems and make some plans for future action. Through the week of September 17, thirty-seven key engineers from points in nine provinces, assembled at the Canadian Civil Defence College in Arnprior to constitute a forum on basic C.D. issues with which engineers are concerned. They came at the invitation of the Federal Civil Defence coordinator Worthington, and represented government, public utilities, professional societies and associations, city engineers, consulting engineers, and regional civil defence staffs. At the time of the forum the E.I.C. president and general secretary were engaged on their tour of the branches in the Atlantic Provinces, but were officially represented by two other senior Institute delegates, R. E. Hayes, councillor, Ottawa, and E. C. Luke, assistant general secretary.

The program for the five days was excellently organized, very interesting, and the visitors must certainly have had their eyes opened to the complexities of civil defence and to its vital importance to the nation and to the safety of the Canadian people. For the writer, at least, the forum cleared away the haze which had shrouded "C.D." in his mind, and demonstrated the real, practical nature of the plans and recommendations which these people are trying earnestly to put into effect.

The first days were devoted to giving the engineers the essential background information on such topics as nuclear warfare, disaster effects, radioactive fall-out, rescue organization, communications, welfare, and all the associated subjects. This was accomplished by means of lectures and films in the school's efficient and well appointed training wing building. At the appropriate times, the engineering problems were introduced. In general these are questions concerned with the provision and maintenance of emergency services in the reception or support areas and, later, the restoration of normal life in the target zones. A wide range of engineering responsibilities was outlined, including such items as transportation, power and water supply, heavy equipment and construction materials, sewerage, debris removal, fire-fighting, stockpiling, and the organization of engineer services.

Best results were obtained from the presence of such a broadly rep-

This group of engineers followed a Civil Defence course at Arnprior, Ont., recently.

resentative group by active participation. The vistors were divided into half a dozen syndicates, in staff college fashion, and were given the outlines of various practical problems — based on imaginary but typical situations involving some phase of disaster action resulting from atomic attack. These were investigated by each syndicate group separately, followed by general discussion in the large theatre and comparison of notes. Unresolved problems were noted for future study. The results were encouraging, and showed keen interest by those attending. Both college staff and engineers profited from the frank development of ideas.

A suggestion was made which was strongly endorsed by the forum in general session. The Canadian Civil Defence College should conduct more meetings of the same kind and endeavour to obtain the attendance of engineers who are in executive positions in management — presidents, general managers, and other top level men whose interest and influence are essential to give the C.D. plan the impetus it needs.

A lot more sustained effort will be required, and considerable expense, to get the Canadian civil defence organization into proper working shape. The results will be well worth this money and effort. To do our collective part the Institute has offered its facilities in the investigation of special engineering problems, or its help in any other practical way that Council may decide. Many members will recall the leading part that the Institute took in these matters in the last war. The support of the present membership is requested in future civil defence efforts which we may be called upon to undertake.

The Honourable Paul Martin, Minister of National Health and Welfare, when discussing civil defence in the recent parliamentary debates, made the following statement:

"I am now able to inform the Committee that the Government has reached the following decision:

"That our civil defence policy should now be based on the development and testing of plans for the orderly evacuation on short notice of the main urban areas in Canada should the possibility of attack on such areas by nuclear weapons appear to be imminent.

"Canada's military authorities have now advised the Government that it must be anticipated that in any major war the North American Continent will be attacked with high-yield nuclear weapons from the outset with little, if any warning. Accordingly, our civil defence policy must be so designed as to ensure the survival and safety of as many of our population as possible in the event of a nuclear attack on this country."

Knewstubb Lake

Nearly thirty years ago the chief hydraulic engineer with the British Columbia Department of Lands and Forests, Water Rights Branch, advanced the theory that one of the greatest potential hydro electric power sites of North America was on the Nechako River.

This engineer was Frederick William Knewstubb, M.E.I.C.

This year, the lake created as a reservoir for Kitimat power by the Kenny Dam of the Nechako-Kemano-Kitimat development, was officially designated by the Canadian Board of Geographical names as Knewstubb Lake.

There is reason to attribute the existence of this great power development to the early survey and research work carried out by Mr. Knewstubb and his associates. The later investigations for the Kitimat project confirmed his early findings made at a time when a project of such magnitude was startling, transmission of power for great distances was uneconomical, and no immediate need for such power existed. Engineers verifying his calculations, were impressed by the accuracy of the data gathered long before under much more difficult conditions, and the conclusions which indicated a vision of today's great developments.

In 1928, when Mr. Knewstubb was 54 years old and had worked with the Water Rights Branch since 1911, the government started to catalogue its water resources on a systematic basis. This policy was administered by the late J. C. MacDonald and was carried out by Mr. Knewstubb as chief hydraulic engineer.

In a paper given to the British Columbia Natural Resources Conference in February 1954, W. H. Sparks of the Aluminum Company of Canada, Ltd., Kitimat, said, "There is on file a memorandum from Knewstubb to the comptroller dated 1928 in which he outlined the possible combinations of diverting the lakes and rivers of the upper Nechako watershed through the coast range to develop large blocks of power. One of the schemes he mentioned is in substance the one carried out by the Aluminum Company so there is little room to doubt that he had thought out and planned his projects well in advance, for it was not until several years later that the surveys had made sufficient progress to provide the data for more than an educated guess."

In 1929 a start was made on the investigation which resulted in the Aluminum Company of Canada's Nechako-Kitimat development. "This investigation", said Mr. Sparks, "was another case where his vision and imagination supplemented by the careful collection of basic data proved to be correct, for when this report was reviewed just prior to the receipt of the application of the Aluminum Company his almost uncanny estimates needed no changing."

There has been comment on the wisdom of obtaining and providing information of this kind. The B.C. government's research in the prewar years has had demonstrable effects other than the Kitimat project. For example, the Campbell River survey laid the groundwork for what later became the John Hart development; the Skeena River was surveyed with a view to developing the Kitsilas Canyon. Studies of the storage possibilities of the Babine and Stuart Lakes recognized their importance to any development of the Fraser River. Early investigations of the Quesnel and Murtle Rivers have been under active discussion again in recent years.

Frederick Knewstubb was originally from England, but was a graduate of McGill University in civil engineering. He served in World War I and for the rest of his life suffered a loss of hearing and a partial paralysis. He originally had joined the Water Rights Branch in 1911 as a draughtsman. He became a member of the Engineering Institute of Canada in 1915.

In the years until his death in 1937 he travelled the province extensively for the Branch. Knewstubb Lake, as it will appear on maps in the future will honour a great engineer and express the indebtedness of the Province and all of Canada.

President McKillop Visits Maritime Branches

The Moncton Branch greeted Mr. and Mrs. McKillip. Above, left to right: L. McIsaac, R. M. Wickwire, Mr. McKillop, G. E. Franklin, V. C. Blackett and Mrs. McKillop.

The ladies, God bless them. Mrs. A. W. Purdy, Mrs. M. F. K. Leighton, Mrs. Blackett, Mrs. T. H. Dickson, Mrs. Franklin, Mrs. Wickwire, and Mrs. McIsaac.

Mr. and Mrs. McKillop visited Memorial College, St. John's, Nfld. At right they are shown with S. J. Carew, dean of engineering, and Dr. Raymond Gushue, president of Memorial (right).

Corner Brook dinner meeting (above). Gordon Tibbo, Mrs. Bugden, A. Martin, Mrs. McKillop, L. Austin Wright, Branch Chairman F. H. Clark, the president, Mrs. Clark, Mayor A. Bugden, Mrs. Martin.

Amherst. Secretary W. G. Miller, Mrs. Alexander, Pro-Mayor E. J. Moore, Mrs. Wilson, President McKillop, Chairman R. L. Alexander, Mrs. McKillop, Vice-Chairman John Wilson and Mrs. Moore.

At the Amherst meeting: (below) Mr. and Mrs. J. F. C. Wightman, Mr. and Mrs. L. E. Burrill, Mr. and Mrs. C. L. Archibald, and Dr. F. Binns.

The president and the Mayor of Charlottetown, Jack Stewart.

At Government House, Charlottetown: (above left) W. R. Brennan, C. W. Currie, Lt. Gov. T. W. L. Prowse, the president, and N. F. Stewart.

Branch meeting, left to right, above, E. K. Macnutt, N. F. Stewart, Mrs. McKillop, Chairman G. J. Hayes, Mrs. Stewart, President McKillop and Mrs. Hayes.

Halifax. Here the president called on H. W. L. Doane, Senior (above). He and Mrs. McKillop dined with Chairman G. A. Cunningham and Mrs. Cunningham, and Vice-President H. W. L. Doane at branch meeting (above right).

Harvey Doane was host for a yacht tour of Halifax harbour. With Mr. McKillop in this group are Past President Ira P. Macnab, Mrs. R. D. T. Wickwire, and G. A. Cunningham.

Nova Scotia Technical College President Alan Cameron received the president at the university. Left to right, Harvey Doane, Mr. McKillop, R. D. T. Wickwire, President Cameron, and G. A. Cunningham.

THIRTY-FIVE YEARS AGO

Comment in the Journal of November, 1921.

What must have been a very early, if not the first, attempt to make silica brick, in Canada, is reported in the *Journal* for November, 1921, in a paper by A. W. McMaster, A.M.-E.I.C.

Wartime restrictions had made it difficult for the steel company to import silica brick from the United States, the usual source of supply, so it experimented with quartzite from three Nova Scotia areas as a raw material. All made good brick, one a superior quality which was better than the imported article.

R. J. Blair, the Forest Products Laboratories' pathologist, wrote on decay in wood in this *Journal.* He emphasized that wood decay was due to one cause only, fungus infestation, thus exploding many popular beliefs and ended his paper with an exhortation: "It is time that the wood-using public realized that . . . trouble (from decay) may be avoided. Long and saisfactory service may be obtained by using wood if it is handled with a knowledge of its inherent properties and of the agencies which bring about its deterioration."

A plea for the immediate the compulsory adoption of the metric system of weights and measures was made before the Border Cities Branch by David A. Molitor, M.E.I.C., and is reported in this *Journal.* Although Mr. Molitor was one of the best-known and influential engineers of the United States, and although his arguments in favour of the metric system are as valid today as they were then, we are still about where we were.

I.J.C. Decision Reported

This Journal included the International Joint Commission's decision as to the division of the waters of the Milk and St. Mary rivers between Canada and the United States, handed down in October, 1921. Western Canada had been waiting impatiently for this, for it had several irrigation schemes with which it wanted to proceed, which were to take water from these rivers.

Sir John Kennedy, K. B., Hon. M.E.I.C., the grand old man among Canada's engineers, died on October 25, 1921, at the age of eighty-three. The author of his obituary in this November *Journal* is unknown to the writer, but whoever he was, he succeeded well in expressing the feelings of Sir John's engineering contemporaries:

"The passing of Sir John Kennedy . . . marks the removal from the engineering profession of one who occupied a warm place in the affections of his fellow engineers and who stood at the pinnacle of his profession in this country. Ripe in years, rich in experience and endowed with those . . . sterling qualities which made him a credit to the profession, his judgment respected and his presence welcomed, his death removes one of those . . . who organized the Canadian Society of Civil Engineers, and is a monument to the service which engineers may render humanity."

The evergreen question of the engineer and his status was never out of print for long. Here we read of a speaker at the Victoria Branch who "gave it as his opinion that to a very large extent . . . (engineers) were themselves responsible for the low standing of the profession in the sight of the public." A variety of views was expressed by speakers at the Toronto Branch — that the engineer was rather too much of a monk; that he needed to be more publicity conscious; that he was the victim of "excessive modesty"; that he paid too little attention to economic problems; and that he was probably the world's worst speaker in public. At any rate, we were willing to criticize ourselves.

A Branch in Lethbridge

A group of members in Lethbridge decided to work for the establishment of a branch there and appointed a committee under the chairmanship of S. G. Porter, M.E.I.C., to take the necessary steps. They expected to start off with a membership of about sixty; in fact, that many had already attended a preliminary meeting to listen to a talk on "Recent Development in Concrete", expounding the next water - cement ratio theory.

R.DEL.F.

Watch For E.I.C. Film Catalogue

In order to fill a need long felt by branch program committees, for a reliable source of information on films of engineering interest, the Engineering Institute has compiled a film catalogue which will be ready for distribution by the time this is read. The catalogue lists not only the films available in the Engineering Institute film library but also films from more than 80 other sources. It contains 40 pages of titles, classified according to the various branches of engineering. Including cross - references, it provides over 1,000 references.

Choosing a film by its title can be very disappointing, like choosing a breakfast food by the colour of its wrapper. For this reason great care was exercised in providing brief and accurate descriptions. The catalogue contains 122 pages of film descriptions, each of which indicates the theme of the film, the method of treatment and, wherever possible, the type of audience for which the film is best suited. The program committee will then be able to make an intelligent selection and not be embarrassed to find, after the showing, that they have been trying to teach the rudiments of arithmetic to experienced engineers.

Other sections of interest indicated by the table of contents are: how to use the film catalogue, procedures on the loan of films and, good projectionist practice. First examination of the catalogue will show that its usefulness will last for many years.

A copy of the catalogue will be mailed to the secretary of every branch immediately.

E.I.C. tieclip, described in last month's Journal. Picture is twice the size of tieclip.

NEWS OF THE

Associations and Corporation

Information received through co-operation of the provincial organizations.

ONTARIO

Seeks Solution Postgraduate Training Problems

The 15,000-member Association of Professional Engineers of Ontario today called upon governments at all levels to give immediate support to Canadian industry in financing the expansion of university facilities to provide adequate post-graduate training.

The Association's stand resulted from a statement made yesterday by Dr. G. N. Patterson, director of the University of Toronto's Institute of Aerophysics, to the effect that the institute was unable to accept even half of this year's applicants for advanced studies due to lack of facilities.

The reputation of the Institute has become such that applications from young scientists in many parts of the world have been received for postgraduate work.

In the Association statement issued today, Merritt W. Hotchkin, Kirkland Lake, Association president, said: "How is Canada to maintain and expand her leadership in the aeronautical field if we are not prepared to provide financial means for adequate postgraduate training?"

"The federal government is spending millions of dollars annually in aircraft development, yet because educational facilities are starved, we find aerophysics director, Dr. Patterson having to make the shameful admission that because of the lack of $500,000, less than half the applicants in this important branch can be accepted."

Need for Immediate Action

"The present grave situation as indicated by Dr. Patterson emphasizes the need for immediate action by the federal government in helping Canadian industry to implement the recommendations made at the recent National Manpower Engineering Conference at St. Andrews, N.B.," Mr. Hotchkin added.

The Association official also referred to a statement made Sept. 24 by Dean R. R. McLaughlin of the University of Toronto's faculty of applied science in which the dean described present facilities for engineering applicants as "completely inadequate". He added the situation was threatening to create a problem with respect to proper training of postgraduate students.

Engineers in the News

George O. Grant has been appointed to the position of deputy roads commissioner for metropolitan Toronto. In this post he will succeed B. W. Bemrose, who will become chief project engineer. The Metro Roads Commissioner is Leslie B. Allan.

Mr. Grant graduated from Queen's University in 1942 in civil engineering and from that date until 1946 served with R.C.E.M.E. Following his discharge he joined the Ontario Department of Highways and was for five years division engineer in Ottawa. In 1954 he was appointed assistant to the deputy minister of Highways in Toronto. In 1955 Mr. Grant was awarded a scholarship by the Canadian Good Roads Association and obtained his master's degree from the University of California.

Fred H. Chandler, of the Hydro-Electric Power Commission of Ontario, has been appointed director of engineering. Mr. Chandler succeeds J. R. Montague, who has retired to the position of consultant.

Mr. Chandler graduated in engineering from the University of Toronto in 1915 and joined the Power Commission in 1918 as an assistant engineer. Until 1943 he took an active part in engineering related to Commission power stations. For the past ten years stations engineer, he was in 1953 named assistant director of engineering.

Arthur Kendall, of the Utah Construction Company of San Francisco, has returned to Korea and is located in Seoul, Korea, where he is associated with the construction of a chemical treatment plant for the purification of tungsten concentrates. The contract is with the Korea Tungsten Mining Company which has one of the largest known deposits of scheelite ore in the Free World. Mr. Kendall's postal address is c/o Utah Construction Company, APO 102, San Francisco, Cal.

Dr. J. W. Rutter, has moved to Schenectady, N.Y., where he is a research associate with the General Electric Research Laboratory.

Dr. Rutter obtained his B.A.Sc. in metallurgical engineering at the University of Toronto in 1948, where he also obtained master's and doctor's degree. Prior to his move to the United States he was engaged in post-doctorate research in physical metallurgy in the department of metallurgical engineering at the University of Toronto.

James W. Britnell, has been appointed County engineer for the county of Huron, with headquarters at Goderich, Ontario. Mr. Britnell graduated in civil engineering from the University of Toronto in 1952 and was formerly with Imperial Oil Ltd., in London, Ontario as asphalt sales engineer.

Dr. W. L. Fairbairn, of Gypsum, Lime & Alabastine, Canada, Ltd., has moved to the Toronto office of the company, where he is chief engineer. Previous to the move Mr. Fairbairn was plant manager at the company's plant on Lakefield Ave., Montreal.

Stanley C. Roberts has moved from St. Catharines, Ont., to Toronto. A member of the engineering staff of H. G. Acres and Company Limited, in his latter position, he now serves Eastern Power Devices Limited, of 29 Wabash Avenue, Toronto.

Michael A. Harrison, has left Toronto for London, Eng., with his wife, to take up studies at the London School of Economics under the Athlone Fellowship. During his stay in England Mr. and Mrs. Harrison will reside at 13 Norfolk Place, Welling, Kent.

Mr. Harrison, who graduated in electrical engineering from the University of Toronto in 1952, has held the post, with the Canadian Broadcasting Corporation, of administrative assistant to the Ontario director of CBC.

Dr. A. E. Berry, of the Ontario Department of Health, is chairman of the newly formed Advisory Health Group of the National Building Code of Canada. He was recently appointed general manager of the Ontario Water Resources Commission.

The Advisory Group will include sanitary engineers from all provinces in Canada, together with medical officers of health, engineers, architects, building inspectors, as well as a representative of the Central Mortgage & Housing Corporation. These specialists have been called together to guide the future development of the National Building Code of Canada as it pertains to matters of public health. It is expected that this group, the only one of its kind in Canada, will become a recognized national authority.

Tullis N. Carter, of Toronto, who is vice-president and general manager of the Carter Construction Co. Ltd., and a member of the council of the Ontario Association of Professional Engineers, is a national vice-president of the Canadian Construction Association for 1956. **Norman A. Eager**, president and general manager of Burlington Steel Co. Ltd., Hamilton, and a past member of council, is honorary secretary of C.C.A. for this year.

C. G. E. Downing, head of the department of agricultural engineering, at the Ontario Agricultural College, Guelph, Ontario, has been appointed chairman of the Education and Research Division of the American Society of Agricultural Engineers. He also serves the council of the American Society for Engineering Education, representing A.S.A.E.

Dr. P. J. Sandiford, of Toronto, was elected vice-president of the Canadian Association of Physicists for 1956-57 at its annual meeting in Montreal.

E. N. Baker, is employed as a sales engineer with the Linde Air Products Company, division of Union Carbide Canada Ltd. Mr. Baker graduated in engineering and business from the University of Toronto in 1954 and has since attained the degree, Master of Business Administration from the University of Western Ontario.

L. J. Lacey, of Toronto, has been appointed associate director of electronics with the management advisory services division of Price - Waterhouse & Company, Toronto. He was formerly mathematician-in-charge of Ontario's Hydro's computing centre and more recently chairman of Hydro's data processing team.

L. A. Coles, of Ontario Hydro has ceased to act as technical and trade training officer, personnel branch, Toronto, and has become operating superintendent of Hydro's east central region, Belleville, Ont.

Faculty Changes at the University of Toronto

A number of staff changes in the engineering faculty of the University of Toronto, announced by president Sidney Smith include promotions to the rank of professor, conferred on **J. E. Reid**, of the department of electrical engineering, to associate professor **Dr. I. I. Glass**, aerophysics, and **Dr. A. I. Johnson**, chemical engineering. Promotion to the rank of assistant professor goes to **Dr. G. K. Korbacher**, also of the aerophysics department.

Dr. G. B. Craig, who has been with the Physical Metallurgical Research Laboratories in Ottawa joins the department of Metallurgical Engineering as assistant professor.

MANITOBA

Publish News-Letter

The Manitoba Association of Professional Engineers began publication of a bi-monthly news - letter, appropriately called, the Manitoba Professional Engineer. Named editor was Gordon T. Christie, managing editor, W. H. Dickens, and E. M. Scott and D. E. Haig, associate editors. Appointments as reporters go to A. R. Towler, of Pine Falls, M. N. Collison, Flin Flon, and R. Diamond, of the faculty of engineering, University of Manitoba.

Membership Mounts

Opening its own office in February 1956, the Manitoba Association has recorded greater activity and interest in Association matters. Since the beginning of 1956, membership has increased forty percent. More applications for membership have been received this year than in the last three years.It is anticipated that membership may reach the 1,000 mark by the end of the year.

September Meeting

In order to profit by a prolonged and uninterrupted meeting, the Council of the Manitoba Association spent forty-eight hours at a camp at Waugh, in the Lake of the Woods area, on Indian Bay, Man., for their September meeting. It is the first time in the history of the Association that Council has met outside the City of Winnipeg.

Golf Tournament

The Manitoba Association held its annual golf tournament for the Sullivan cup at Elmhurst Golf and Country Club on September 11, 1956. Winner of the cup was George Flavell, other winners included Joe Sill, Joe Brako, and Gerry Foley.

Win Four Major Team Matches

Well represented at the annual Dominion of Canada Rifle Association service rifle matches held at Connaught Ranges, Ottawa, in August, were Manitoba's engineers. Four major team matches were won by the Manitoba team — the Provincial match, London Merchant's match, Barlow match and Coates Match, and in addition placed three men on the Canadian Bisley team, which will travel to England next year to shoot in the annual matches at Bisley. Manitoba engineers who participated in the matches were **W. L. Bunting, J. W. Battershill,** and **A. R. Towler.**

Reunion—Class of '46

Graduates of the 1946 engineering class at the University of Manitoba held a very successful reunion in Winnipeg this summer. Dinners, dances and stags were enjoyed by engineers from Fonthill, Ont., Port Arthur, Toronto, Peterborough, Kenora, Yorkton, Sask., Los Angeles, Minneapolis, Erie, Pa., and Oklahoma City. Thoroughly enjoyed by all who attended, the class plans to reunite again in 1966.

Engineers in the News

Larry A. Kay is spending a period of twelve months in New Delhi, India, with Indian and American personnel, on public health projects sponsored by the Colombo Plan. He will return to Winnipeg at the end of his stay.

G. McDermid has been appointed assistant general manager of the Greater Winnipeg Transit Commission. A graduate of the University of Manitoba in electrical engineering, he entered the service of the Winnipeg Electric Company in 1928, employed in maintenance and construction work.

Cornelius Rempel, who has been with the Manitoba Paper Company at Pine Falls for several years, was recently transferred to the head office of the Abitibi Power and Paper Company in Toronto. For the past year and a half Mr. Rempel has been design engineer for the speed-up and modernization program at Pine Falls, which in its present phase, is nearing completion. He will find a similar position in Toronto for the enlarging of the Abitibi "Mission" mill at Fort William, Ont., which will include a new paper machine, additional grinder capacity and much auxilliary equipment.

T. J. Halme has been appointed manager, system sales and application engineering for Canadian General Electric Company Limited, with headquarters in Peterborough, Ont.

Hugh A. MacKay, former plant engineer, Manitoba Rolling Mill Company Limited, has been promoted to the post of superintendent.

BRITISH COLUMBIA

Municipal Engineers' Convention

The fourteenth annual convention of the Municipal Engineers' Division of the Association of Professional Engineers of B.C. concluded its three-day session on Oct. 22, at Penticton, with a record-breaking attendance of 300 delegates and wives from 42 cities and municipalities throughout the province.

Saanich was chosen for next year's

meeting, with municipal engineer H. P. Dawson as chairman of the convention committee. Other members of the 1956-57 executive are R. M. Martin, Vancouver; J. C. Garnett, Victoria; J. Graeme, Esquimalt, and D. P. I. Hawkins, West Vancouver. Continuing members are E. R. Gayfer, past chairman, of Penticton, A. S. G. Musgrave of Oak Bay, honorary secretary, and J. A. Merchant, of Vancouver, secretary-treasurer.

A lively discussion took place during the open forum on Friday afternoon concerning responsibility of the provincial and municipal governments for flood damage. The convention endorsed a resolution recommending the immediate formation of a committee of provincial and municipal representatives to study the problem and recommend immediate steps for its solution.

Panel Discussion Opens Business Sessions

Opening business sessions Thursday morning was a panel discussion on "Frost Damage", led by G. P. Harford of Prince George; E. B. Wilkins of the Department of Highways, Victoria; and D. McMullen of the Meteorological Services branch, Department of Transport, Vancouver. Successful experiments made in Prince George to combat the sustained freeezing condition last year for the city water system, by connecting electric currents to the house mains were discussed as well as various matters pertaining to the frost-warning service to fruit growers.

The second half of Thursday morning's session was devoted to a joint paper on "Services of the Water Rights Branch", delivered by W. A. Ker, deputy controller, and co-authored by T. A. J. Leach, chief engineer of the branch.

Dean R. M. Hardy on "Foundations and Soil Mechanics"

Dean R. M. Hardy, Dean of engineering, University of Alberta, stimulated an animated question period with his paper on "Foundations and Soil Mechanics". He dwelt in considerable detail on a variety of specific problems common throughout the country, such as backfilling in trenches and around buildings, and the question of building on fills. He stated that if a higher standard of backfilling is to be achieved it must be accomplished by compaction. Contrary to widely held opinions about the hazards of construction on fill soil, Dean Hardy maintained that under controlled conditions of compaction, it is possible to maintain a stable material superior in bearing capacity and uniformity to the natural soil at the sight. With reference to road construction, he stated that millions of dollars have been wasted in Canada within the past ten years by building flexible pavements of insufficient strength for the traffic they have had to carry. He expressed conviction that under-building could be as extravagent as over-building, and strongly urged the construction of asphalt surfaces with a safety factor adequate for all foreseeable contingencies.

In later discussion on frost damage to highways he expressed the opinion that the Vancouver area was probably the most difficult in all Canada because of the frequent variations above and below freezing temperatures, and the fact that freezing, when it takes place, is comparatively shallow. A seeming paradox was confirmed by several engineers present, in that underground pipes can be frozen during a thaw because of a thermo-dynamic phenomenon resulting in the sinking of the freezing zone during rising surface temperatures.

Traffic Problems Discussed

Final discussion on the first day centred around a paper on "Traffic Control of Intersections", delivered by F. R. Hole, assistant director of traffic for Vancouver. A great deal of practical detail on methods for determining the precise nature of controls required under different

(Continued on page 1642)

Above, this candid convention shot shows, left to right, R. H. Hardy, dean of engineering, University of Alberta; E. R. Gayfer, superintendent of works, Penticton; R. P. Walrod, B.C. Tree Fruits, Kelowna; Mayor Oscar Matson and Alderman E. A. Titchmarsh, of Penticton.

Some of the members of the newly elected 1956-57 executive of the Municipal Engineers' Division shown below are, left to right, E. R. Gayfer, Penticton; A. S. G. Musgrave, Oak Bay; H. D. Dawson, Saanich; R. M. Martin, Vancouver, and J. A. Merchant, Vancouver.

OBITUARIES

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Dr. A. L. Clark, Hon. M.E.I.C., former dean of science at Queen's University died at Kingston, Ont., on September 19, 1956.

Doctor Clark was born at Worcester, Mass., on February 19, 1873. He received a B.Sc. degree from the Worcester Polytechnic Institute in 1894, and in 1905 was awarded the degree, Ph.D., at Clark University.

His initial experience gained as foreman in charge of the plant and mains for the New Rochelle Gas and Fuel Company at New Rochelle, New York, he later served as professor of physics at Bates College, Maine. Named to the staff of Queen's University as professor of physics in 1906, he was appointed dean of the faculty of applied science at that university in 1920.

Besides carrying on his administrative functions, he made intensive studies in physics and particularly in thermo-dynamics. In 1919 he spent some time in Holland working on thermondynamics problems, at the University of Leyden.

Chairman of the Service Control Board for Queen's Engineering Society, he was in 1947 awarded the Montreal Medal for outstanding contributions to Queen's University. Clark Hall, housing technical supplies and the science students' club rooms, was named after him.

A Fellow of the Royal Society of Canada he was also a member of the National Research Council, a chairman of the University Research Committee, and a member of the Board of Governors of the Ontario Research Foundation.

Retiring in 1943, Dr. Clark continued to serve the university as a consultant on the administrative problems of the faculty.

Dr. Clark joined the Institute in 1920 as an Affiliate Member, and became an Honorary Member in 1922.

Louis D. W. Magie, M.E.I.C., retired works engineer with the Peterborough plant of Canadian General Electric Company Limited, died in Peterborough, Ont. on June 7, 1956.

Born at East Orange, New Jersey, on April 8, 1872, he was educated in the United States, but moved to Canada in 1894, after initial engineering experience gained with two American firms. One of these was the Stanley Electric Manufacturing Company, at Pittsfield, Mass., from which concern he was transferred to the Canadian General Electric Company in Montreal. Works engineer in that city for six years, he first went to Peterborough in 1900 as chief engineer of the plant and held this position during the next thirty-eight years of development of electrical engineering in Peterborough and in Canada generally.

Very largely responsible for the development of the Canadian company, Mr. Magie had, at the time of his retirement in 1938, built up Canadian General Electric engineering to the point where it was stoutly able to stand on its own feet. He was also vitally concerned with organizing the student committee of which he was chairman for years. That committee selected and supervised the training of the university graduates who were looking for the opportunity of postgraduate experience.

He joined the Institute as a Member in 1920 and attained Life Membership in 1950.

Langdon Pearse, M.E.I.C., sanitary engineer for the Sanitary District of Chicago for forty-seven years, died at his home in Winnetka, Illinois, on July 20, 1956.

A native of Boston, Mass., Mr. Pearse graduated from Roxbury Latin School in 1895 and obtained a B.A. degree from Harvard College in 1899. Later, enrolling at the Massachussetts Institute of Technology he studied for a B Sc. degree, attained in 1901, followed by an MSc. degree the following year.

Various civil engineering connections leading to employment on the water and sewage systems of Columbus, Ohio and Oakland, Cal., occupied the first five years of his professional career.

His long association with the Sanitary District of Chicago began in 1909 when he became assistant engineer assigned to the development of a system for dispoal of sewage by artificial treatment. Mr. Peare organized and carried through the program of research which led to development of principles of sanitary engineering. This became the basis on which the present Chicago and suburban system is served.

A member of the Institution of Civil Engineers, the American Institute of Consulting Engineers, he was also a Life Member of the American Society of Civil Engineers; an honorary Fellow of the Institute of Sanitary Engineers, London; an honorary member of the Central States Sewage Works Association; a fellow of the American Public Health Association and the American Academy of Arts and Sciences.

Mr. Pearce was the author of many technical reports and publications.

He was recognized as an expert witness in court cases and served as consultant in matters pertaining to public health and sanitary engineering.

He joined the Institute in 1926 as a Member and attained Life Membership in January, 1956.

John Elmer Mikkelson, M.E.I.C., senior engineer with the Bechtel Corporation, San Francisco, died February 8, 1956.

Born at Salmon Arm, B.C., on October 15, 1918, he attended the University of British Columbia, graduating with the degree, B.A.Sc. in chemical engineering in 1942.

Mr. Mikkelson worked for the Canadian government, on the Inspection Board of the United Kingdom and Canada, before joining the Pearl River Paper and Pulp Mills of Canada. Later he went to the Bahrien Islands in the Near East on an assignment for the Caltex Company. He remained there for four years.

Returning to the United States, he went to work for Arthur G. McKee, Inc., at Union, New Jersey, in 1948. In 1950 Mr. Mikkelson joined Stone and Webster in Boston and later transferred to their Froomfield, Canada, project. He also worked for Hall Inc., of Toronto, as resident engineer for their Sarnia Refinery. In 1952 he joined the firm with which he was associated when taken ill, late in 1955.

Mrs. Mikkelson, also an engineer, has returned to her profession and practices in San Francisco.

Mr. Mikkelson joined the Institute in 1955.

Frank Taylor, M.E.I.C., retired member of the engineering department of the Canadian Pacific Railway, Montreal, died at Westmount, Que., August 27, 1956.

Eighty-three years old, Mr. Taylor was born in Birmingham, Eng., on October 20, 1872. Elucated there, he came to Canada in 1889, joined the C.P.R. and began his career as a rodman with the railway's eastern division.

By 1905 he was an assistant engineer in the chief engineer's office, Montreal. Three years later he went to North Bay as a division engineer. In 1916 the railway company named him right of way and tax agent, a post he continued to fill until, 1938, the date of his retirement. He had served the company forty-nine years.

A Life Member of the Institute since 1938, Mr. Taylor was first known to the Institute in 1898, became an Associate Member in 1904, and a Member in 1910.

Frank Taylor, M.E.I.C.

Personals

News of the Personal Activities of Members of the Institute.

Dr. F. L. West, M.E.I.C. New vice-president of Mount Allison University is Dr. Frank Leslie West, for a number of years dean of the university's faculty of science.

A graduate of Mount Allison and McGill Universities, in civil engineering, Dr. West returned from service with the R.C.E. at the close of World War I and joined the staff of Mount Allison University. Since that time, during thirty-six years of service he has held the posts of professor of civil engineering, professor of engineering, and director of the McClelan School of Engineering, before being appointed dean of the faculty of science in 1949.

Officer commanding the New Brunswick Rangers for ten years prior to World

Dr. F. L. West, M.E.I.C.

War II, Dr. West commanded them in the Active Force from 1939 to 1942. He was later attached to National Defence Headquarters, on the army education staff. In 1945 he became head of the physics department of the Khaki University and commanded the unit until it was disbanded. He retired from the army in 1946 with the rank of lieutenant-colonel.

Long an active member of the Institute and a Life Member since 1955, Dr. West served the executive of the Moncton Branch in 1937, became vice-chairman in 1938, and the following year held office as chairman.

He is a member of the Association of Professional Engineers of New Brunswick and is an associate member of the American Society of Civil Engineers.

In 1952 the honorary degree of Doctor of Engineering was conferred on him by the Nova Scotia Technical College.

As a practising engineer, Dean West has at various times been associated with the Canadian Northern Railways, the Imperial Munitions Board, and the Canadian National Railways. He was engineer for the town of Sackville for a ten-year period, 1929 to 1939. He has been consultant on numerous surveying and engineering projects.

Dr. H. W. McKiel, M.E.I.C., vice-president of Mount Allison University since 1949 has retired from the faculty after forty-three years of service.

In 1908 a Queen's University graduate with a B.A. degree in chemistry, he went on with studies leading to the B.Sc. degree, awarded him at that University in 1912. Following this he did post-graduate work and also lectured at Queen's before beginning his career with Mount Allison University in 1913, as professor of mechanical engineering. Chosen as Brookfield Professor of Engineering in 1920, his other appointments were those of secretary of the faculty of applied science, dean of that faculty, and dean of the faculty of science, to which post he was named in 1934. He also served in a consulting capacity to a number of prominent maritime industries and gave his time to professional development and engineering education while carrying out his regular duties.

Awarded the honorary degree of Doctor of Laws in 1943, he was called upon to receive the degree of honorary Doctor of Engineering at the Nova Scotia Technical College during this year's convocation exercises.

An active Rotarian throughout his life, he has successively held the positions of maritime district governor, Canadian director and third vice-president of Rotary International.

He has behind him the record of councillor of the Institute in 1927, vice-president, 1936-37, and in 1939 was honored in holding office as president of the Institute.

Portrait of Dr. H. W. McKiel unveiled at 1956 convocation in May, by Dr. R. E. Heartz.

Dr. R. L. Hearn, M.E.I.C., chairman of the Hydro-Electric Power Commission of Ontario, took part in the annual dinner of the Institution of Mechanical Engineers in London, Eng., on October 18, 1956. He responded to the toast to the guests. The toast was proposed by Professor Saunders, vice-president of the Institution, along with a toast to the Institution which was proposed by Sir Brian Robertson and replied to by the president of the Institution.

N. F. Moodie, M.E.I.C., has left the National Defence Headquarters, R.C.N., at Ottawa, to take up a position with Dutton-Williams Brothers Limited at Calgary.

Mr. Moodie graduated from the University of British Columbia in 1936 with a B.A.Sc. degree in mining engineering and then worked for Canadian Mining and Smelting, Sudbury, Ont., and the International Nickel Company. In 1940 he joined the United Kingdom Technical Mission and the British Admiralty Technical Mission in the United States, and remained in that work for three years. In 1944 he became an R.C.N.V.R. armament supply officer and officer in charge of armament depots. Since 1946 he has held a number of posts with the R.C.N., which include those of ordnance officer with H.M.C.S. Magnificent and H.M.C.S. Sioux, resident naval ordnance overseer at

Vancouver, and staff officer, ordnance personnel, at Ottawa.

J. A. Vance, M.E.I.C., president of the Institute in 1950, has been awarded the Julian Crandall Trophy at a ceremony held recently at London, Ont. The award is made annually to the Canadian who has contributed most to the conservation of Canada's natural resources, soil, forest and water.

Mr. Vance, who has an engineering business in Woodstock, Ont., has been chairman of the Board of the Canadian Forestry Association for the last three years. A member of the Association for more than seventeen years, he was intrumental in the formation of the Ontario branch of the Canadian Forestry Association during 1947 and 1948, and was its president for three years. His work in this branch resulted in an effective educational campaign now extending to some one million persons each year in conservation and forest fire prevention.

He is also a keen supporter of the Canadian Tree Farm Movement which encourages farmers and woodlot owners to grow trees for profit and for conservation measures by employing recognized forest management principles.

In summing up his attitude on forest conservation at the National Forestry Conference at Winnipeg recently, Mr. Vance declared, "Since the forests represent the largest single item of our national resources, I believe that every Canadian should be interested in doing everything possible to promote and assist in the proper management of this country's forest resources."

Mr. Vance is a native of Tavistock, Oxford County, Ont., and a graduate of the Univerity of Toronto in civil engineering.

In 1953 Mr. Vance was awarded the Sir John Kennedy Medal of the Institute in recognition of outstanding merit in the profession and noteworthy contribution to the science of engineering and to the Institute.

W. A. Mather, Hon. M.E.I.C., chairman of the board of the Canadian Pacific Railway, was recipient of an honorary Doctor of Laws degree at McGill's Founder's Day convocation on October 5, 1956.

Mr. Mather, whose career with the C.P.R. began at the age of eighteen, was in 1942 elected vice-president of the company, and six years later, in 1948, became the seventh president of the C.P.R. and the first civil engineer to hold this office. In May 1955 he was appointed chairman.

G. G. M. Eastwood, M.E.I.C., of the Spruce Falls Power and Paper Company in Kapuskasing, Ont., has been transferred to the firm's head office at Neenah, Wisconsin, where he is working in the automation-instrumentation section of the research and development division of Kimberley-Clark.

Mr. Eastwood has, therefore, been obliged to resign from the post of councillor for the North Eastern Ontario Branch of the Institute, to which he was this spring elected to serve a two-year term.

John W. Tomlinson, M.E.I.C., has been appointed vice-president-engineering of Northern Ontario Natural Gas Company Limited, Toronto.

Last year Mr. Tomlinson was named assistant sales manager of Trans-Canada Pipe Lines Limited in Calgary, with offices located at Trans-Canada's sales headquarters in Toronto. Previous to that, Mr. Tomlinson had five years' experience with the Saskatchewan Power Corporation and was one of the leaders in the development of the Saskatchewan natural gas industry. His record in introducing natural gas to cities, towns and villages in Saskatchewan, as general manager of the Saskatchewan Power Corporation led to his appointment to his present position. Mr. Tomlinson's responsibilities will include design and construction of transmission and distribution facilities, as well as industrial gas sales, contracts, gas rates and measurement and despatching and operation of the system.

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

Mr. Tomlinson is a graduate of the University of Manitoba.

J. R. Mills, M.E.I.C., formerly secretary of the Foundation Company of Canada Limited, has been appointed a vice-president of the organization.

Mr. Mills joined Foundation Maritime Limited in 1941 as an engineer. He was appointed secretary of the Foundation Company of Canada Limited in 1951. He is president and a director of Geocon Limited, a director of the Construction Equipment Company Limited, assistant secretary of Foundation of Canada Engineering Corporation Limited and secretary of Chemiebau Canada Limited.

R. J. Askin, M.E.I.C., of the Abitibi Power and Paper Company, Limited, Toronto, has become vice-president of development and engineering with the firm.

A past-councillor of the Institute, Mr. Askin has been associated with the pulp and paper industry for many years, join-

J. A. Vance, M.E.I.C.

W. A. Mather, HON. M.E.I.C.

J. R. Mills, M.E.I.C.

Labatt's Brewery Installs . . .

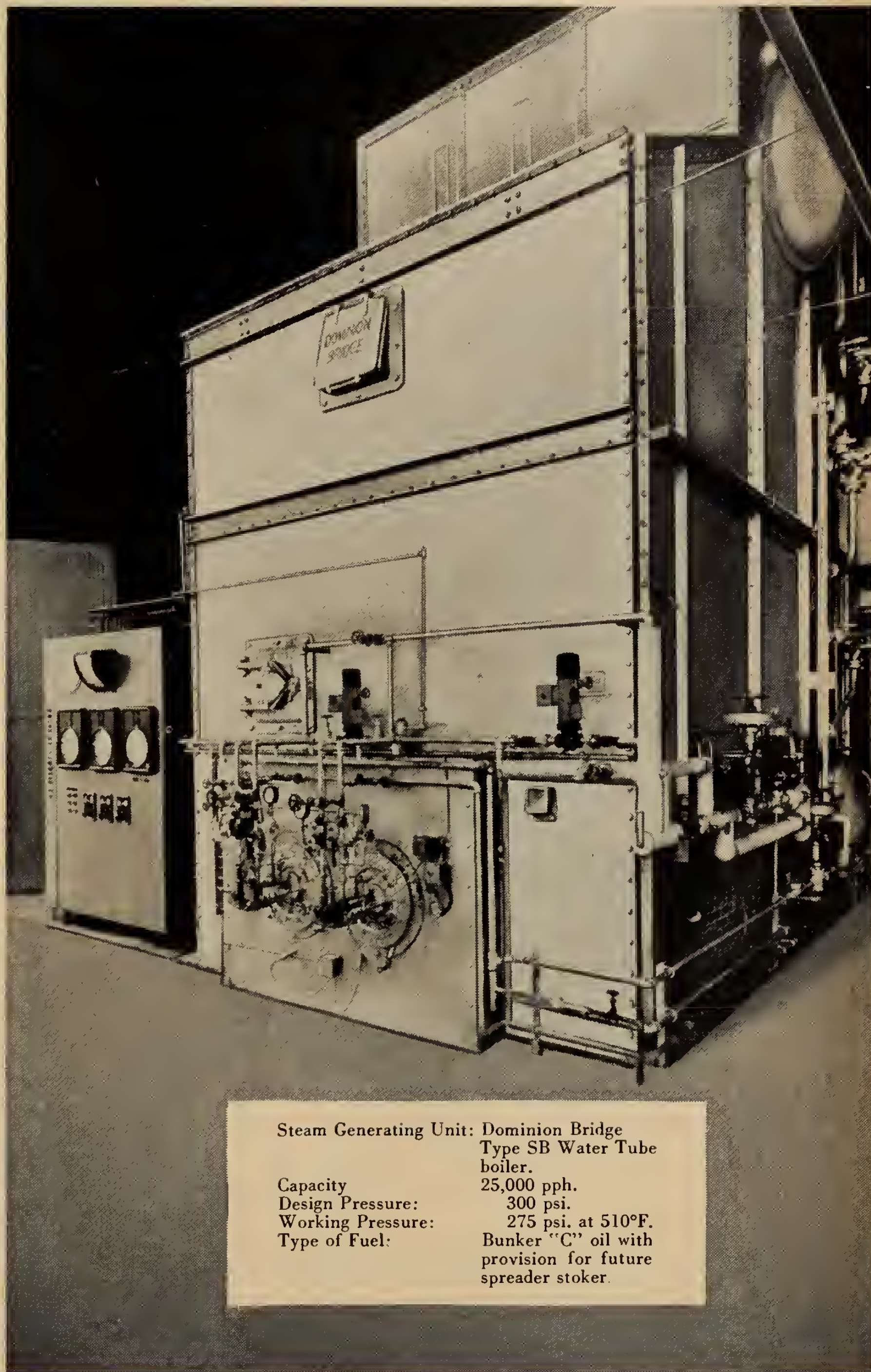
Economy of operation and flexibility in meeting varying load conditions are two important reasons why Labatt's Brewery Ltd. installed Dominion Bridge boilers for its new brewery in Ville LaSalle, P.Q.

The Dominion Bridge Type SB Water Tube boiler shown here supplies super-heated steam to drive a back pressure steam turbine used as a prime mover in the refrigeration operations, and for process and heating requirements. Labatt's also purchased a Dominion Bridge Scotch Dry Back boiler of 9000 pph. capacity for standby service. It is a portable unit which can be used in other plants when steam loads require the use of an additional generator.

Provision has been made in the design of the building for the installation of additional Water Tube boilers.

Auxiliary equipment, consisting of oil pumping and heating set, oil burners, forced draft and induced draft fans with drives, metering and automatic combustion control equipment, deaerating feed water heater, feed pumps, water softeners and continuous blow-off equipment was also supplied and installed by Dominion Bridge.

Information on Dominion Bridge Type SB Water Tube boilers is contained in Catalogue No. B [illegible]-113. Copy will be sent to you gladly, on request.



Steam Generating Unit:	Dominion Bridge Type SB Water Tube boiler.
Capacity	25,000 pph.
Design Pressure:	300 psi.
Working Pressure:	275 psi. at 510°F.
Type of Fuel:	Bunker "C" oil with provision for future spreader stoker.

Plants at: **MONTREAL • OTTAWA • TORONTO • WINNIPEG • CALGARY • VANCOUVER**
Assoc. Company Plants at: **AMHERST, N.S.:** Robb Engineering Wks., Ltd. **QUEBEC:** Eastern Canada Steel & Iron Wks., Ltd. **SAULT STE. MARIE:** Sault Structural Steel Co. Ltd. **WINNIPEG:** Manitoba Bridge & Eng. Wks. Ltd. **CALGARY:** Riverside Iron & Eng. Wks., Ltd. **EDMONTON:** Standard Iron & Eng. Wks., Ltd.
Divisions: Boiler • Structural • Platework • Mechanical • Warehouse

Boilers by Dominion Bridge

ing the Fort William Paper Company, Fort William, Ont., in 1923, shortly after a Queen's University graduation in mechanical engineering. With Abitibi Power and Paper Company, Limited since its merger with the Fort William company, he was in 1930 appointed manager of the Thunder Bay division. In 1942 he moved to Toronto as assistant manager of mills. Until his recent appointment, Mr. Askin held the office of vice-president manufacturing.

L. H. Laffoley, M.E.I.C., of the Canadian Pacific Railway has been appointed engineer of hotels, with headquarters at Montreal.

Mr. Laffoley, whose railway service dates to 1919, graduated from McGill University in 1916 with a B.Sc. degree in civil engineering. He served overseas with the Royal Flying Corps during the closing years of World War I. Employed as draughtsman during his early years with the C.P.R., he became an assistant engineer in 1923, and assistant engineer of buildings in 1937. Named engineer of buildings in 1946, he held that position until his present appointment.

L. H. Laffoley, M.E.I.C.

J. G. Sutherland, M.E.I.C.

J. G. Sutherland, M.E.I.C., has been named engineer of buildings for the Canadian Pacific Railway, with headquarters at Montreal.

Mr. Sutherland joined the C.P.R. in 1930, on graduation from the University of Toronto, with a B.ASc degree. Through the thirties he served the company as transitman, assistant engineer, and division engineer, at various points in Eastern Canada. In 1943 he became assistant engineer in the chief engineer's office at Montreal, and the following year was assistant engineer of track.

Since 1946 Mr. Sutherland has been assistant engineer of buildings.

G. A. Morison, M.E.I.C., has received the appointment of assistant engineer of buildings with the Canadian Pacific Railway at Montreal.

Mr. Morison is a 1943 graduate of the University of Manitoba, with a B.Sc. degree in civil engineering.

In 1946, after two years' service with the Canadian Army he joined the C.P.R. at Montreal, working as a building inspector. Later that year he was transferred to the chief engineer's office. In 1948 he received the appointment he has held until the present, which was that of assistant engineer at Montreal.

G. A. Morison, M.E.I.C.

E. G. Gagnon, M.E.I.C., was recently appointed contract services manager of Northern Electric Company Limited, following service as sales manager of the communications equipment division.

With the company since 1928 he has had experience as equipment service superintendent, in the communications equipment division. During the war, he was superintendent of government sales and was chief engineer of the communications equipment division for more than five years.

Mr. Gagnon is a graduate of McGill University in electrical engineering.

G. D. Lewis, M.E.I.C.

G. D. Lewis, M.E.I.C., secretary of Dominion Engineering Works Limited, has been transferred to the paper machinery division of the company. He becomes research engineer in product and market planning. In his new capacity Mr. Lewis will be in contact with all phases of manufacturing in the pulp and paper industry with the objective of co-ordinating Dominion Engineering's expanding research and production facilities to the needs of that industry.

Mr. Lewis is a graduate of the Nova Scotia Technical College and Dalhousie University and has been with his present firm since 1946.

R. T. Mactavish, M.E.I.C., of Brown Boveri (Canada) Limited has joined the organization of Gordon Russell Limited at Vancouver under an arrangement which augments the engineering and sales services of Brown Boveri Products to British Columbia clients.

Mr. Mactavish has been with the Brown Boveri organization for three years during which time he has received training in the company's factories in Switzerland and Canada, and latterly served as a sales engineer at head office, Montreal.

A native of Cumberland, Eng., he is a graduate of Faraday House Electrical Engineering College and Oxford University.

R. H. Stokes-Rees, AFFIL. E.I.C., president of Hydrotechnic Limited, Montreal, has been elected a director of the Abitca Lumber and Timber Corporation Limited, Montreal. He has also been appointed a vice-president of the firm.

Named a vice-president of the Kaiser Engineers Division of Henry J. Kaiser Company (Can.), Ltd., Montreal in 1953 he also became a director with Rubenstein Brothers in 1955.

Brig. Noel D. Lambert, C.B.E., M.E.I.C., of Vancouver has been appointed a director of Central Mortgage and Housing Corporation.

A director of the Corporation from its inception in 1946 until 1951, he is also president of Northern Construction Com-

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Revolution in Rubber

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Yes, Polysar *can* give reality to many product ideas, previously impractical with other materials. Why? Because *there's been a revolution in rubber.* Now . . . with Polysar chemical rubbers and the help of Polymer research chemists . . . you can have a rubber tailor-made to fit the exact requirements of *your* product idea.

Whether rubber now enters into your products or not, you owe it to yourself to investigate what Polysar can do for them. You'll find—as have manufacturers in 40 countries—that Polysar can make a world of difference.

Polymer Corporation Limited, makers of Polysar rubbers, has the largest industrial research and development division in Canada. Why not make full use of these facilities and learn how Polysar can improve present products and create new ones?

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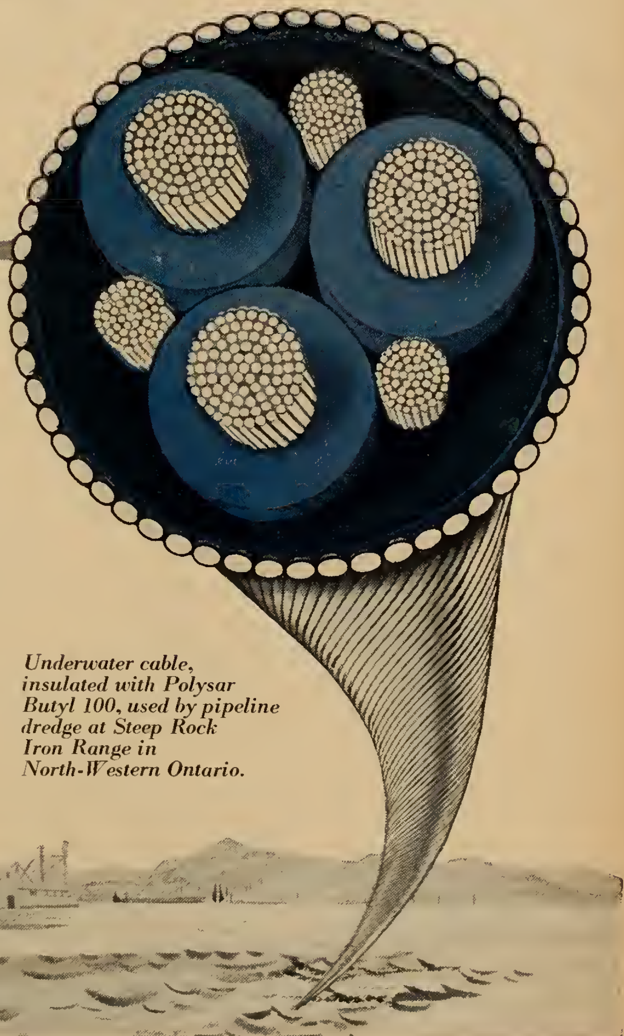
Here's How POLYSAR Beat a Critical Insulation Problem

When Northern Electric Company Limited was looking for an insulation rubber—to be used in underwater electric dredge cables subject to extremely rugged treatment—they chose Polysar Butyl 100. This special type of Polysar gives high resistance to ozone, water, heat and cold; provides excellent dielectric properties; has good flexibility; and is readily processed.

If you, too, have a critical rubber problem, Polymer will be glad to help find the solution.



Underwater cable, insulated with Polysar Butyl 100, used by pipeline dredge at Steep Rock Iron Range in North-Western Ontario.

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pany and J. W. Stewart Limited, Vancouver.

Brig. Lambert graduated from the University of British Columbia in civil engineering, served with the R.A.F. during World War I and in the second conflict was in 1941 appointed director of engineering services at National Defence Headquarters. A year later he was named Deputy Quartermaster General and promoted to the rank of brigadier.

D. C. Jones, M.E.I.C., has been chosen for the office of chairman of the Calgary Branch of the Institute for the term 1956-57.

A native of Calgary, and educated at the University of Alberta and McGill University, he holds a B.Eng. degree in mechanical engineering from the latter college, gained in 1937.

Following service in the R.C.A.F. Joint Air Training Plan, he spent a short time with Dominion Bridge Company in Calgary and then joined the Canadian Western Natural Gas Company where he remained for a period of six years, associated with the special projects department. In 1951 he moved to the consulting firm of Denton-Spencer Company and spent three years as gas project engineer.

Mr. Jones' present professional capacity is that of superintendent of gas operations with Hudson's Bay Oil and Gas Company Limited at Calgary. He is also a director of the Alberta Gas Trunk Line Company.

Joseph A. Chalmers, M.E.I.C., who has served on the City of Ottawa engineering staff since 1953, resigned from this position in April and has established a practice in that city as a consulting engineer specializing in municipal works.

Mr. Chalmers came to this country in 1952 after extensive experience in municipal engineering in Great Britain. A Corporate Member if the Institution of Structural Engineers and the Institution of Municipal Engineers since 1944, he had his education at the College of Technology, Leeds, Eng., and at Leeds and Glasgow University.

J. M. den Hartog, M.E.I.C., has accepted a position with the Aluminum Company of Canada, at Arvida, Que.

Mr. den Hartog was previously a junior engineer with the Canadian Natural Gas Company at Calgary.

Commodore Frank Freeborn, R.C.N., M.E.I.C., previously principal naval overseer of the Montreal area, has been recently promoted to his present rank and elevated to the position of naval-constructor-in-chief for the Royal Canadian Navy, at Ottawa.

In his former capacity Commodore Freeborn was in charge of the construction of H.M.C.S. St. Laurent.

Prior to that he was manager of the construction department of the Department of National Defence, Naval Service at H.M.C. Dockyard, Esquimalt, B.C.

H. S. McCleave, M.E.I.C., who has been associated with the New Brunswick Telephone Company Limited, at St. John, N.B., for a number of years, has been transferred to Moncton, N.B., as an engineering supervisor, outside plant engineering department. He is concerned with the planning, detailing and estimating of outside plant work for the eastern section of New Brunswick, from the Nova Scotia boundary to Campbellton.

Mr. McCleave is a 1947 graduate of the University of New Brunswick, in electrical engineering.

A. P. Balodis, M.E.I.C., formerly of the Department of National Defence, Ottawa, has joined the staff of the Polymer Corporation Limited, at Sarnia, Ont., and works as a senior engineer in the design section of the engineering and construction department.

Mr. Balodis worked as a construction engineer with F. C. McRostie, consulting engineer and surveyor, in Ottawa, in 1953.

He came to this country from Latvia, where in 1940 he was awarded an engineering diploma from the University of Latvia.

R. M. Wickwire, M.E.I.C., building engineer with the Canadian National Railways, Atlantic region, has been elected chairman of the Moncton Branch of the Engineering Institute.

• PERSONALS

A native of Yarmouth, N.S., he was educated there, at Acadia College, and at the Nova Scotia Technical College. He received a B.Eng. degree in civil engineering at N.S.T.C. in 1947.

Following graduation Mr. Wickwire joined the Canadian National Railways an an instrumentman at Campbellton, N.B. He remained there a year before being transferred to Moncton, where he was at first engaged to work on the staff of the building engineer. He was appointed to his present position in 1953.

Maintaining an interest in affairs of the Institute since joining as a Junior Member in 1949, Mr. Wickwire has also served a term on the Branch executive.

Percy C. Toft, M.E.I.C., is now employed with the Canadian General Electric Company Limited, civilian atomic power department, Peterborough, Ont.

A University of New Brunswick graduate, class of 1949, Mr. Toft has previously been associated with Imperial Oil Limited, Sarnia, Ont.

E. H. Fisher, M.E.I.C., of the Canadian National Railway has been named manager of work equipment with the company's engineering department in Montreal He was previously system superintendent of mechanical maintenance for the road transport department of the railway, which appointment he received in 1953.

He is a 1944 graduate in mechanical engineering from the University of Saskatchewan.

J. R. Harvey, M.E.I.C., formerly western branch manager of Babcock-Wilcox and Goldie-McCulloch Limited at Calgary, has been transferred to head office at Galt, Ont.

Graduating from the University of Toronto with a degree in mechanical engineering in 1945, Mr. Harvey joined Babcock-Wilcox and Goldie-McCulloch Limited at Galt, as a junior engineer engaged in design and service work. Transferred to Montreal as an engineer in 1953 he later that year became manager at Calgary.

R. L. Sanders, M.E.I.C., of the firm of Babcock-Wilcox and Goldie-McCulloch Limited, Galt, Ont., has received the appointment of manager of the firm's western branch at Calgary.

With the firm in Galt, in 1952, Mr. Sanders worked as an erection superintendent. Prior to that time he was associated with the Power Corporation of Canada Limited, at Montreal.

He is a 1941 graduate in mechanical engineering from Queen's University.

A. B. Danard, M.E.I.C., has been appointed sales engineer with the firm of Babcock-Wilcox and Goldie-McCulloch Limited in their eastern branch offices at Montreal.

A 1945 graduate of the University of Toronto in mechanical engineering, he spent a short period of time with the Royal Canadian Artillery and then joined Foster Wheeler Limited at Montreal as a sales engineer, where he has been employed until recently.

A. L. Berry, M.E.I.C., is principal pipeline engineer with the Westcoast Transmission Company Limited, Calgary, Alta.

A University of Alberta graduate in civil engineering, Mr. Berry has also held affiliations with Northwestern Utilities Limited, and Denton Spencer Company Limited, both at Edmonton.

Frank Hollingworth, M.E.I.C., of the University of Manchester, class of 1951 in civil engineering, has gone to Afghanistan as an assistant field engineer with Morrion Knudsen Afghanistan Inc., on an irrigation project.

Last year he spent some time as a design engineer with P.F.R.A., at Regina, Sask., and with the B.C. Engineering Company Limited, Vancouver.

J. G. McLellan, M.E.I.C., of the Northern Electric Company Limited, formerly manager of and also a director of the Fort William branch of the firm, has been transferred to Montreal where he acts as communication and export sales manager of the wire and cable plant.

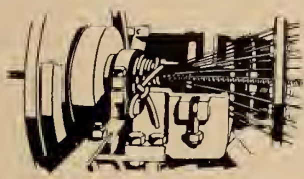
Employed by Northern Electric since 1936 and his graduation from the University of British Columbia, he has served the firm in Vancouver, Calgary and Montreal and went to Fort William in 1954.

In February 1954, BICC were awarded a contract by the British Columbia Electric Company to supply and lay a submarine power link between Vancouver Island and the mainland.

MADE BY BICC

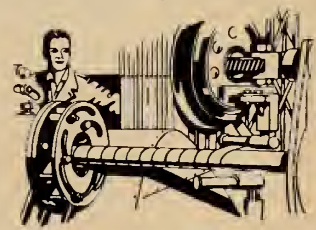
The contract required some 91 miles of 138,000-volt, gas-filled cable—*including five continuous lengths of over 15 miles.*

A special single-core gas-filled cable was designed with a hollow duct conductor, for operation at a pressure of 300 lbs. per square inch. This was necessary in order that the cable's gas pressure should always exceed the water pressure at the bottom of the Georgia Strait, some 600 feet deep in places.



The cable was sheathed in lead alloy and reinforced against internal gas pressure by bronze tapes. A layer of vulcanized rubber protected the tapes against corrosion. Finally, the cable was armoured with galvanized steel wires for mechanical protection and to take the strain during coiling and laying operations.

With the design settled, special plant was installed at a BICC Group factory in Manchester close to the docks, and production commenced.



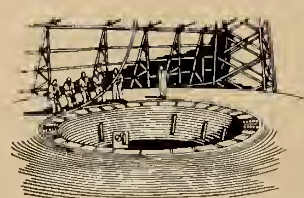
15 mile CONTINUOUS LENGTHS of SUBMARINE POWER CABLES

MADE & LAID by BICC

LAID BY BICC

From Manchester to Vancouver (via Panama) it is some 8,700 miles. But the first few hundred yards of this journey presented one of the greatest problems . namely, moving the very long and heavy lengths of cable (some weighing 800 tons) from the factory to the ship.

A 45 feet high gantry with power winches was built to carry the cables, first to the coiling down shed for testing and storage, and later, when all the cables had been made, over the docks area to be loaded aboard the "Ocean Layer." This up-to-date, 4,600 ton vessel is the second largest cable-layer in the World. Equipped with a Pleuger active rudder, housing an auxiliary propeller, she has the extreme manœuvrability essential for cable laying. The long journey to Vancouver was uneventful. Laying operations were successfully carried out under the control of BICC engineers, who also terminated and tested the installation. Thus, from start to finish, design, development, manufacture, transportation, and installation were undertaken or controlled by BICC—*the only organization with the facilities to manufacture long, continuous lengths of power cable and to install them anywhere in the World!*



Now, after only two and a half years, this joint Anglo-Canadian venture has been completed, on schedule. Thanks to the courage and enterprise of the British Columbia Electric Company and the engineering skill of the BICC Group, the swiftly growing and highly important timber, pulp and paper industries of Vancouver Island can now obtain adequate power from the hydro-electric generating stations on the mainland.

BICC CABLES THE name for cables-everywhere

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• PERSONALS

Col. C. W. Jones, M.E.I.C., commandant of the Royal Canadian Electrical and Mechanical Engineers School, Kingston, is the 1956-57 chairman of the Kingston Branch of the Institute.

Col. Jones, who was born in Ottawa, and attended schools in that city, received his engineering training at Queen's University and graduated with a B.Sc. degree in mechanical engineering in 1939. Then, prior to joining the army, he was, for a short time associated with Babcock-Wilcox and Goldie-McCulloch. During the war he served in the Royal Canadian Ordnance Corps, as an ordnance mechanical engineer, and later transferred to the Royal Canadian Electrical and Mechanical Engineers. He served in No. 2 Army Field Workshop and in Light Aid Detachments, Second Field Regiment of the R.C.A., and the Second Canadian Infantry Brigade in England, then with the Directorate of Mechanization, Ministry of Supply, and finally with the Inspection Tanks and Mechanical Transport Inspection Board of Canada as the assistant director.

Since the war he has held the appointments of assistant director and deputy director of electrical and mechanical engineering, at Army headquarters, prior to his appointment as commandant of the R.C.E.M.E. School at Kingston.

J. N. Ford, M.E.I.C., for the past five years chief electrical engineer with Canadian Utilities, Edmonton, has been appointed manager of operations of the electric utility.

A native Albertan, from Calgary, he is a University of Alberta graduate, class of 1934, in electrical engineering, and was at an earlier date associated with the Calgary Power Company Limited, at Calgary.

W. M. Brenan, M.E.I.C., formerly on the staff of Wiggs, Walford, Frost and Lindsay, consulting engineers in Montreal, has joined Giffels and Vallet of Canada, Limited. Attached to Polymer Corporation, Limited, at Sarnia, Ont.; his position is that of project engineer.

Mr. Brenan is a University of New Brunswick graduate of the class of 1941 in civil engineering.

J. L. Hope, M.E.I.C., is with the Department of National Defence, inspection services branch, in Ottawa.

Last year Mr. Hope was project development engineer with the English Electric Company at St Catharines, Ont.

D. R. Beckett, M.E.I.C., has accepted a position with North West Power Inc., Ottawa.

Resident in Port Arthur, Ont., for a number of years, Mr. Beckett has been associated with the C. D. Howe Company Limited, and the Marathon Paper Mills of Canada Limited.

He graduated from Queen's University in 1945 with a B.Sc. degree in civil engineering.

Col. C. W. Jones, M.E.I.C.

Eric F. Walker, M.E.I.C., has joined the staff of Atomic Energy of Canada Ltd., commercial products division, at Ottawa.

Mr. Walker has within the last few years been employed with Picker X-ray Engineering Limited as maritime manager at Halifax, and with the medical X-ray division of Philips Industries Limited, Toronto, as a divisional manager.

J. E. Reardon, M.E.I.C., of the Public Service Commission, Halifax, has been elected secretary-treasurer of the Halifax Branch of the Institute

A native of Halifax, Mr. Reardon graduated from the Nova Scotia Technical College in 1946 with a B.Eng. degree.

Herve Gauvin, M.E.I.C., has been named to the post of general manager of A. Belanger Ltd., at Montmagny, Que.

With Clare Brothers and Company Limited, as general manager at Preston, Ont., for some time, he has been associated with his present company previously as general superintendent from 1937 until the onset of World War II, at which time he entered military service.

A. Campbell, M.E.I.C.

J. S. Campbell, M.E.I.C.

A. Campbell, M.E.I.C., since 1952 vice-president of Dominion Bridge Company Limited and manager of its western division, has been elected president of the Manitoba Bridge and Engineering Works Limited and the Manitoba Rolling Mill Limited.

Beginning an engineering career with Western Steel and Iron Works, Winnipeg, Mr. Campbell underwent millitary service in World War I and then attended McGill University. He graduated in civil engineering in 1924, received an M.Sc. degree from that University two years later, and in 1927 joined Dominion Bridge Company Limited's contract department. Later assigned the duties of contract engineer, western division, he held this position until his appointment as vice-president and manager of Dominion Bridge Company Limited's western division.

J. Stewart Campbell, M.E.I.C., has been appointed manager of the Manitoba Bridge and Engineering Works Limited.

Mr. Campbell, who has spent his entire engineering career with Manitoba Bridge and Rolling Mill Companies, has held a number of positions since graduating from McGill University in 1937.

Until his recent appointment Mr. Campbell's duties were those of secretary and assistant general manager of both companies. He will however continue to hold the office of secretary.

M. B. Allan, M.E.I.C., has accepted a position with the Toronto firm of Cassels, Desfries and DesBriss.

Mr. Allan was previously associated with the C. D. Howe Company Limited at Montreal a a mechanical engineer.

• PERSONALS

He is a University of Toronto graduate, class of 1946.

Alex J. Branch, M.E.I.C., has been elected chairman of the Lethbridge Branch of the Institute for the 1956-57 season.

Originally from London, Eng., Mr. Branch began his professional career as assistant to an architect and a surveyor

Alex J. Branch, M.E.I.C.

in that city. After a few years experience he came to Canada in 1910 as an assistant to the town engineer at MacLeod, Alta, on waterworks and sewers construction. Then came World War I and a five year tour of duty overseas with the Canadian Engineers. In 1919, returning to Alberta, he took a position as leveller and topographer with the Dominion Irrigation Department. The following year he became instrumentman and inspector on the construction of the Lethbridge Northern Irrigation District. Named water master of the District, in 1923, he was promoted to assistant engineer in 1939, and has remained in this capacity until the present.

Mr. Branch previously served as chairman for the Lethbridge Branch of the Institute in 1939.

Ralph E. Crysler, M.E.I.C., a 1949 graduate of the University of Toronto, and formerly of the firm of M. M. Dillon and Company Limited, London, Ont., has accepted a position with W. S. Atkins and Associates Limited, of Toronto.

A. F. Bauer, M.E.I.C., has accepted a position as project engineer with Mannix-Stolte, at the Cheakamus Powerhouse, Squamish, B.C.

Mr. Bauer obtained his engineering training in Vienna where he was awarded a diploma in mechanical engineering in 1948. Since coming to this country he has held professional affiliations with the B.C. Power Commission, Victoria, and H. A. Simons Limited, Vancouver, both in 1955.

Max Schuller, M.E.I.C., has joined the staff of the Catalytic Construction Company of Canada as a project engineer at Sarnia, Ont.

A McGill University graduate in chemical engineering, his professional affiliations have included Defence Industries Limited and Canadian Arsenals Limited.

R. O. Jonasson, JR.E.I.C., a 1949 civil engineering graduate of the University of Manitoba, has joined Dominion Bridge Company, sales department, Winnipeg.

Mr. Jonasson was with the firm previously for three years after receiving his degree, and was engaged in the detailing and designing of structural steel. In 1952 he went to Trail, B.C., working until recently on a smelter revision project with Canadian Mining and Smelting Company Limited.

A. F. Tiesdell, M.E.I.C., is employed with the Sarnia Board of Education as

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MR. W. D. IRWIN
Department Manager

MR. C. T. HAMBLEY
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MR. E. J. SURRETT
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MR. W. D. DAWSON
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• PERSONALS

a lecturer in drafting, at the Sarnia Northern Collegiate Institute and Vocational School.

He was previously a designer, draughtsman and estimator with Davis Shipbuilding Limited, Lauzon, Que.

R. D. Christie, JR.E.I.C., formerly of Industrial Cellulose Research, Hawkesbury, Ont., is now at Temiskaming, Que, with the Canadian International Paper Company.

Mr. Christie is a 1954 graduate of the University of Toronto in chemical engineering.

W. J. Hogg, JR.E.I.C., formerly associated with Canadian Industries Limited in Montreal has moved to Vancouver where he has accepted a position as maintenance engineer with Standard Oil.

He is a University of British Columbia graduate, class of 1949.

Dr. Emile Nenniger, JR.E.I.C., a 1951 graduate of McGill University with an M.Eng. degree, has returned from Great Britain where he received the degree of doctor of philosophy in chemical engineering at the University of Manchester.

Dr. Nenniger has been resident in Manchester for the past three years. Prior to that he was employed as a process engineer with the Liquid Air Company, Montreal.

Ian K. Leslie, JR.E.I.C., has joined the staff of the Department of Transport, marine services branch, at Ottawa, where he is employed in the Aids to Navigation Division.

Mr. Leslie was formerly with the Gatineau Power Company, in Ottawa and is a graduate of McGill University. He received a B.Eng. degree in 1951.

E. N. Baker, JR. E.I.C., is employed as a sales engineer with the Linde Air Products Company, Division of Union Carbide Canada Limited, at Toronto, Ont.

Mr. Baker studied engineering and business at the University of Toronto, graduating in 1954.

D. W. Hawes, JR.E.I.C., formerly of the Canadian General Electric Company and the National Steel Car Corporation Limited, has joined the Toronto engineering firm of Ewbank and Partners (Canada) Limited.

He is a 1950 graduate of McGill University in electrical engineering.

Roy Bushfield, JR.E.I.C., of the Canadian Westinghouse Company Limited, now holds the position of supervisor of graduate training and placement, at Hamilton, Ont.

Mr. Bushfield, who has been with the company for a number of years is a graduate of the University of British Columbia, 1947, in electrical engineering.

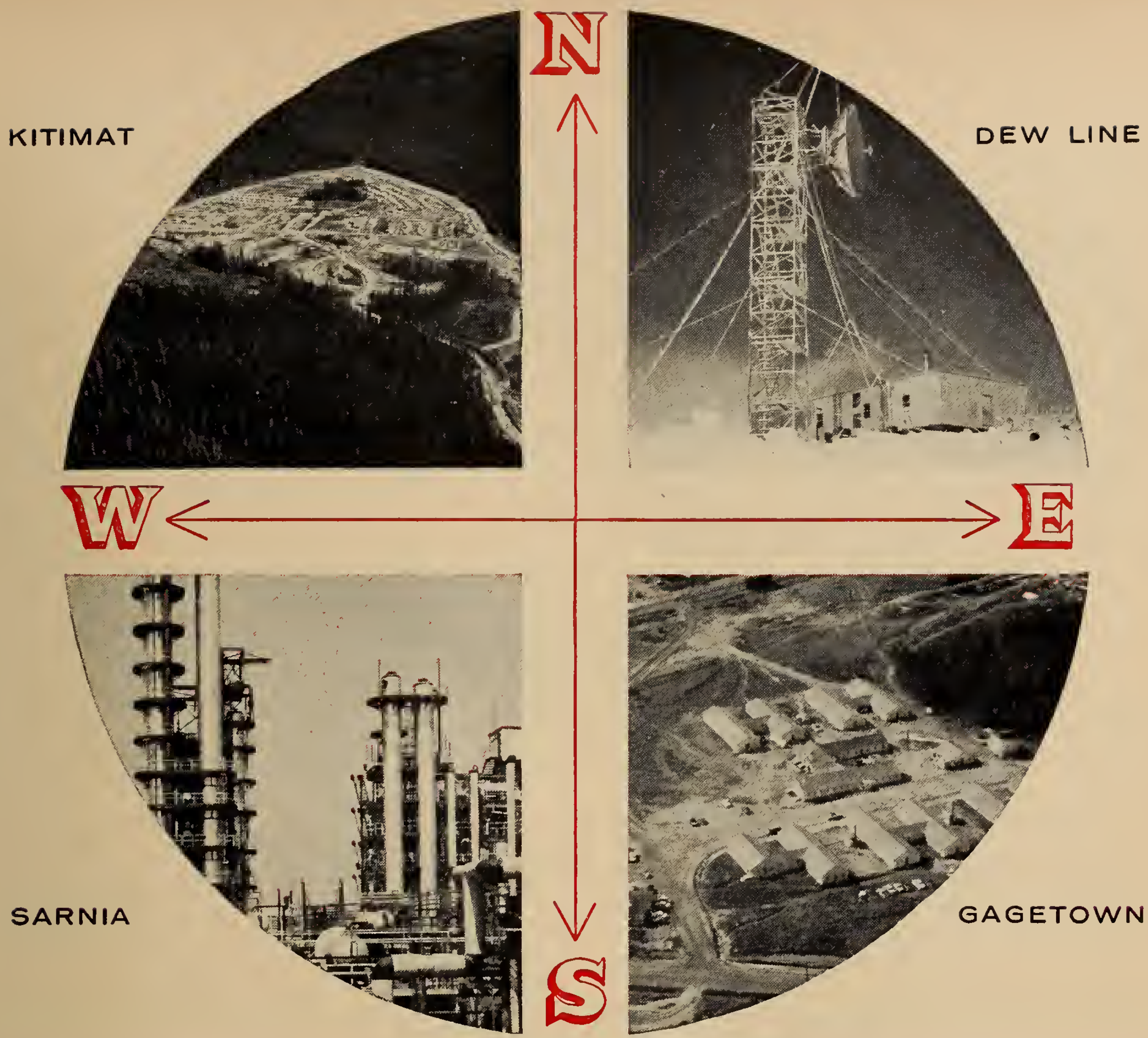
J. W. Breed, JR.E.I.C., formerly a production engineer with the City of Winnipeg Hydro Electric System, has become associated with the engineering section of the electrical branch of Aro Incorporated, technical services division, at Tullahomma, Tenn.

Mr. Breed is a University of Manitoba graduate, class of 1951 in electrical engineering.

S/L I. G. Duncan, JR.E.I.C., has been transferred to Ottawa from Beaver Bank, N.S., where he held the position of chief technical services officer. At Air Force Headquarters in Ottawa, S/L Duncan is concerned with the Directorate of Systems Evaluation.

He is a 1948 graduate of the University of Manitoba in electrical engineering.

L. Marc Gauthier, JR. E.I.C., has accepted a teaching position with the University of Sherbrooke Engineering School, mechanical engineering department, at Sher-



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• PERSONALS

brooke, Que.

Mr. Gauthier holds a B.A.Sc. degree in mechanical and electrical engineering from the Ecole Polytechnique. He graduated in 1954.

K. H. Wu, JR. E.I.C., a civil engineering graduate of the University of Lignan, China, class of 1949, who was last year with the Department of Mines and Natural Resources, water resources branch, at Winnipeg, Man., has accepted a position with P.F.R.A., at Regina, Sask.

F. J. Bollinger, JR.E.I.C., of the Canadian Kellog Construction Company, has left Montreal and is working for the firm as field engineer in Tuscola, Ill., where the company is extending the existing facilities of the National Petro Chemical Company Limited.

A 1954 graduate of McGill University he was awarded a B.Eng. degree in civil engineering.

Ivan Brucky, JR.E.I.C., a 1954 graduate of the University of Manitoba, in civil engineering, is employed with the Abitibi Power and Paper Company, Toronto, as a junior structural engineer.

Prior to this Mr. Brucky was associated with the Ontario Department of Highways.

R. Giovannetti, JR.E.I.C., formerly a design engineer in the maintenance engineering department of the Ford Motor Company of Canada, at Windsor, Ont., has transferred his services to the Canadian Gypsum Company Works, Windsor, N.S.

Mr. Giovannetti obtained his engineering training at the Nova Scotia Technical

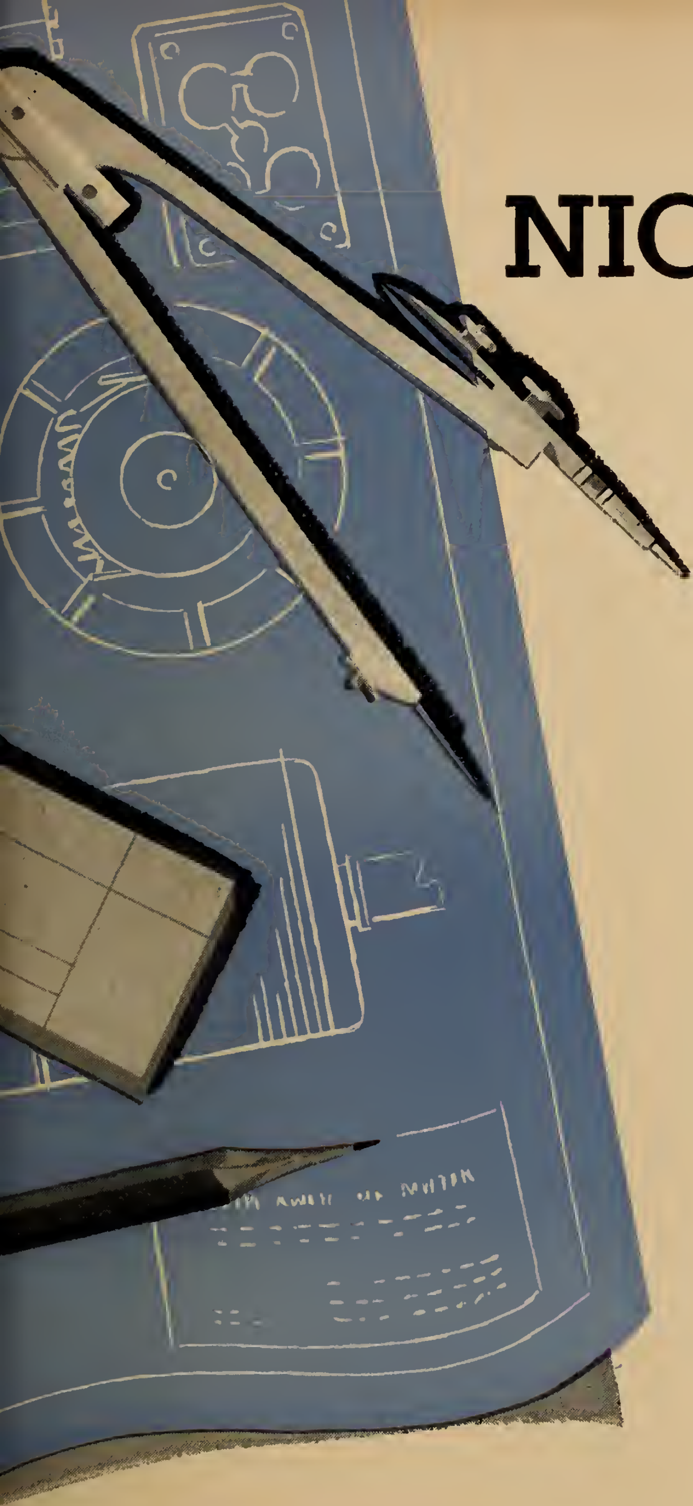
Corrections

It was reported in the Personals column, October issue, that A. M. Clark, M.E.I.C., of the Canadian Blower and Forge Company Limited, Toronto, had moved to the Hamilton office. This statement was incorrect. There is no change in Mr. Clark's position as branch manager for the company at Toronto. The error arose from a misinterpretation of mailing instruction.

In the October issue of the Journal it was reported that R. E. Chamberlain is employed with Bailey Meter Company in Montreal. This is correct.

However there are two Junior members of the Institute by the name of R. E. Chamberlain, both of whom now work in Montreal. Unfortunately, biographical material used for the Personal was confused, and does not pertain to Robert Ernest Chamberlain as it should but rather to Ross Edwin Chamberlain of Dominion Bridge Company Limited.

The Journal regrets this error and extends apologies to both gentlemen. A corrected Personal will appear in the December issue.



• PERSONALS

College, graduating with a B.Eng. degree in mechanical engineering in 1952.

D. H. Smith, JR.E.I.C., has joined the staff of Consolidated Mining and Smelting Company of Canada Limited, at Trail, B.C.

Mr. Smith, who graduated from the University of British Columbia in 1952, with a B.A.Sc. degree in mechanical engineering, has since been affiliated with the Electric Reduction Company of Canada Limited in Toronto.

R. B. Kerr, JR.E.I.C., has been appointed manager of Cooper-Bessemer of Canada Limited in Edmonton.

For a number of years associated with the Canadian Westinghouse Company Limited at Hamilton and Edmonton, he is a University of Saskatchewan graduate in electrical engineering, class of 1948.

Lt. Cmdr. G. L. Hopkins, R.C.N., JR.E.I.C., previously deputy electrical officer on the cruiser H.M.C.S. Quebec, is now serving at the R.C.N. Air Station, H.M.C.S. Shearwater, at Dartmouth, N.S., also as deputy electrical officer.

Lt. Cmdr. Hopkins graduated in electrical engineering from McGill University in 1952.

Gabriel Gagnon, JR.E.I.C., employed for several years with the Lower St. Lawrence Power Company, Rimouski, Que., has joined the operating department staff of the Quebec Power Company in Quebec City, Que.

Mr. Gagnon graduated from Laval University in 1948 with a B.A.Sc. degree in electrical engineering.

F. George Pack, JR.E.I.C., is a design engineer with Giffels and Vallet of Canada Limited, Windsor, Ont.

Last year he was employed by Dominion Structural Steel Limited in Montreal as a reinforcing manager.

He is a 1950 graduate in civil engineering from Queen's University.

Allan E. Toole, JR.E.I.C., is on the staff of the National Research Council, Ottawa. He is a design engineer working in the power section of plant engineering services.

Mr. Toole is a Queen's University graduate, class of 1950, and was previously employed with Canadian Industries Limited.

C. G. Thompson, JR.E.I.C., formerly plant engineer on the staff of Simmons Limited, Montreal, has transferred his services to the Escambia Bay Chemical Corporation, Pensacola, Florida.

He is a 1949 graduate in mechanical engineering from McGill University.

Lieut. (E) R. A. Williams, R.C.N., JR.E.I.C., carrying out administrative and engineering work with the R.C.N. is posted at H.M.C.S. Ontario at Esquimalt, B.C.

Lieut. Williams graduated from the University of New Brunswick in 1953 with a B.Sc. degree in mechanical engineering and then underwent a period of naval and engineering training with the R.C.N. In 1954 he joined the cruiser H.M.C.S. Quebec, and obtained further qualifications as a marine engineer. Last year Lieut. Williams was sent to the Royal Naval Engineering College, Plymouth, Eng., for a twelve month course in marine engineering theory.

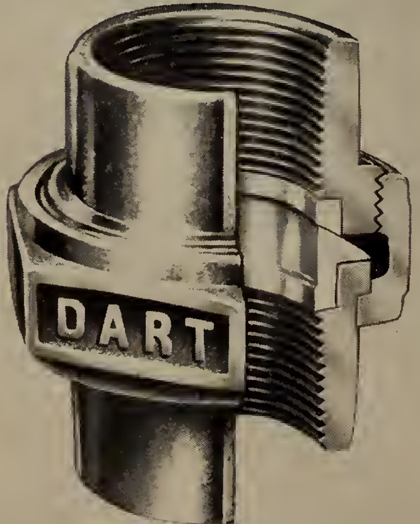
R. P. Baronet, JR.E.I.C., is with Ford Motor Company of Canada Limited, production engineering department at Windsor, Ont.

Mr. Baronet graduated from McGill University with the degree B.Eng. in mechanical engineering in 1950 and then gained experience with the Singer Manufacturing Company.

C. Markopoulos, JR.E.I.C., is an electrical engineer with Aluminium Laboratories in Montreal.

Formerly associated with A. D. Ross and the Canadian Comstock Company in Montreal, he is an electrical and mechanical engineering graduate from the National Technical University of Athens, class of 1950.

H. L. Bachman, JR.E.I.C., is employed with Pacific Car and Electric, power



transmission engineering design section, at San Francisco, Calif.

Since graduating from the University of Manitoba in 1949 Mr. Bachman has gained experience in electrical engineering with the Manitoba Telephone System in Winnipeg, the Canadian Westinghouse Company Limited, Hamilton, and most recently has been associated with the B.C. Electric Commission transission department at Vancouver.

Flt. Lt. J. P. Pagnutti, R.C.A.F., JR.E.I.C., is assistant professor of mechanical engineering at the Royal Military College, Kingston, Ont.

Flt. Lt. Pagnutti graduated from Queen's University with a degree in mechanical engineering in 1953 and then spent some time with the technical training unit of the R.C.A.F. in Vancouver.

Jean Choquet, JR.E.I.C., of the British American Oil Company has been transferred from Montreal to Calgary where he is employed as a refinery engineer.

Mr. Choquet joined the B.A. Oil Montreal east refinery shortly after he received a degree in civil engineering from the Ecole Polytechnique in 1948.

K. A. Mellish, JR.E.I.C., of the Department of Health and Welfare, Public Health Engineering Division, formerly of Truro, N.S., has been transferred to Regina, Sask., where he will hold the position of district engineer.

Mr. Mellish was graduated from the University of New Brunswick in 1950 with a degree in civil engineering.

R. A. Carter, JR.E.I.C., is employed with Canadian Industries Limited as an assistant project engineer.

Mr. Carter has been associated with Canadian Refractories Limited at Kilmar, Que., and shortly after his graduation from the University of Manitoba in 1949 gained experience with Duplate Canada Limited at Oshawa, Ont.

J. C. Gilmore, JR.E.I.C., has been named assistant manager of the Port Arthur Public Utilities Commission, Port Arthur.

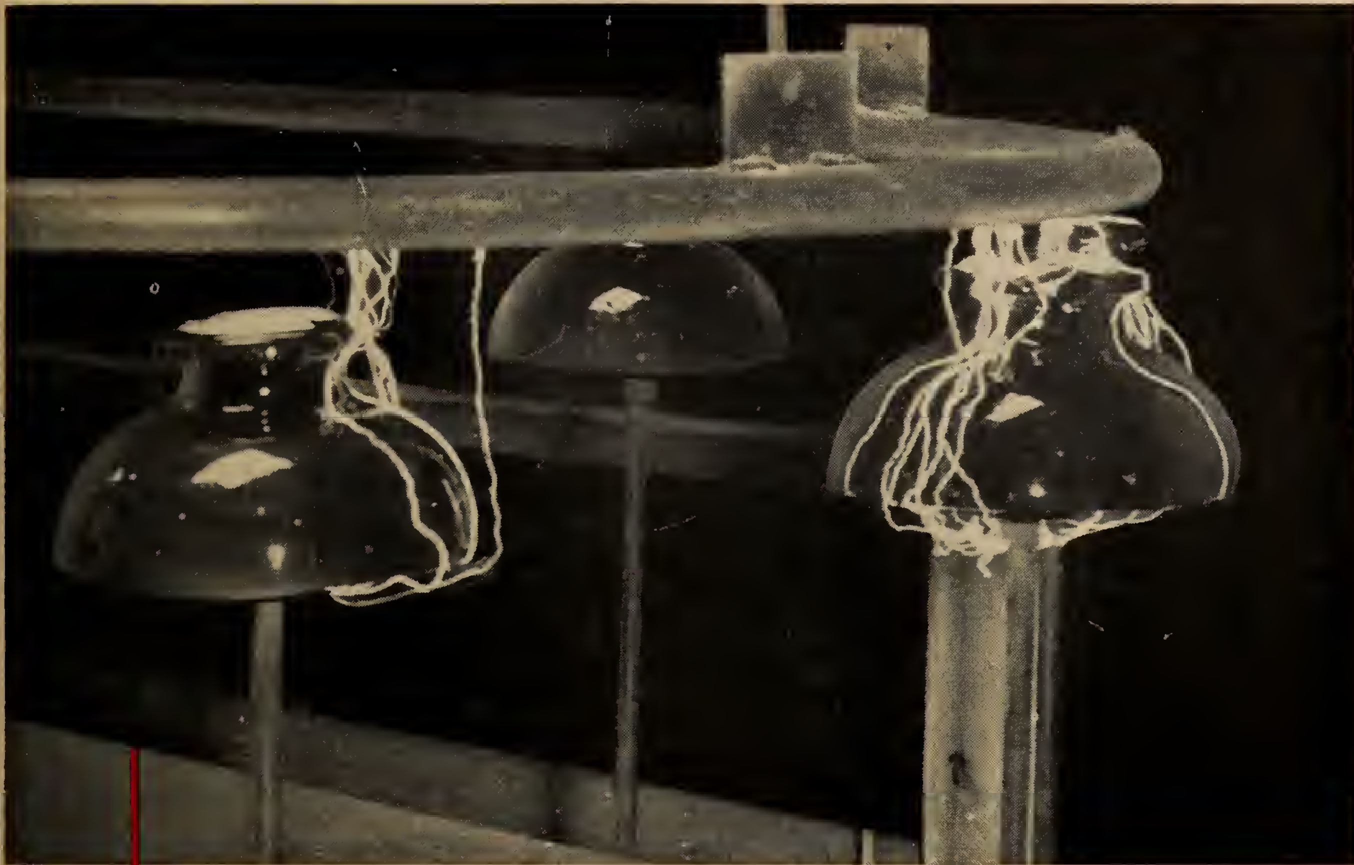
Mr. Gilmore has served the Commission for two years, since transferring his services from the Gatineau Power Company in Ottawa. He is a graduate of the University of Manitoba, class of 1949.

D. W. Durst, JR.E.I.C., a 1949 graduate of Cambridge University is employed as a development engineer with Hayward, Tyler and Company Limited, at Luton, Bedfordshire, England.

In 1951 he was associated with the Canadian General Electric Company Limited at Peterborough, Ont.

W. R. Hammond, JR.E.I.C., has accepted a position with Super Oil Seal Manufacturing Company Limited in Hamilton, Ont.

Most recently a design engineer with Martlin and Lawrie Limited, Hamilton, he has also been employed with Canadair Limited in the same capacity.



He is a University of Toronto graduate, class of 1953.

Robert J. Cream, JR.E.I.C., is employed as an economic analyst with Polymer Corporation's economics department at Sarnia, Ont.

A chemical engineering graduate with a B.Eng. degree awarded him in 1952 at McGill University, he has since been employed with Donnaconna Paper Company at Donnaconna, Que., and has been engaged in post-graduate studies in business administration at the University of Western Ontario.

R. L. Nordlund, JR.E.I.C., originally a graduate of the University of British Columbia, class of 1951, has returned to Canada from the University of Illinois where he was recently awarded a Ph.D. Degree in civil engineering. He has accepted a position with Raymond Concrete Pile Company in Vancouver.

Dr. Nordlund has also studied at the University of Texas. He received an M.Sc. degree in civil engineering from that university in 1954.

Eric E. Lang, JR.E.I.C., of Canadian Industries Limited, has received a transfer from the Brownsberg, Que., plant, where he has been methods engineer in the industrial engineering section, to the Millhaven works, at Kingston, Ont. where he will continue to hold the position of methods engineer.

Mr. Lang graduated from the University of Toronto in 1950 and then gained experience with Ford Motor Company and Bickle-Seagrave, Limited before joining the company he now serves.

Lieut. C. A. Leech, JR.E.I.C., a 1953 graduate of the University of Manitoba in civil engineering is serving a two-year term of duty with the First Field Squadron, R.C.E., Second Canadian Infantry Brigade Group in Germany.

Lieut. Leech was formerly with the Royal Canadian Engineers in Chilliwack, B.C.

J. M. S. Cherry, JR.E.I.C., is working as a civil engineer at Downsview, Ont., with the structural department of the firm of J. B. Parker and Associates, Toronto.

Mr. Cherry was employed with Canadian British Engineering Consultants of Toronto in 1955. He received a B.S.Eng. degree from Leeds University in 1954.

M. Erdstein, JR.E.I.C., a Purdue University graduate of 1955 with an M.Sc. in civil engineering has accepted an appointment as structural design engineer with Aluminium Laboratories Limited, in Montreal.

Earlier this year he was engaged in the same type of work with the Shawinigan Engineering Company Limited, Montreal.

W. J. Swanson, JR.E.I.C., has been transferred from the position of resident engineer on the DEW Line to work in the same capacity on the construction of a pulp mill at Thurso, Que., for the Foundation Company of Canada.

Mr. Swanson first became associated with the firm in 1951, on graduation from the University of British Columbia in civil engineering.

J. A. M. Bell, JR.E.I.C., until recently concerned with seismic work in Alberta has taken a position with Canadian Industries Limited, Vancouver, in the technical services section of the company's explosives division.

Mr. Bell obtained a B.Sc. degree in civil engineering at the University of New Brunswick in 1950.

George P. Miller, Jr.E.I.C., has been appointed to the engineering staff of L. E. Shaw Limited, Halifax, N.S.

Mr. Miller received a B.Eng. degree in civil engineering from the Nova Scotia Technical College in 1951 and then joined the Montreal Engineering Company Limited as a structural designer, remaining with the firm until the present time.

Raoul Verret, JR.E.I.C., has recently joined Werner Textile Consultants of New York. His first assignment with the firm of management consultants for the textile industry has taken him to Rio Grande do Sul, Brazil.

Previously employed with Dominion Textile Company in Valleyfield, Que.,

• PERSONALS

he is a graduate of the Ecole Polytechnique, class of 1952.

J. D. McIlveen, JR.E.I.C., formerly divisional supervisor (Eastern Canada) for Defence Construction (1951) Limited, in Ottawa, now holds the position of branch manager for the firm in Toronto.

He is a Queen's University graduate, formerly associated with the Central Mortgage and Housing Corporation, Toronto, and the Department of Highways.

John E. Sackville, JR.E.I.C., has joined Canadian Westinghouse Company Limited, industrial products division, at Hamilton, Ont. His position is that of associate engineer.

A University of Saskatchewan graduate in electrical engineering, class of 1950, Mr. Sackville has for some time served the firm of Wheaton Electric Company Limited in Saskatoon, Sask.

W. M. Carr, S.E.I.C., a graduate in mechanical engineering from the University of Toronto, class of 1955, holds the position of sales engineer with C. A. Dunham Company Limited in Hamilton, Ont. He also supervises the installation of heating equipment and services and advises on their maintenance.

A. O. Dyregrov, S.E.I.C., a 1955 graduate from the University of Manitiba. is employed with the St. Lawrence Seaway Authority in Montreal.

Kaare Hoeck, S.E.I.C., formerly at work with Haddin, Davis and Brown at Regina, Sask., has accepted employment with the Foundation of Canada Engineering Corporation Limited in Vancouver.

Mr. Hoeck followed civil and structural engineering studies in Denmark and raduated with an M.Sc. degree in 1955.

J. Claude Allard, S.E.I.C., a mechanical and electrical engineering graduate of the Ecole Polytechnique, class of 1955, has gone to Kingston, Jamaica where he is employed with Sprostons (Jamaica) Limited.

Until recently Mr. Allard was employed with the firm of J. A. Beauchemin and Associates, consulting engineers, in Montreal.

Georges Blouin, S.E.I.C., a 1950 graduate of Laval University in civil engineering is in La Oroya, Peru where he is employed with an American mining concern, the Cerro de Pasco Corporation. He holds the post of staff engineer in the construction department.

Jack B. Lutz, S.E.I.C., a Queen's University graduate of 1956 in mechanical engineering has found employment with Imperial Oil Limited, Sarnia, Ont.

G. A. D. Reed, S.E.I.C., a B.Eng. graduate in chemical engineering from McGill University, class of 1956, has joined the staff of Johnson and Johnson Limited, Montreal, in their new Canadian Research Centre.

NEWS OF THE BRANCHES

Activities of the Forty-Seven Branches of the Institute and abstracts of the papers presented at their meetings

HAMILTON

A. F. BARNARD, JR.E.I.C.,
Secretary-treasurer

W. A. H. FILER, JR.E.I.C.,
Branch News Editor

Tour of Aircraft Plant

The Hamilton Branch commenced its fall activities on September 14, 1956, with a tour of the De Havilland Aircraft plant at Downsview, Toronto. Some fifty members enjoyed an extremely well organized tour in groups of four or five with aeronautical engineers as guides. Aircraft production in general is similar to automobile production in so far as assembly line procedure is concerned. However the basic material is sheet aluminum instead of tin plate and there is much more custom work since there are many varied uses to which these planes are put.

Two planes currently in production, the Beaver and the Otter, have a similar basic structure for all orders but the future use of the aircraft determines whether it will be equipped with wheels, floats or skis and to some extent how the interior will be finished. The Beaver, a single-engined, high wing monoplane is now in operation in thirty countries throughout the world. Its uses vary from taxi service in South America to military service with the United States and Canadian armed forces. The Otter, a similar but larger plane capable of carrying ten people, is used on commercial air routes in Norway and also by the armed forces. Several are to be used in the Antarctic next year for survey work forming part of the Geophysical Year activities. These planes have been used extensively by bush pilots in northern Canada.

Major components of both these aircraft are fabricated by subcontractors and the assembly is completed at this plant. The Pratt and Whitney piston engines forming the power plant for these craft are not new. It is interesting to know that no new engines as such are in production but those used are completely rebuilt.

De Havilland is making a major contribution to both civilian and military air power. Bush pilots and air force pilots alike are assisted in their various roles by these sturdy craft.

Professional Development Program Re-Opens

The Professional Development Program sponsored by the Hamilton Branch began its courses on Wednesday, Sept. 19, with Registration Night. Applicants for the four groups totaled two hundred and ten. This course offers engineers continued education in non-technical subjects varying from public speaking to business administration. Hamilton can be proud that it has the largest of eleven such programs operating across Canada. An outline of the aims and operation of the program was given by the director, W. H. Hohn. Mr. J. J. Kelly, Hamilton Branch chairman, spoke on the advantages of membership in the Institute. Colonel J. M. Muir represented the Association of Professional Engineers of Ontario. Colonel L. F. Grant, field secretary of the E.I.C., and the originator of these programs in Canada, provided a history of the establishment and advance of them since 1950.

TECHNICAL SECTION

E. R. BUSHFIELD, JR.E.I.C.,
Chairman

Technical Section Formed

A technical section has been formed within the Hamilton Branch of the E.I.C. This has come about as a direct result of enthusiastic response to the technical questionnaire. Due to numerous requests a committee was formed consisting of D. B. Williamson, R. G. Vicarv, M. M. Kennedy, D. W. Hawes, G. Elliot and E. R. Bushfield

Because of the heavy response of the mechanical and electrical engineers to the survey, the committee sought a technical subject which would appeal to this group — and also appeal to the remaining members who were good enough to send us their opinions.

Lecture Program on Atomic Energy

The committee decided on "Atomic Energy" and proceeded to organize a lecture programme on this interesting science which will become such an important factor in daily and industrial living.

Having arrived this far the committee were then very fortunate in obtaining two well-known and personable nuclear physicists to conduct the program. These gentlemen are: Dr. M. W. Johns, of McMaster University, and Dr. D. M. Roberts of the Canadian Westinghouse Company.

The lectures and subsequent discussions are planned so that any member of the E.I.C. may come, learn and enjoy the science of nuclear energy. The course consists of six lectures beginning with the basic theory of nuclear composition — graduating to elementary reactor design. These lectures interlock so that any engineer can pick up the subject through regular attendance from the first lecture on. Two texts which will assist you in enjoying the nuclear subject will be used as reference.

Provides Grounding for Future Study

The approach is such that the groundwork this season will provide a position from which to move into more specialized nuclear fields in following years, provided sufficient interest is shown.

For the first year it has been decided to make no charge for the course to E.I.C. members, despite the considerable expense. Non-members will be charged $10.00 for the program.

Lectures were arranged for the first Monday of each of the winter months, from 8.00 to 10.30 p.m.: at Canadian Westinghouse Electronics Auditorium, Longwood Road.

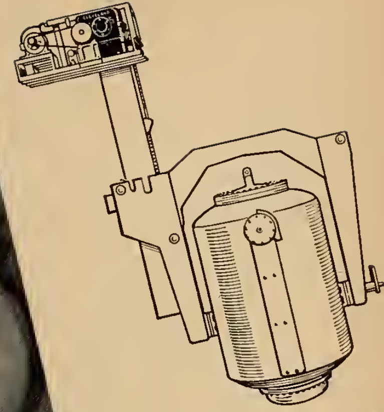
Outline of Lectures

Lecture 1—(October 1)	The nucleus and nuclear Radiations.
Lecture 2—(November 5)	Neutrons: The biological effects of radiation.
Lecture 3—(December 3)	The fission process and nuclear reactor principles.
Lecture 4—(January 7)	The reactor as a tool for industry.
Lecture 5—(February 4)	Nuclear reactor design.
Lecture 6—(March 4)	Problems of the reactor engineer.

KOOTENAY

G. T. J. HUGHES, M.E.I.C.,
Branch News Editor

The Kootenay Branch of the Institute, meeting over a turkey dinner in Trail,



Close-up of CLEVELAND Series 63F Double Reduction Worm Gear Speed Reducer used to raise and lower this G.E. 2-million volt X-Ray Tube Head.

CLEVELAND positions 2,000,000 volt X-ray machine

QUITE an X-ray machine, this—built by General Electric to serve the New England Deaconess Hospital in Boston, Mass. Quite a job, too, to raise and lower its head—it's heavy, it's delicate, and it has to be positioned accurately. That's why Cleveland was specified to transfer the speed of the motor into slow, smooth and dependable power.

For, with Cleveland worm gear speed reducers, smooth torque flow is assured by virtue of the sliding action of worm on gear. Constant angular velocity assures positive control. Precision matching of case-hardened steel worms to nickel-bronze gears insures 100% dependability.

Experience has demonstrated that a Cleveland actually improves with use. Even when operating under continued severe overloads, danger of sudden failure is remote. Thousands of Clevelands, in fact, operate for the life of driven machines.

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CLEVELAND Worm Gear Speed Reducers

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TRADE MARK REG'D.

PEACOCK BROTHERS LIMITED

B.C., on September 19, heard R. Fraser Mitchell, superintendent of maintenance and construction at the Warfield plant of Consolidated Mining and Smelting, describe his impressions of a recent trip to Hong Kong.

Visiting the East on a business trip sponsored by the International Co-operative Administration of New York, Mr. Mitchell went there to advise the Taiwanese on the starting of a new coke ammonia plant. Slides of rural, domestic and industrial life illustrated his talk and drew attention to the contrast between present day conditions in the Orient and in the West.

LETHBRIDGE

R. D. HALL, JR.E.I.C.,
Secretary-treasurer

Dr. L. B. Thomson Addresses Meeting at Vauxhall

The Lethbridge Branch was very sorry to hear of the recent death of Dr. L. B. Thomson of Regina, director of P.F.R.A. Dr. Thomson had addressed the dinner meeting following a trip to The Bow River Project of the P.F.R.A., on Saturday, September 15, 1956. A personal friend of a number of Lethbridge Branch members, Dr. Thomson was well known and held in high esteem by his associates and his staff, a number of whom belong to the Lethbridge Branch.

Trip To Bow River Project

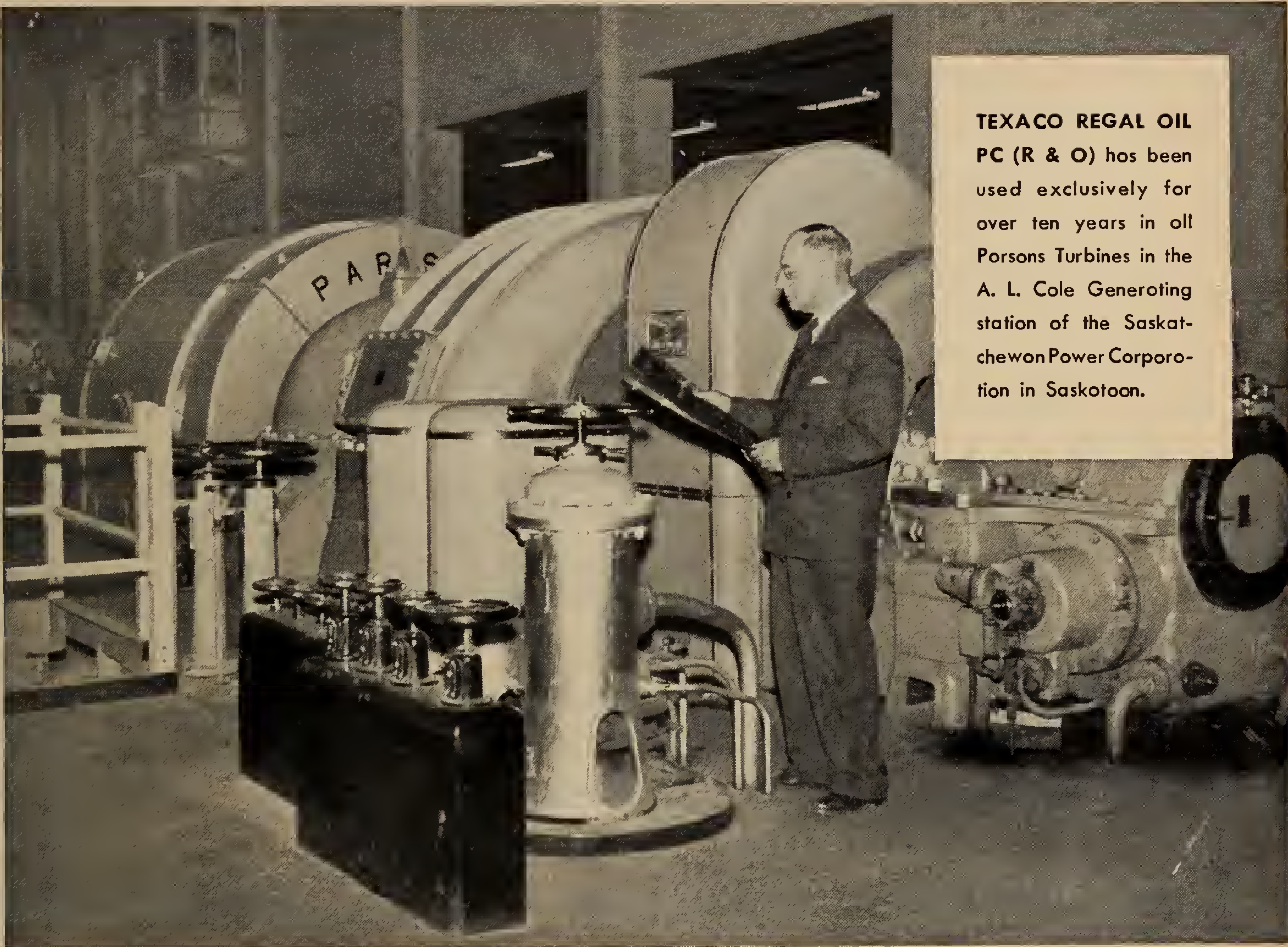
Some 50 members of the Branch and their wives toured a portion of the Bow River project of the P.F.R.A. commencing at the Travers dam, about 40 miles north of Lethbridge.

Travers dam is 3,000 ft. long, 1,000 ft. wide at the base, of earth fill construction and containing some 4½ million cu. yds. of earth and gravel fill. It was built at a cost of 2½ million dollars and serves the double purpose of eliminating 6 miles of steep and sliding sidehill canal and provides 100,000 acre feet of live water storage in the reservoir.

From Travers Dam the party followed the main canal, past the Little Bow Dam and reservoir and visited a number of concrete drops and check structures. The tour terminated at the Expanse Coulee siphon, an inverted siphon of wood stave construction, 4,810 feet long, 10½ ft. in diameter.

The portion of the project toured was the central portion of this undertaking. The whole project extends from the Bow River diversion works at Carsland, 30 miles south east of Calgary, for some 140 miles to Medicine Hat. Ultimately 227,200 acres of land will be irrigated. and about 99,000 have water available at present.

W. F. Hall, M.E.I.C., and W. D. Gray.



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REG. T. M.

• BRANCH NEWS

M.E.I.C., were in charge of the tour. Mr. Hall and other Vauxhall members looked after arrangements for the field trip and dinner meeting.

Vauxhall Laboratories

Following the tour, a visit was made to the Vauxhall laboratories, operated jointly by the P.F.R.A. drainage division and the Dominion Experimental Station, Department of Agriculture. It was noted that the work of soils testing for suitability to irrigation; drainage without which land under irrigation soon becomes ruined by alkalinity; and development and testing of suitable crops is some of the work carried on at this station. E. A. Olafson, M.E.I.C., outlined the work performed by the P.F.R.A. and W. L. Jacobson briefly described the projects carried out by the Dominion Experimental Station.

Dinner Meeting

Members and their wives enjoyed a cocktail hour and dinner at the P.F.R.A. station following the tours. A. J. Branch, chairman of the Lethbridge Branch was in charge of the dinner meeting.

Mr. Olafson introduced the speaker, paying tribute to the part he has played in the development of irrigation in Western Canada.

Some Aspects of Irrigation Development

In his address, the late Dr. Thomson stressed the need for teamwork between agriculturists and engineers in irrigation development.

P.F.R.A., which had its beginning in depression years sought to reduce the drought problem then being experienced. Investigations were made into problems of soil drifting, water storage and land suitability. P.F.R.A. has spent about 20 million dollars in an effort to bring a better balance to agriculture. Wheat is still Canada's number one industry, with pulp number two. The movement of people from unsuitable to suitable land is one of the major projects in Canada's irrigation development. Dr. Fairfield, former head of the Dominion Experimental Station at Lethbridge was credited with the successful promotion of the Lethbridge Northern Irrigation Project. This project together with the St. Mary's and Milk River Irrigation Development under the joint efforts of federal and provincial governments has resulted in expenditures of between 40 and 50 millions of dollars.

Projects under development or planning now include the Red Deer projects which will irrigate 400,000 acres, and the South Saskatchewan River project which will assist in water conservation and irrigate 600,000 acres of land.

Drainage is important if land is to remain productive, and the biggest job is to make the most efficient use of land, which in turn is responsible for the largest portion of Canadian economy.

In conclusion the speaker stressed again the need for continuing co-operation between members of the agricultural and engineering professions, and cautioned all persons in irrigation work to constantly consider the men who are to farm and are farming irrigated lands.

OTTAWA

STEWART G. FROST, JR.E.I.C.,
Branch News Editor

Talk by R. G. Johnson Opens Program For 1956-57

Over $925 million worth of contracts have been processed by Defence Construction (1951) Limited during its six years of operations. This was disclosed by R. G. Johnson, president and general manager of D.C.L., speaking to the Ottawa Branch at a luncheon meeting on September 10, 1956.

Mr. Johnson outlined the wide range of activities of his crown corporation; from dams to gate houses, from Pakistan to France. New construction work is being awarded at the rate of $12 million per month, mainly buildings, and is being performed at a rate of half a million a day.

Need for Construction Management

Speaking of the construction industry, Mr. Johnson stressed the need for construction management. Small family size construction firms are finding it necessary to merge into large companies in order to meet the need for proper planning and management of large complicated projects. Men with sound engineering knowledge and experience and capable of assuming administrative and management positions are urgently needed.

He added that winter construction must be increased, explaining that D.C.L. had been forced into winter construction due to the urgency of its work, and was now carrying out almost half its work each year between November and April. Some extra costs are involved but these must be accepted if progress is to come.

Mr. Johnson's talk opened the 56-57 program of the Ottawa Branch. Other luncheons will be addressed by Premier J. S. Smallwood of Newfoundland and Mr. D. C. MacCallum of Racey-MacCallum Associates. A field trip to the St. Lawrence Seaway and an Architects'—Engineers' Dance are also planned.

SARNIA

T. H. DOBBIN, M.E.I.C.,
Secretary

K. J. RADCLIFFE, JR.E.I.C.,
Branch News Editor

The first meeting of the Sarnia Branch of the Institute this season was held on

Sept. 27, 1956, at the Vendome Hotel with Charles Phelps, M.E.I.C., chairman of the Sarnia Branch of the Institute presiding at the meeting. Guest speaker was J. R. Nickolson, who was at one time associated with the Polymer Corporation in Sarnia, as general manager and later as executive vice-president. Recently returned from Brazil, where he was vice-president of the Brazilian Traction and Power Corporation and senior resident executive officer in that country until his resignation last spring, Mr. Nickolson was introduced by G. R. Henderson, M.E.I.C., and addressed the group on "Modern Developments in Brazil".

Too Rapid Development a Problem

Mainly a result of too rapid development of the country, are the problems arising in Brazil today, Mr. Nicholson felt after five years residence in the country, noting that it is trying to go from an oxcart to a jet plane economy overnight. As an example he described the major power development with which he was associated in the South American Republic--the Lagos underground power plant, and the Paraiba-Parai River diversion. In less than five years the entire project, which included diversion of two major rivers, construction of tunnels through solid rock, construction of dams, penstocks and powerhouses was completed, as well as the new power station, adding 350,000 kilowatts of power to the system, which feeds Rio de Janiero and Sao Paulo.

He said that the pumps which raise water from one intermediate reservoir to a second, 115 feet above it, have a capacity of 10,000 gallons per second each, and four pumps are in constant use.

Twelfth Annual Dance

MONTREAL BRANCH — JUNIOR SECTION

on

NOVEMBER 23, 1956

at

Sheraton-Mount Royal Hotel
Champlain Room

A feature of this dance will be a fashion show, presented by France-Del Modes, with furs by Reid, hats by Yvette Brillon, jewels by Jane Harvey.

Fashion Show — 8:30 p.m. Price — $5.00 per couple
Dancing — 10:00 p.m. — $2.00 per couple (for students)

Music by Stan Bankley's Orchestra and Trio

Tickets available from:—
E.I.C. Headquarters—PL 5078
D. H. Walkington—PL 2211, loc. 504
J. A. Laporte—RI 8-7361 — office
DE 4191 — home

Door Prizes and Novelties Dress Optional

D. H. Walkington — entertainment

Total output of Brazilian Traction and its subsidiaries now is 1,700,000 kilowatts, or about twice the output when Mr. Nickolson went to Brazil five years ago.

Mr. Nickolson added that while political upsets in the country have contributed to making life difficult for senior executive or administrative officials in Brazil, and economic unrest, due to a period of drought has also accentuated the nation's difficulties. However, the sense of humor, seldom lacking in Brazil, keeps it from being as difficult a country as it might be, in which to live and do a good job.

Ted Dill, M.E.I.C., thanked Mr. Nickolson for the seventy-five members and guests present.

Sao Paulo—City of Skyscrapers

Sao Paulo, a city of Skyscrapers, studded and surrounded by modern factories producing textiles, high quality footwear, automotive, glass, electrical, chemical, rubber, steel and countless other products, has grown from less than 400,000 people to nearly 2,700,000 in thirty-five years. This growth is due largely to the ready availability of power.

Natural resources, which include deposits of manganese, bauxite, tungsten and nuclear metals, gold, precious and

Described on the following pages is a field trip undertaken by the Vancouver Branch to Crown Zellerbach Box and Paper Converting plant, Lulu Island. Shown above are, left to right, S. S. Lefeaux, Branch chairman, Art Morrow, engineer, Don Carlson, director of public relations, W. C. Gigler, plant manager, and F. Webb, production manager of the converting plant.

*

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*ADVANTAGES OF RAYMOND CONCRETE PILES... Number four of a series

THE 5 TYPES OF RAYMOND PILES SHOWN... from left to right

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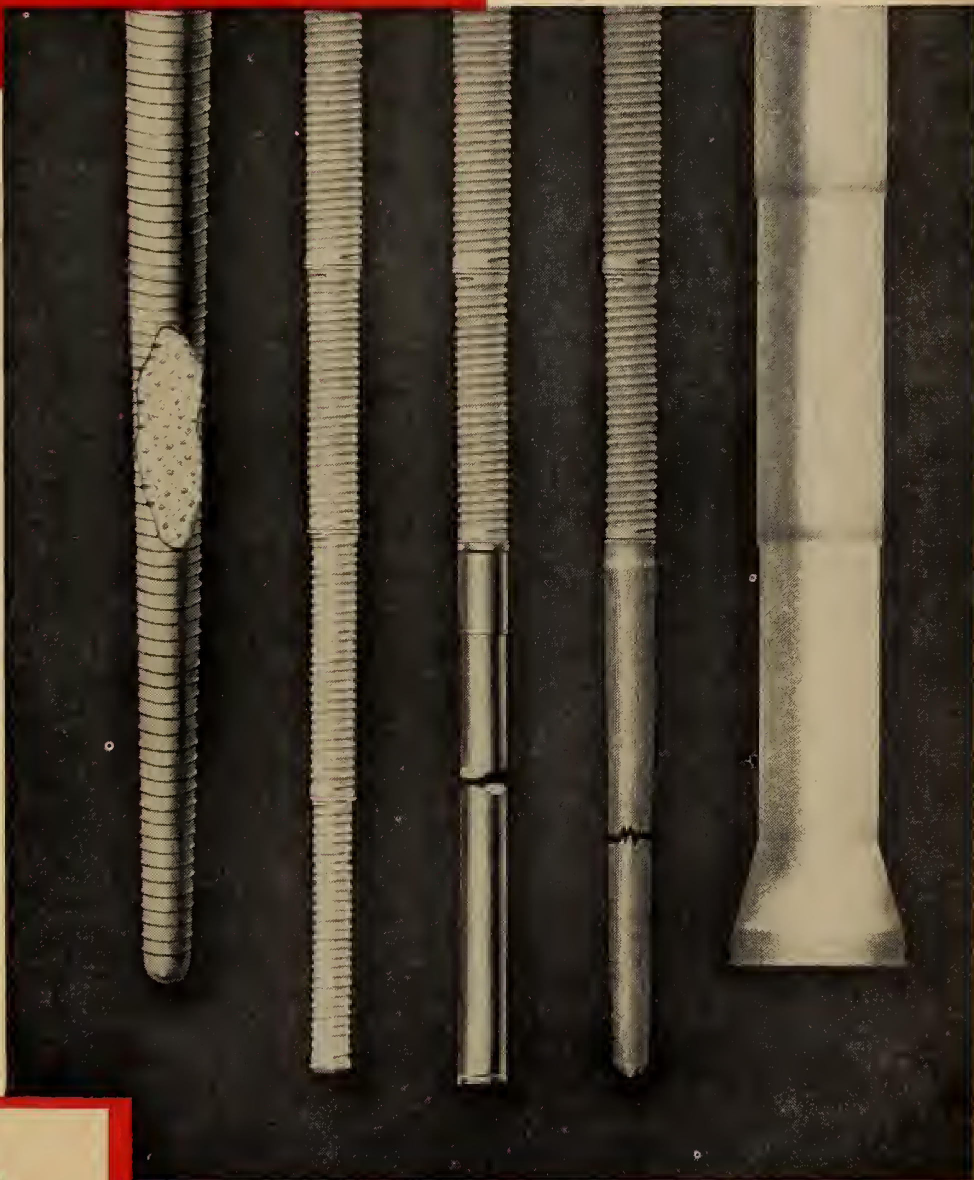
WOOD COMPOSITE • CAISSON



REGARDLESS of the subsoil conditions there's a Raymond Pile specifically designed to do the job safely and onomically. The *Standard Pile* with its heavy taper is ideal as a friction pile. The *Step-Taper Pile* is used where it is desirable for the pile to ach a hard stratum at a considerable depth. The *Pipe Step-Taper Pile* is used where piles of great length are required. *Wood Composite Piles* combine the advantage of the permanence of concrete piles with the low cost of wood piles. *Raymond Gow Caissons* are efficient and economical for supporting heavy concentrated loads under certain soil conditions.

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AROUND THE WORLD FOUNDED 1897

semi-precious stones, and a tremendous oil potential also play a major part in the development of Brazil.

VANCOUVER

A. D. CRONK, JR.E.I.C.,
Secretary

T. F. HADWIN, M.E.I.C,.
Branch News Editor

The 1956-57 program committee of the Vancouver Branch of the Institute arranged a fall program which had sufficient variety to appeal to all members, with their wives not forgotten. Also the newly formed structural section of the Branch prepared an attractive schedule of papers up to November.

On September 26, 1956, H. T. Libby, M.E.I.C., spoke on "How Natural Gas Will be Introduced to Vancouver". The meeting of October 13 featured "Ladies Night", with games and dancing, and on October 24, J. T. Madill, M.E.I.C., addressed members on "Installation and Operating Experiences with 2500 foot Head Kemano Impulse Turbines". Field trips were organized to Crown Zellerbach Box and Paper Converting plant and to Sicks' Capilano Brewery, where a succession of small parties also visited.

The Structural Section met on September 18 to hear O. Safir, M.E.I.C., discuss "Precast Concrete Construction," and on October 16, L. Narod, M.E.I.C., spoke on "The Design of the La Connor Bridge". On November 13, P. Christofferson addressed the group on "Structural Design Using Model Analysis".

Field Trip

The Branch chairman, S. S. Lefeaux, was successful in negotiating a pre-official opening inspection of the new Crown Zellerbach box and paper converting plant on Lulu Island on September 18. The thirty visiting members of the Institute were met by executives of the plant, including W. C. Gigler, plant manager, R. Dyrsmid, resident engineer, A. Morrow, engineer, O. Carlson, public relations manager, and F. Webb, production manager.

Building

The main building has an area of about 8½ acres and is the second largest area under one roof in Canada. The foundation for the building on river silt presented many problems and the walls are of precast construction. A visitor is struck by the lack of obstructions and excellence of lighting.

Ramp

Paper is brought to the plant by barge from Ocean Falls and ultra-modern facilities are provided for the efficient unloading of this paper to railway cars for transhipment or to the factory for con-

(Continued on Page 1602)

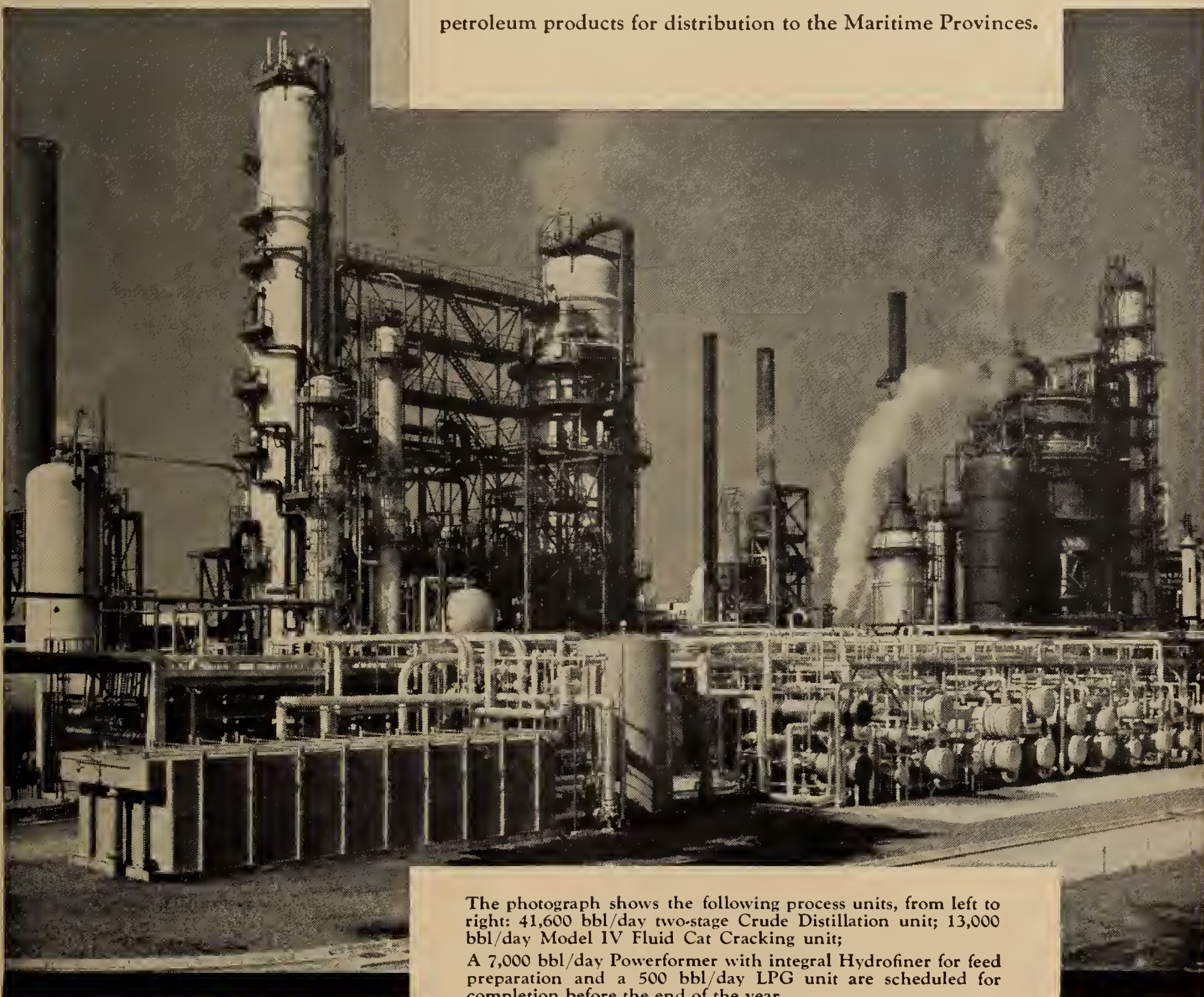
"On Stream"......

A COMPLETE GASOLINE-FUEL OIL REFINERY FOR

IMPERIAL OIL LIMITED

At the Halifax plant of Imperial Oil Limited, a completely new and up-to-date refinery is now "On Stream". All the processing units and the utility plant were designed and constructed by Foster Wheeler.

On the occasion of the formal opening, Foster Wheeler welcomes the opportunity to congratulate Imperial Oil on the completion of their modern refining facilities producing superior quality petroleum products for distribution to the Maritime Provinces.



The photograph shows the following process units, from left to right: 41,600 bbl/day two-stage Crude Distillation unit; 13,000 bbl/day Model IV Fluid Cat Cracking unit;

A 7,000 bbl/day Powerformer with integral Hydrofiner for feed preparation and a 500 bbl/day LPG unit are scheduled for completion before the end of the year.

FW-56-15

FOSTER FW WHEELER

HALIFAX • MONTREAL • TORONTO • **ST. CATHARINES, ONTARIO** • WINNIPEG • EDMONTON • VANCOUVER

News of Other Societies

CGRA Meets at Quebec

The annual convention of the Canadian Good Roads Association was held at the Chateau Frontenac, Quebec City, October 2 to 5, with an attendance exceeding 1000.

The Hon. P. A. Gagliardi, minister of Highways for British Columbia, was elected president of the Association for the coming year.

Roads Roundup

The Tuesday afternoon session was devoted to 'Roads Roundup', the annual feature in which reports are presented by highway officials, as follows:

Trans Canada Highway

At the time of the federal-provincial highway conference held in Ottawa November 14-15, 1955, there was not more than 10 per cent of the mileage of the trans-Canada highway within any province on which no highway existed. To accelerate construction, Ottawa proposed increasing federal participation by 40 per cent on 10 per cent of the highway, contingent on completion of a good standard of paved road by the end of 1960, and on maintenance by provinces of outlays excluding the 10 per cent share on selected sections equal to their average for 1954-55. The maximum limit to be contributed by Canada was increased from $150 to $250 million.

Up to September 15, commitments for the year by nine provinces over the past seven years totalled $285 million. Total mileage in participating provinces and national parks is some 4,470 miles, of which 2,356 miles have been approved for grading with 1,990 miles completed. Some 1,625 miles are approved for paving with 1,348 miles completed. Added thereto is 1,320 miles of paved road along the designated route built prior to 1949.

British Columbia

With a 1956 highway budget of $80 million, British Columbia is exceeding even last year's record. A total of 149 miles of highway has been built, 62 of which were on the trans Canada highway and the balance on other arterial highways.

291 miles of Trans Canada is now built to standard; 95 miles are paved to low standard; 90 miles are under construction; 19 miles are gravel-surfaced, and 90 miles are under survey; a total of 585 miles through the province. Due to a change of location from the Big Bend to the Rogers Pass route because of the Mica Creek dam, the distance has been reduced by 100 miles. The province now has a total of 2,498 miles of good highway, paved to a high standard.

The province is pioneering with a four lane highway tunnel under the south arm of the Fraser River at Vancouver. From today's date it will take 2½ years to complete.

During the year, 21 bridges were built by contract at a cost of $3.8 million, exclusive of bridges built under the Toll Bridges and Highway Authority. Of the major toll bridges the Agassiz-Rosedale will be the first to be completed, in October. To follow are the Oak Street bridge at Vancouver over the Fraser River, in May 1957; the $15 million Second Narrows bridge in three years; and the bridge over the Kootenay River at Nelson, to be opened by October, 1957.

Alberta

Alberta appropriated $61.9 million for highways in 1956. Of this $32 million will be spent on provincial highways, and $7.5 million on the trans Canada highway. Municipal maintenance and grants will total $8.5 million; $6.5 million was voted for bridges, $6.25 million for bridge maintenance and $3.7 million on highway maintenance.

Greater emphasis was placed on paving, with 267 miles base course and 308 miles of asphaltic plant mix. 324 miles of subgrade and grade will be built and more than 257 miles will be gravel-surfaced, as well as 22 major bridges and two grade separation structures.

The trans Canada highway is practically complete from the Saskatchewan border to Calgary. 67 miles from there to Banff is under construction. The province's four lane divided highway program has been given prominence, with 39 miles completed and 43 more miles graded.

Saskatchewan

1956 will establish a record in highway improvement. The province appropriated $19.7 million and total expenditure including the TCH will exceed $26 million. This excludes expenditure on local roads by grants and other services. There was a large carry-over from 1955. Wet weather in June and July retarded surfacing. Construction equipment has been short of demand. Supply of materials has been adequate and no serious labour shortage occurred, though engineers are scarce.

All trans Canada highway work excepting 5 miles of surfacing and some seal coating is completed. New pavement is complete from the Manitoba border to Regina and between a point 70 miles west of Swift Current and the Alberta border. There is a completely paved route across the province.

Manitoba

Manitoba's overall program may be summarized as follows: (a) Early completion of the trans Canada highway and international connections; (b) Reconstruction to modern standards of the existing provincial trunk highway system; (c) Extension of the system into established production areas; (d) Construction of development roads into areas of potential natural resources.

Extension of the TCH agreement has permitted a reversion to stage construction on certain sections. Highway budgets at all levels were increased for the past season. The cabinet approved a resurfacing program equal to nearly half the total annual vote. The early part of the season saw most road building equipment and personnel engaged on a system of permanent diking in the Greater Winnipeg area.

Ontario

Total highway expenditure for Ontario in 1956 will probably amount to $226 million, calling for 800 miles of new paving, 350 miles of resurfacing, 780 miles of grading and 156 structures. Tenders are being called for $25 million of new work to begin in 1956.

Up to the end of August 312 miles of dual highway, most of it controlled access, had been completed, with another 140 miles under construction. Every effort is being made to complete key sections of the trans-provincial controlled-access highway 401, 504 miles long. There is now a complete by-pass across metropolitan Toronto east and west. Another 26 miles from Tilbury to Windsor and 20 miles at Kingston, 140 miles of '401' is open for traffic, with an additional 38 miles expected to be opened by bypassing cities in western Ontario.

The Queen Elizabeth Way is resur-

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to assure extra belt life ...equal pull...less slippage

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BELT MATCHING IS MIGHTY IMPORTANT AT GOODYEAR! Each set of Goodyear Multi-V belts is subjected to length inspection on a precision matching machine. Each V-belt must match . . . must measure up to its companions in the set . . . and the set can be identified by the red tag.

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For complete information write or call your nearest Goodyear office at—Moncton, St. John, Quebec City, Montreal, Toronto, London, Windsor, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Vancouver, or Head Office, New Toronto.

faced from Burlington to Niagara. Work on the Burlington Skyway bridge is progressing well and is scheduled to open early in 1958. The Allumette bridge near Pembroke will be completed in October.

This year a five-year program for completion of Ontario's 1,465 mile share of the trans Canada highway was begun at a cost of $75 million. This calls for annual expenditure of $15 million.

Quebec

Quebec's highway budget was increased from $50 million in 1950 to over $100 million for 1956. During the last year 670 miles of asphalt and concrete roads were completed; grading and gravelling were done on 521 miles of main highway, and 1,000 miles of rural roads were rebuilt or improved. Highways leading to adjoining provinces were improved and in some cases rebuilt to Trans Canada standards. Last winter 25,000 miles were maintained and kept open at a cost of $7 million.

The main highway on the Gaspe peninsula is near completion and Lake St. John and Saguenay highways have been completed this year. The Quebec-Murray Bay section of the Quebec-Seven Islands highway was also completed this season but the balance will take two or more years to complete. By year-end Quebec's road network of 45,000 miles will have 31,000 miles of improved road —9,000 paved with concrete or asphalt; thus 72 per cent of the network is in good condition.

New Brunswick

For 1956 the province allocated approximately $7 million from capital account for roads and bridges. An additional $14½ million was earmarked for roads and bridges including maintenance for same, plus ferries, etc.

This year the province is laying some 52 miles of new pavement and another 44 miles of recap on existing pavements, on pavements where recap could carry them along for a reasonable time. By year's end some 324 miles of surface treatment will be finished, plus some 114 miles of seal coating. About 263 miles of grading and gravelling projects were also scheduled for the year.

An extensive bridge building program includes new large bridges at Fredericton, Hartland, Rexton, Andover, Coles Island, Eel River, and Edmundston. Design is completed for two bridges at Oromocto for access to the army camp at Gagetown.

Nova Scotia

Nova Scotia will spend over $13 million on maintenance and $12 million for capital construction including the trans Canada highway. Thirty miles of grading and 18 miles of paving on the Trans Canada will be done in 1956, as well as preparing 80 miles for paving, and paving 140 miles on other highways, all by contract. Fifty miles of highway will be paved by the Roads Department. The province this year will thus have at least 208 miles of new pavement.

Prince Edward Island

During the current year, the province built 10½ miles of subgrade, 7 miles of concrete pavement and 17½ miles of asphalt pavement for the trans Canada highway, completing 90 per cent of the province's TCH mileage.

Elsewhere the hot plant mix asphalt road total is being increased by 5 per cent and light pavement is also being increased. Construction of gravelled roads will be less than in previous years.

Newfoundland

The province's reconstruction program for 1956 is about the same as for 1955, with work limited to improvement of drainage and addition of ballast, so that a greater mileage can be conditioned for traffic during spring breakup. No paving is being built this year.

Construction of the trans Canada highway now permits traffic from Port au Basques to a point 35 miles east of Gander airport. Between there and Clarenville a 50-mile gap occurs, over which the C.N.R. operates a daily rail-car ferry. Contracts are being let for 16 miles of this section for completion in 1957. It is then proposed to operate a car ferry on the two-mile stretch of water at Clode Sound on Bonavista Bay, making road travel possible for the full 600 miles from Port au Basques to St. John's.

Since 1949 the province's highway program has made road travel available to 150 communities having a population of 50,000. Almost a fourth of the province's population has been connected with a central highway system.

The Hon. Antonio Talbot, retiring president of CGRA, addressing the meeting, said, "Bearing in mind all the obvious limitations and possibilities for substantial error inherent in long-range estimates, we can predict that up to $30 billion may have to be spent on the construction and maintenance of Canada's roads and streets in the next 25 years. This would imply an average annual road expenditure of $1,200 millions for the next quarter century, or not quite double the amount devoted to road purposes this year."

National Forestry Conference

The first National Forestry Conference in fifty years was held on September 17, 18 and 19 in the Fort Garry Hotel in Winnipeg. Sponsored by the Canadian Forestry Association, The Canadian Chamber of Commerce, the Canadian Institute of Forestry and the Engineering Institute of Canada, the Conference was the first step in the establishment of a strong partnership between the public owning the forests, and private individuals and industry harvesting, fabricating and marketing their produce. The Conference was a public forum—not a pressure group—which allowed the various non-forest elements of Canadian life and its people along with officers of the governments to whom the care of our forests had been entrusted, to sit down with those in the forest industries and other private forestry organizations to study forestry problems and opportunities and to determine what can be done to meet and grasp them.

Lowell Besley, Chairman, Woodlands Research Department, Pulp and Paper Research Institute of Canada, delivering the theme address on September 17 pointed out that it would be difficult to over-estimate the value of the forest industries to Canada's economy. "Their net value of production", he said, "every year is more than a tenth of Canada's entire net national income. They are furnishing more than a third of Canada's domestic exports and contribute well over a billion dollars a year towards a favourable balance of trade . . . the forest industries are maintaining and even increasing their importance in Canada's economy."

Mr. Besley expressed his belief that the people of Canada — vigorous, energetic and creative — will seize their wonderful opportunities and face up to their responsibilities of managing the forests, which they themselves own, as the living and renewable resources which these forests are. Mr. Besley went on to say that Canada's forests will properly respond to good treatment and will produce in the years to come greater and greater wealth and better living for all Canadians. "But to bring about this happy state of affairs, we must first learn to appreciate what we have now, we must secondly learn what is required to establish our forests as a truly going concern, and lastly, but most important of all, we must put our forests to work producing wood and fibre to be fashioned into the thousands of products so useful to man."

G. S. Thorvaldson, Q.C., past president of the Canadian Chamber, addressing a luncheon meeting of the Conference on September 19 told his audience "that it is good business to see to it that everything possible is done to ensure perpetual crops of timber in this great country of ours. This calls for a public awareness of the value of forestry in our economy, which must be done largely through education."

During the three day Conference a great deal of valuable information was made available to the 130 delegates and to Canadians generally through the medium of the press. It is sincerely to be hoped that this "first step" will be but the beginning of an educational process which cannot help but result in benefit to all Canadians.

Reprinted from Newsletter of the Canadian Chamber of Commerce, No. 166.

PICTURE OF A MOUNTAIN ON THE MOVE

THROUGH THIS PIPELINE, solids are travelling. Every hour of every day, at one of the largest mines in Northern Ontario, thousands of tons of ore concentrates are pumped along pipes like this. Over the year, if you gathered all that material together, it would make a sizeable mountain.

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• NEWS OF OTHER SOCIETIES

Calendar

Aeronautics

The Canadian Aeronautical Institute (Commonwealth Bldg., Metcalfe St., Ottawa) and the Institute of the Aeronautical Sciences will hold the 1956 international meeting on November 26 and 27 at the Royal York Hotel, Toronto.

Chemical Engineering

The annual meeting of the American Institute of Chemical Engineers (25 West 45th St., New York 36) will be held at the Hotel Statler, Boston, December 9-12, 1956.

The ninth national chemical exposition, is scheduled for November 27 to 30, 1956, at the Cleveland Public Auditorium. It is sponsored by sections of the American Chemical Society.

Welding

An invitation is extended to Canadian engineers to attend the annual assembly of the International Institute of Welding, at Essen, Germany, June 29 to July 6, 1957.

Canadian engineers were also invited to present at this meeting unpublished papers on the metallurgy of welding, under the following topical headings: Gas Absorption and Its Influence on Weld Metal; The Behaviour of Welds as Regards Aging and Caustic Embrittlement; The Metallurgy of Brazing; The Metallurgy of the Welding of Stainless and Heat Resisting Steels of Ferritic, Semiferritic and Austenitic Types; The Metallurgy of the Welding of Non-ferrous Metals: titanium and its alloys, magnesium and its alloys, aluminum and its alloys; nickel and its alloys.

Titles of papers and information about the authors were requested by the Canadian Council of I.I.W., so that this information could be transmitted to the German Committee by November 15. The full paper must be submitted by December 31, 1956.

In the matter of receiving papers the responsible Canadian Committee members are R. A. Dunn, general sales manager, Canadian Liquid Air Company Limited, 1111 Beaver Hall Hill, Montreal; and R. W. Stickney, Canadian Welding Bureau, 1393 Yonge St., Toronto.

Mr. Dunn and Mr. Stickney are the provisional chairman and executive secretary, respectively, of the provisional Canadian Council for the International Institute of Welding, recently formed. Further information about the formation of the Canadian Council will appear in an early issue of the Journal.

Steel

Fifty years of electric furnace steelmaking will be celebrated at the annual electric furnace steel conference, sponsored by the American Institute of Mining, Metallurgical and Petroleum Engineers, 29 West thirty-ninth Street, New York 18.

The conference will be held in December 5-7, 1956, in the Morrison Hotel, Chicago.

Soil Mechanics

The Associate Committee on Soil and Snow Mechanics of the National Research Council of Canada, will hold the tenth Canadian Soil Mechanics Conference in Ottawa, December 17 and 18, 1956. Landslides will be the main theme of the conference.

Anyone interested in the field of soil mechanics is invited to attend. Further information can be obtained from Edward Penner, c/o Division of Building Research, N.R.C., Ottawa 2.

IATA Meets in Edinburgh

The twelfth annual general meeting of the International Air Transport Association was held in Edinburgh September 17 to 21, 1956. Lord Douglas of Kirtleside, chairman of British European Airways, took office as the new president of IATA, succeeding Juan T. Trippe, president of Pan American World Airways.

Sir William P. Hildred, the director general, told presidents of the association's 74 member carriers that while prospects are good for greatly increased traffic by 1960 to fill the jetliners they have ordered, airlines are being pressed to continue fare reductions at a time when their margin of profit on all operations is only 1.1 per cent and their international operations as such show an actual loss. "With profits consistently cut to less than a bare minimum we could not withstand for long any decline in traffic," he warned.

Hildred reported that 1955 traffic results "gave the lie direct to those who said the expansion in air transport could only go on at a decreasing rate". Passenger traffic went up 16 per cent during last year, as compared with a 13 per cent increase in 1954; while in 1955 rate of increase in cargo was 18 per cent after hovering at 10 per cent during three previous years. He said, however, that a 14 per cent increase in mail loads was "somewhat disappointing."

North Atlantic traffic rose 19 per cent to a total of 700,000 passengers in 1955. "It will not be long before the airlines carry a million people a year across the Atlantic — and when we do, we shall be carrying as many as the ships do now," he predicted. Total revenues of all airlines from both domestic and international operations were just over $3 billion last year, but operating profit was only $33 million before taxes, interest and similar charges. "On international operations alone," he said, "we appear to be making a $3 million loss."

Reporting that the airlines will in the next few years add to their fleets anything between 200 and 300 jet aircraft, he pointed out that "each new jet aircraft on order will be able to carry more passengers in a year than a large transatlantic liner like the Queen Mary; and their overall capacity will exceed by a substantial margin that of the existing IATA fleet of 2,500 aircraft."

Hildred said his own forecast of the future, "lies halfway between the extremes" of those who hold that the airlines have gone on "an irresponsible equipment spree" and those who believe there will be more traffic than even the jets can carry. But he cautioned that to fill their capacity in the 1960s, "airlines must find out how to go all out for the mass market and recommend to governments a fare pared down to the lowest level consistent with sound operation."

The advent of the jet "had emphasized the obsolescence of current facilities and services, magnified the problems of inadequate and crowded airways and had raised weighty technical and economic questions," Hildred declared. "The airlines have invested hundreds of millions in new equipment to make air travel available to a far greater number of people."

"Operation of jets will require substantial improvements in air traffic control," Hildred said. He attacked the unnatural and outmoded practice "of setting up air traffic control areas on the basis of national boundaries," asserting that with the jet these areas will be "totally impracticable." Better training and status for "that much abused and seldom praised individual, the air traffic control officer," was also recommended, he said. The ATC officer should have as personal a part in the operation as the flight crew themselves. Jets would also require more up to date and better co-ordinated airport buildings and apron facilities to speed ground handling.

The high speeds of jet aircraft and the need to get maximum use out of them will make aviation "a round the clock operation" by 1960, Hildred declared. Passengers will have to accustom themselves to departures at any time of the day or night and airports, airline offices and customs and immigration checkpoints will have to provide full facilities at any time of the day or night.


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Library Notes

Additions to the Institute library
Reviews, Book Notes
Standards

BOOK REVIEW

Noranda.

Leslie Roberts. Toronto, Clarke, Irwin, 1956. 223 p., illus., $5.00.

The history of the growth of the city of Noranda and the company from which it takes its name is a part of the history of the growth of Canada, and finds many parallels in the vast expansion which is taking place in the Canadian North today.

When Ed Horne was prospecting in the wilderness Rouyn area of northwestern Quebec forty years ago, the Province's vast mineral potential was practically untapped, and its extent was unknown. In those days the search was for gold; today there are many minerals of interest to the prospector and mine owner.

Leslie Roberts begins the story of Noranda in the days when Ed Horne, with a grub-stake of $225, went by canoe to the present site of the mine. He tells of the difficulties of the prospectors, the efforts to form a company, the early explorations, the building of the railroad and mine buildings, the planning and construction of a new town, and he brings to life the people, many of whom he knew.

He concludes his story with the expansion of Noranda Mines into the Gaspe and the development of the copper mines which has brought a new era to the peninsula. We should be grateful to Mr. Roberts for writing this history, and hope that he, or another, will do the same for other areas. S. C.

BOOK NOTES

Prepared by the Library The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

ASTM manual for rating motor fuels by motor and research methods.

Philadelphia, American society for testing materials, 1956. 192p., $6.75.

Careful study and use of this Manual for rating motor fuels by motor and research methods should enable qualified personnel to install and operate knock testing equipment for both the motor and research methods. Methods are: standard method of test for knock characteristics of motor fuels, by the motor method (D357), and standard method of test for knock characteristics of motor fuels by the research method (D908), commonly referred to as the motor and research methods. Also included are six appendices (I-Apparatus; II-Reference materials and blending accessories; III-Operation; IV-Maintenance; V-Installation and assembly; VI-Building requirements and utility requirements) containing valuable and necessary information for conducting standardized octane ratings on motor fuels. Short statements on the essential features of each method are included. The Manual is illustrated throughout. In addition to drawings and photographs there are numerous tables and charts.

Members may borrow the books mentioned in these Notes on application to the librarian. Two books may be borrowed for two weeks.

LIBRARY HOURS

Monday to Friday
9 a.m. — 5 p.m.
Saturday 9 a.m. - 12 noon.

Applied electrical measurements.

I. F. Kinnard. New York, Wiley, 1956, 600p., diagrs., $15.00.

The basic principles of commonly used electrical measurement devices are covered in this work, and their application to the measurement of electrical and non-electrical qualities is shown.

The author maintains an analytical approach. For each subject and method of measurement, the fundamental laws of the operation are given. These serve as a review of the basic physical and mathematical principles. There are many references for further reading given.

The first section of the book deals with the measurement of electrical quantities, while the second covers the measurement of nonelectrical quantities such as light, heat, sound, liquids, gases, static and kinetics and time.

The book serves to show how indispensable electricity has become to all types of measurement.

Arc-welded machinery construction in mild steel.

A. G. Thompson. London, British welding research association, 1956. 36p., illus., 6/—.

This booklet deals with the design of arc-welded machinery construction, and includes details on the welds used and the static and fatigue stresses imposed on them. Two chapter cover factors for the reduction of costs and information required for manufacture. The bibliography contains more than fifty references.

Argon-arc welding of aluminium alloys, parts 1 and 2.

London, British welding research assoc., 1955-56.

These are the first two booklets in projected series which will cover all aspects of argon—arc welding of alu minum and its alloys.

The first booklet covers general principles, and provides a general introduction to the subject. The second, Electrical characteristics and equipment, discusses the electrical requirements of the A.C. argon—arc process and the function of each item of the equipment.

Other publications in the series will deal with metallurgical considerations, design, applications and costs, techniques and procedures and inspection and testing.

The art and science of protective relaying.

C. R. Mason. New York, Wiley, 1956. 410p., diagrs., $12.00.

This is an elementary textbook on protective relaying, and to understand it the reader requires a knowledge of only the fundamental principles of electrical engineering. The approach is essentially practical, and proofs are not generally given, although reference is made to the sources where these may be obtained. Selected bibliographies list further readings on the subject.

Relay protection of all elements of a power system against all abnormal operating conditions is dealt with, and the relation of relaying to the other power system elements is discussed. The material in the book is applicable to any make of relay.

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• LIBRARY NOTES

Basics of phototubes and photocells.

D. Mark. New York, Rider, 1956. 128p., illus., $2.90.

Phototubes and photocells have many uses in the fields of industry, communications and warfare. Principles, practices, circuits, and practical applications of photoelectricity are here presented for the non-specialist. Subjects covered include: the photoelectric effect, photoconductive cells, photovoltaic cells, phototubes, photocurrent amplifiers, instrument applications, commercial applications.

A bibliography is appended, giving references to more detailed coverage of these subjects and their applications.

°Bibliographic survey of corrosion 1952-1953.

Houston, National association of corrosion engineers, 1956. 382p., $12.50 (U.S.)

Summaries of over 3000 references on corrosion and corrosion prevention are arranged in the following main goups: general, testing, characteristic phenomena, corrosive environments, preventive measures, materials of construction, equipment and industries. The references are indexed by subject and by author. An appendix has been included to aid the user in locating and obtaining copies of foreign or domestic journals or articles.

°Careers in engineering, 3rd ed.

L. O. Stewart. Ames, Iowa State College Press, 1956. 105p., $1.25 (U.S.)

This booklet gives information on the nature of the engineering profession; the aptitudes, interests, and personality necessary for the study of engineering; factors that determine success in college and after; and the engineer's fields of work. The engineeering fields are considered from three points of view: by degree-granting departments of universities, by industries employing engineers, and by function such as design, construction, research, etc. Aids to counselors and teachers and other books on the profession are listed in an appendix.

°Chemical engineering kinetics.

J. M. Smith. Toronto, McGraw-Hill, 1956. 402p., $9.60.

This is a presentation, for practicing engineers and advanced students, of design methods for reaction equipment and their application to practical problems. Emphasizing process rather than plant design, the book reviews the fundamentals of thermodynamics and kinetics, presents the construction features and design principles for several types of reactor, and discusses in detail the design of homogeneous batch, homogeneous flow, semibatch, and catalytic reactors. The next to last chapter discusses heat and mass transfer in catalytic reactors as preparation for the final chapter which deals with the complex problem in which heat transfer, mass transfer, and chemical reaction processes all affect the design.

Climatic summaries. v. 3, Frost data.

C. C. Boughner and others. Toronto, Department of transport, Meteorological division, 1955. 94p., 30 cents.

The incidence of frost is of great importance to an agricultural program. This publication contains charts of summaries of frost data by meteorological station throughout Canada, probabilities of last spring and first fall temperature of 32 deg. or lower, probability of duration of frost free period, as well as maps showing mean dates.

The condensed chemical dictionary, 5th ed.

Arthur and Elizabeth Rose, eds. New York, Reinhold, 1956. 1200p., thumb indexed, $12.50 (U.S.)

This enlarged edition of an indispensable chemical reference book provides concise data on chemicals, chemical terminology, trade-name products and related substances.

There is also information on containers, shipping regulations, safety instructions, and new use of chemicals in nuclear energy, chemotherapy and other fields.

For greater convenience the book is thumb-indexed, and there are many cross-references. The revision has been six years in preparation.

Earth satellites as research vehicles.

Philadelphia, Franklin institute, 1956. 115p., diagrs., $2.50 (U.S.)

During the International Geophysical Year (IGY) 1957-58, it is hoped to launch man-made satellites into the outer atmosphere, to be used for scientific experiments.

The purpose of the Symposium held in April by the Franklin Institute was to emphasize the peaceful uses which can be made of rockets and other guided missiles.

The papers presented discussed the IGY earth satellite programme, the moon rocket, astronautical and space-medical research with automatic satellites, astrophysical research with an artifical satellite, an artificial celestial navigation system, and the recovery of data in physical form from satellites.

Electric utility economics.

R. E. Caywood. Toronto, McGraw-Hill, 1956. 236p., $12.00.

This is a practical guide to the economic and technical factors involved in utility rate making, pointing out their interrelationships. Rate work involves a knowledge of engineering, accounting, sales, statistics, engineering economics, etc.

This book considers the fundamentals

of the electric utility business, the theoretical basis of the price structure and the tariff, metering, statistical methods and cost analysis, earnings, depreciation, etc. There is a long bibliography keyed to the different chapters.

The first book on the subject to be written for some years, this should prove a useful addition to the library of many engineers, and may well form a basis for training in rate-making.

Fraser's Canadian trade directory, 1956.

Montreal, Fraser, 1956. 1784p., $6.00.

With this forty-third edition, Fraser's directory appears in a new format. It is now in one, cloth-bound volume, although the arrangement of the contents is the same.

The classified section lists over 6,500 products, and their Canadian manufacturers, all with their street addresses. There are some 11,500 Canadian manufacturers in the alphabetical listing, and more than 15,000 names appear in the list of trade names. Ten thousand foreign companies are listed, together with their Canadian agents.

There is a useful Market Section giving information on foreign trade, cities and towns in Canada with over 1,500 population, Canadian transportation companies, utilities, banks, etc.

This is one directory which should be in every library.

Frequency modulation engineering, 2nd ed.

C. E. Tibbs and G. G. Johnstone. Toronto, British Book Service, 1956. 435p., illus., $7.75.

Written by two British engineers, this book attempts to give a survey of the whole field of frequency modulation engineering. The field had, prior to 1954, not been as widely exploited in England as in the United States, owing to wartime difficulties.

Some of the topics covered in this revised edition are interference and noise structure, the suppression of interference, propagation, aerials, transmitters, receivers, limiters and discriminators and practical uses of F. M. signals. There are lists of references, many being of American publications, at the end of each chapter.

General education in engineering.

Urbana, American society for engineering education, 1956. 122p., 25 cents.

The question of incorporating humanistic-social studies into an engineering course is one which is raised periodically. This report by the humanistic-social research project of the Society considers the whole question, and its findings are based on the results of visits to some sixty engineering schools.

Excerpts from the reports are given, as are representative courses in the humanities already in operation at the various schools.

***The generation of electricity by wind power.**

E. W. Golding. New York, Philosophical library, 1956. 318p., illus., $12.00 (U.S.)

This account of recent research and development work on the use of wind power on a significant scale is divided, roughly, into three parts. Part one is devoted to wind behavior and its determination: wind distribution, measurement of velocity, energy estimation, and the selection of sites for wind power units. The remaining two parts deal, respectively, with types of wind driven machines and generators and with economic considerations. In addition to chapter bibliographies, a bibliography on surface wind data is included. A glossary of French, German, and English terms is appended.

Géophysique et mécanique des sols dans leurs applications practiques.

G. Aliberti. Montreal, Fomac, 1956. 159p., diagrs., $10.80.

In an introductory section the author presents a brief outline of geologic definitions, and the characteristics of various earth formations.

The three chapters in the second section are concerned with the different soil types, and their values as foundation material. Chapter six considers the statics of foundations.

The final section, occupying nearly half the book, is devoted to worked examples calculating earth pressure, stability and many other problems likely to be encountered in this type of work.

Government contracting in atomic energy.

R. A. Tybout. Ann Arbor, University of Michigan Press, 1956. 226p., $4.50 (U.S.)

In addition to opening up a whole new field for the source of power, atomic energy has introduced a new phenomenon into the American economy — public ownership and private operation.

This work studies the various types of contract which may be entered into by government and industry, and although the study is specifically concerned with the atomic energy industry in the United States, its findings are equally applicable in other fields.

Types of contract considered are: fixed-price, variable-price, and cost-plus-fixed-fee. In an evaluation of cost-plus-fixed-fee contracts, the author has considered incentives and uncertainties, controls, and government and business practices in this field.

The study was made possible by a grant from the University of Michigan, and much of the information on which it is based was obtained from interviews with the Atomic Energy Commission and the contractors concerned. The questions asked at these interviews are reproduced in an appendix.

***The growing shortage of scientists and engineers. Proceedings of the sixth Thomas Alva Edison Foundation Institute, November 1955.**

New York, University Press, 1956. 132p., paper, $4.00 (U.S.)

The speeches and panel discussions recorded in these proceedings deal with the present and future supply and demand for scientists and engineers, the efficient utilization of scientific manpower, means for increasing the supply of engineers, the encouragement of scientific talent, the failures of scientific education, and methods for improving science teaching.

Jig and fixture design.

P. S. Houghton. Toronto, British Book Service, 1956. 256p., diagrs., $6.50.

Growing from a course of lectures on production engineering given by the author, the book owes much to his many years of experience as a mechanic, draughtsman and works manager.

As the author points out in his preface, careful, skillful planning of the machinery used can produce results far in excess of what might be expected. The various topics covered in this book give the bases from which this planning should evolve. Included are planning production and material, design notes, standard clamping methods, indexing mechanisms, drilling, tapping, boring, grinding, air-operated equipment, motion study, etc.

• LIBRARY NOTES

Mineral resources policy.

London, Institute of mining and metallurgy, 1956. 145p., 10/6.

This book contains the record of a symposium held in London in September 1955. The six papers forming the basis of the symposium covered: mineral resources strategy; aspects of the mineral industry in East Africa; economic considerations in a British mineral resource policy; the Canadian mineral industry; a proposal for a central ore treatment laboratory.

The papers were circulated in advance, and were not read at the meeting, when only discussions on them were heard. Both the papers and the discussions are reproduced in this book.

***Polyesters and their applications.**

Bjorksten research laboratories. New York, Reinhold, 1956. 618p., $10.00 (U.S.)

A comprehensive summary of information on raw materials, resin manufacture, fillers, reinforcements, shaping, finishing, and uses of polyesters, including both unsaturated and saturated (linear fiber-forming and di-isocyanate-modified). A brief exposition of the theory of high polymers and of polyesters is included, and separate sections are devoted to physical properties of commercial resins, testing methods, and health hazards. The accompanying bibliography of over 3000 annotated references covers patents, books, articles, and manufacturers' publications.

Power system stability, v. 3, Synchronous machines.

E. W. Kimbark. New York, Wiley, 1956. 322p., diagrs., $10.00.

The first two volumes of this work covered the elements of the stability problem, the factors affecting stability, methods of making stability calculations, power circuit breakers and protective relays. This third volume deals with the theory of synchronous machines and their excitation systems.

Discussed in detail are such effects as saliency, damping, saturation and high speed excitation, giving the reader a greater understanding of power system stability than can be obtained by reading the first volume only. Steady-state stability is given a more detailed treatment than was possible in volume 1, whilst also considered are the characteristics of synchronous machines, reactances, time constants, short-circuit currents and amortisseur winding.

Radioisotopes, the wonder tool; a non-technical source book on practical uses of radioisotopes in industry.

W. A. Shead, ed. Washington, Atomic energy guideletter, 1956. 90p., $7.50 (U.S.)

This publication, concerned with the industrial uses of radioisotopes, lists such information as: commercial sources and

services, various isotope labeled compounds, gauges and other instruments, and publications for radiosotope users. One section gives examples of the uses made of radioisotopes by particular industries.

The pulp and paper manual of Canada, 24th ed.

Gardenvale, Que. National business publications, 1956. 465p.

A useful manual, this edition includes, besides a variety of miscellaneous information, flow sheets for 26 mills, indexes of machinery, supply and service companies, trade names, foreign firms and their Canadian representatives, and a classified index of machinery and supplies.

Rocket propulsion elements, 2nd ed.

G. P. Sutton. New York, Wiley, 1956. 483p., illus., $10.25.

This revised edition of a basic work on rocket propulsion contains a broader treatment of the basic elements and technical problems of rocket propulsion systems. There are also more complete descriptions of the physical mechanisms, application and design of the systems.

The first chapters provide a historical background, and give the general principles of thermodynamics, chemistry and heat transfer as applied to rockets. There are three chapters on liquid propellant rockets, their working fluids and design, and three new chapters on solid propellant rockets, their fundamentals, design and working substances. Two final chapters discuss flight performance and rocket testing.

There is a forty-page bibliography of references for further reading.

Satellite!

Erik Bergaust and William Beller. Toronto, Doubleday, 1956. 287p., illus., $4.75.

With the projected launching by the United States of the earth satellites developed under Project Vanguard not many months away, the appearance of this book is most timely.

The authors, both engineers connected with aviation publications, answer many questions relating to the manufacture, launching and scientific value of earth satellites, in non-technical language.

For those who wish to pursue this fascinating, and, as it is being proved, practical, field further, there are several pages of references for further reading.

The stateman's year book 1956.

S. H. Steinberg, ed. Toronto, Macmillan, 1956. 1622p., $6.75.

The information contained in this ninety-third edition has been brought up to date as much as possible, although in some cases figures given are of necessity estimates.

The book is divided into four sections, the first dealing with international organizations, including the United Nations and its specialized agencies, the World council of churches, the Council of Europe, the Colombo Plan, etc.

In the remaining three sections, the British Commonwealth, the United States and the rest of the world, information given for each country includes details on government, area, population, religion, education, justice, finance, defence, production and industry, banking, etc.

Lists of selected reference books and sources of statistical information are given for each country, and there is a detailed index.

This is an indispensable reference book.

Studies in ancient technology.

R. J. Forbes. Leiden, Brill, New York, Heinman, 1955. 268p., illus., $5.50 (U.S.)

There are to be eleven volumes in this series of essays on pre-classical and classical technology. The first volume dealt with bitumen, petroleum, alchemy and water supply. The second volume covered drainage, land transport and road building, power, and the first domestication of the canal.

The essays in this third volume reveal the secrets of the cosmetics and perfumes used in antiquity. For those interested in ancient recipes, the references in the essays on food and alcoholic beverages might result in some palate-pleasing products.

Other essays deal with grinding, salts and preservation processes and paints, pigment, inks and varnishes.

These glimpses into the achievements of early technology show very clearly how grateful the modern world should be to the engineers who have made possible the great advances of more recent times.

La thermodynamique et le théorème de l'énergie utilisable.

R. Marchal. Montreal, Fomac, 1956. 208p., diagrs., $7.45.

The course given at the Ecole nationale du Génie rural, which forms the substance of this book, was intended to explain the workings of various heat machines, either moving or refrigerating, and the book is essentially practical in outlook. Mathematics are kept to a minimum. Some of the topics covered include temperature, heat, the first and second laws of thermodynamics, the properties of ideal gas, etc.

Written by an engineer for engineers, this should prove a most useful book.

La turbine à vapeur en exploitation.

E. A. Kraft. Montreal, Fomac, 1956. 476p., illus., $21.65.

This treatise on steam turbines is addressed to the user rather than the designer, and consequently details of their construction and function are given only in as much as they are essential to clarify problems with which the user may be confronted.

The first section of the book deals with installation, and covers such topics as transportation to the site, foundation, condenser, assembly and alignment of axial turbines, regulation, etc. Part two,

service, includes detailed instructions for first putting the machine into service, and for measures to take in the different circumstances which are likely to arise while the machine is in use.

Part three deals with the various faults which may develop in service, giving cause and remedy.

The author has drawn on his many years of experience in writing this book which is well illustrated, and contains a thirty page bibliography, most of the items listed being in German.

UFO and the Bible.

M. K. Jessup. New York, Citadel, Toronto, McLeod, 1956. 126p., $3.00.

The author, an instructor in astronomy and mathematics at the University of Michigan and Duke University, has done a great deal of research on unidentified flying objects, and has written two other books dealing with them.

In this work Mr. Jessup presents the thesis that many of the miracles in the Bible can be explained by the presence of flying saucers and other UFO. He shows that many of the phenomena reported in the Bible are very similar to those being reported today. Coming as it does with the announcement of a film documentary showing UFO sightings, this book will doubtless provoke much discussion and speculation.

Vacuum-tube circuits and transistors.

L. B. Arguimbau. New York, Wiley, 1956. 646p., diagrs., $10.25.

An extension of the author's Vacuum-tube circuits, this work includes information on transistors, frequency modulation, inverse feedback and noise. As the author points out in his preface, the field is constantly changing, and much that was new in 1920 is now completely passé. For this reason, the author has concentrated on fundamental principles, and mathematics as much as possible.

The book is concerned primarily with circuitry, although in the case of transistors, the physics involved have been considered in great detail. Each chapter begins with relatively simple material, and considers more advanced points later in the discussion.

The weldability of high-tensile structural steels.

C. L. M. Cottrell and others. London, British welding research association, 1956. 79p., illus., £1.

This report describes the research carried out between 1948 and 1954 on the metal-arc welding of high tensile structural steels.

The investigation was concerned with the problem of cold cracking in the heat-affected zone of welds made in low-alloy structural steels. The first two parts of the report deal with the development and testing of special steels, and the second two with the mechanism of hard-zone cracking, the assessment of weldability and the influence of hard-zone cracking on fatigue life of fillet-welds.

A useful bibliography is included.

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

Automation.

Automation and electronics, a bibliography. H. C. Thole. (Management research service)

Construction industry.

Apartment building standards. (Central mortgage and housing corp.)
Canadian construction association. Proceedings of the 38th annual general meeting.
Choosing a house design. (Central mortgage and housing corp.)
Selected bibliography on building construction and maintenance 2d ed. (U.S. National bureau of standards, Building materials and structures report no. 140)

Copper and copper alloys.

Elevated temperature properties of coppers and copper base alloys. (A.S.T.M. s.t.p. no. 181)

Electrical engineering.

The insulation level of power transformers. (B.E.A.M.A. publication no. 156-1956).

Inverse feedback (New York, Rider, 90 cents)

TV manufacturers' receiver trouble cures. v.8 (New York, Rider, $1.80)

Roads and streets.

Joint spacing in concrete pavements (U.S. Highway research board. Report 17-B)

Report on the AASHO road test project. G. D. Campbell. (Canadian good roads association)

Water resources.

India. Irrigation research institute. Annual research report. 1954.

Waves, water.

Approximate response of water level on a sloping shelf to a wind fetch which moves towards shore.

A laboratory study of short-crested wind waves (U.S. Beach erosion board. Technical memoranda nos. 83, 81.)

Miscellaneous.

The appraisal of executive performance. Bibliography. (Princeton. University. Industrial relations section, selected references, no. 71)
The renascence of city hall. New York City.

STANDARDS REVIEWED

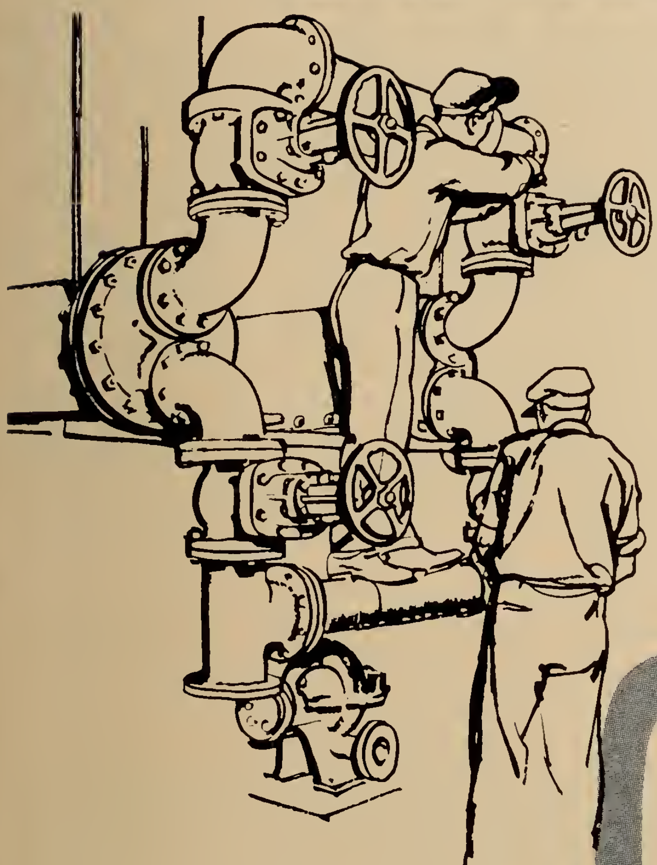
A.S.T.M. Standards, American society for testing materials, 1916 Race St., Philadelphia 3.

Engine antifreezes

A compilation of all ASTM methods of tests pertaining to engine anti-freezes, containing 11 standards. In addition to the test methods and specifications it contains an appendix including notes on significance and interpretation of the glassware corrosion test.

The contents include: methods for sampling, determining freezing points, THE NEW *Labatt's* BREWERY:

where PIPING *really counts*



The new Labatt plant in Montreal marks yet another milestone in the industrial development of Canada . . . as in the growth of CONNOLLY & TWIZELL LIMITED who were entrusted with the Plumbing, Heating and Process Piping installations.

Our own new building, just completed, houses the staff and facilities of Connolly & Twizell, and of its associated companies, **CONNOLLY & TWIZELL SPRINKLERS LTD.** and **COMBUSTION & POWER EQUIPMENT LTD.** in a manner designed to facilitate the execution of such contracts as Labatt's, and other important industrial and institutional buildings.

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physical testing, chemical testing, and specifications for a hydrometer-thermometer field tester and thermometers. 52p., $1.50 (U.S.)

Mineral aggregates and concrete.

This is the latest edition of standard and tentative specifications, test methods, and definitions of terms pertaining to mineral aggregates, concrete, and selected nonbituminous highway materials, or those involving aggregate gradings or tests. It also contains pertinent specifications for cement, and reference to specifications on concrete reinforcement bars (steel).

Subjects covered include specifications and methods of test for aggregates (crushed stone, crushed slag, gravel, light weight); ready mixed concrete; air entraining admixtures; methods of test for air content of concrete, compressive strength, flexural strength, freezing and thawing, slump test; brick and block pavement materials; concrete curing material; expansion joint fillers; cement. 360 p., $3.75 (U.S.)

British standards, British standards institution, 2 Park St., London, W.1. Also available from the Canadian standards association.

B.S. 23: 1956—Trolley and contact wire for electric traction.

A revision of B.S 23:1949 containing an additional standard size of contact wire (0.166 sq. in. section) primarily for use in high voltage alternating current railway electrification. The requirements are substantially the same, for both copper and cadmium-copper wires, but a bending test is now specified in addition to the tensile, elongation and torsion tests. The electrical resistance is now related to the standard reference temperature of 20 deg. C. adopted generally in the British standards for electrical conductors. 4/-.

B.S. 2755:1956—Copper and cadmium-copper stranded conductors for overhead electric traction systems.

This standard provides a range of standard stranded conductors suitable for overhead electric traction systems. Contact wire has been standardized for many years, but with the extensive electrification of railways a need has arisen for standard stranded conductors for such purposes as catenaries and feeders. 5/-.

B.S. 2757: 1956—Classification of insulating materials for electrical machinery and apparatus on the basis of thermal stability in service.

This classification is identical with the International electrotechnical commission document of 1954. Three new classes are introduced and the former class 0 has been re-designated class Y. The basis of the new classification is not the chemical composition of materials but rather their ability to withstand the temperatures assigned to their class. These temperatures are stated and a general description of each class is given. An appendix gives guidance on the classification of a number of particular insulating materials. It should be noted that the temperature rise specified in any particular standard need not in every case be such as to bring the maximum total temperature to that assigned to a particular class of insulation in this classification. 4/-.

B.S. 2762:1956—Notch ductile steel for bridges and general building construction

This publication is based on the fact that there is no general agreement about

• LIBRARY NOTES

tests, however the Charpy 'V' notch impact test, carried out at sub-atmospheric temperatures, provides guidance. The low temperatures used for the impact tests do not necessarily imply that the steels described are guaranteed as being completely satisfactory for use at these temperatures, though in general they can be regarded as progressure improvements over ordinary mild steel. The specification covers four grades of notch ductility and each grade is covered in two tensile ranges. 3/-.

B.S. 2765:1956—Dimensioning system and terminology for industrial temperature-detecting elements and pockets.

This standard defines the terms relating to thermometer elements and pockets, and their protective devices, and describes a dimensioning system, together with appropriate letter symbols, which may be employed in the preparation of purchasing specifications for industrial applications. The temperature-detecting elements to which this standard applies are component parts of liquid-filled, mercury-filled, gas-filled and vapour-presure thermometers, glass-stem thermometers, and resistance, thermocouple and bimetallic thermometers. It is limited in scope to detecting elements. An endeavour has been made throughout to achieve Anglo-American accord in terminology and lettering symbols. Included, as an appendix are some preferred dimensions for attachment threads and attachment flanges, the use of which will be a step toward securing interchangeability of the elements as complete units. 2/6.

B.S. 2771:1956—Electrical equipment of machine tools.

The subject-matter of this standard deals with control apparatus, motors, wiring and related accessories which are furnished as part of the machine tool and originate at its isolating switch. It specifies the conditions under which the equipment is applied on machine tools. The varied existing requirements directly affecting machine tools have been brought together as far as possible. A close check was kept on overseas regulations so as to minimize the difference between it and other such documents. 5/-.

Canadian Standards, Canadian standards association, National research building, Ottawa.

C50-1956—Transformer and switch oils.

Methods and tests used are all in accordance with those issued by the American society for testing materials. 75 cents.

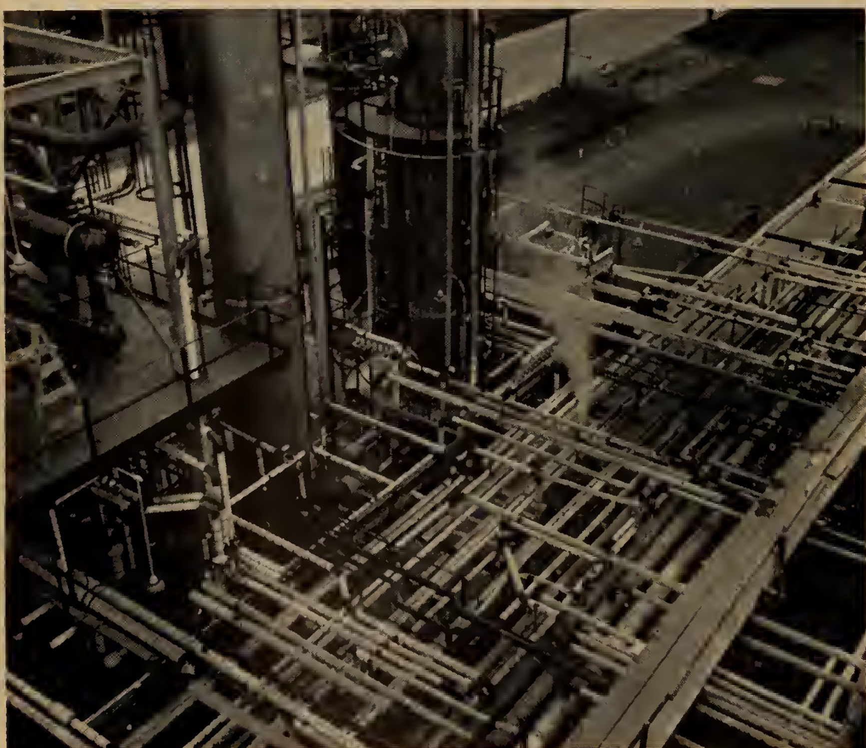
The Chemical Industry

There are still many people, and by no means all of them laymen, who regard the chemical industry as a major employer of chemists and of little else in the way of technically trained men. This view is very far from the truth, particularly where engineers are concerned, for they are essential to the industry and their services are ever more in demand as production, new products, and new techniques are developed.

The Canadian chemical industry has expanded continuously, especially in the last ten years or so, until the 1955 value of chemicals and allied products exceeded $1000 million. This expansion is likely to continue, and an estimated $165 million is to be spent during 1956 on capital expansion in the form of new construction, machinery, and equipment for the industry.

What is the chemical industry? The industry is now a complex combination of producers and processors and in many cases cannot be sharply defined; for example, the pulp and paper industry and the petroleum industry now include major chemical operations. Are petro-chemicals a part of the petroleum refining business or of the chemical industry?

A corner of a modern petroleum-chemical plant shows the complexity of a process industry. The need for engineers for plant design and operation is considerable.



A simple way in which to indicate the scope of the chemical industry is to quote the main divisions into which it is divided for the purposes of the government statisticians. These include: coal tar distillation; heavy chemicals; compressed gases; fertilizers; medicinals and pharmaceuticals; paints and varnishes; soaps and washing compounds; toilet preparations; inks; vegetable oils; adhesives; polishes and dressings; primary plastics; and a miscellaneous group that includes such items as explosives, hardwood distillation, insecticides, matches, and dry colours.

The manufacturing facilities of the chemical industry are well spread out across the country, with certain concentrations such as at Sarnia, Ont., where a large petroleum-chemical industry has grown alongside the established petroleum refining centre. The statistics for 1955, covering the chemical and allied products divisions of the chemical industry listed above, show that over 1100 establishments were involved, employing more than 50,000 people, who earned over $180 million. The cost of fuel and electricity used in the operation of these plants exceeded $33 million, and the cost at plant of materials used was over $480 million. Conservative estimates of the future of the industry foresee an expansion to three times the present volume in the next twenty years.

Agriculture, forest products, and mineral extraction are of major importance in Canada's industrial growth, and all three are major users of chemicals — fertilizers, pest controls, plant foods, bulk acids and alkalis, and so on.

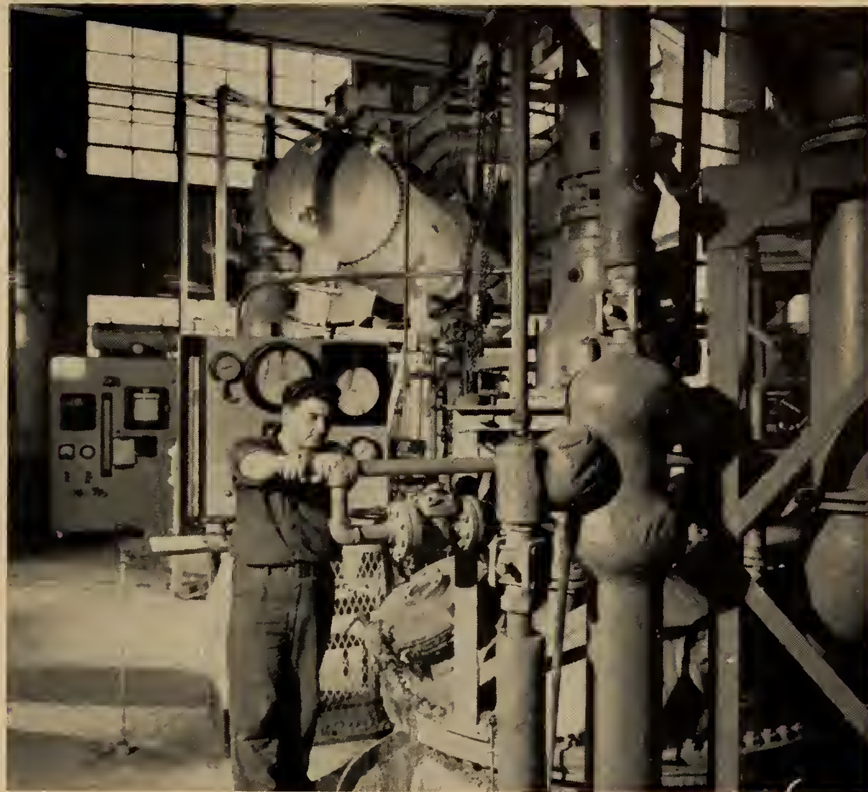
Design and Operation

Many of the chemical products of today are made by continuous processes; that is, in plants designed for continuous operation. Batch processes also play a large part in the industry, but whatever the process the design of plant is all-important.

As new products and techniques are evolved the operating conditions within plants tend to become more and more severe. Extremely high temperatures and pressures are often required and such problems as chemical attack on plant and equipment, already serious enough under normal conditions, become almost insuperable. Almost, but not quite (or there would be no progress) thanks to the continuing development of new materials and the efforts and ingenuity of the design engineer and his associates in various fields of research.

Engineers are required for the design of new projects, for additions to existing facilities, and for changes to layout and equipment. They are also needed for the construction of plants and facilities, and for the continued operation of the plant. The services of mechanical, electrical, civil, and of course chemical engineers are widely used by the industry for the phases of design construction, and operation.

A modern chemical process plant is frequently almost fully automatic in operation and incorporates large installations of automatic control equipment — hydraulic, mechanical, electrical, and electronic — with a consequent need for a knowledge of control and instrumentation. Large quantities of materials are often involved, and products are usually made to strict specifications; men are therefore needed with experience in the fields of materials handling and quality control. Plant maintenance is often a very important field, because of the high rate of attack on vital equipment that may occur.



A typical view of a plant for the production of primary plastics. Recording and control equipment and instruments are a familiar part of the scene in process plants.

Development

Apart from the design and operation of plant, the engineer is becoming more concerned with the development of new products and their application.

A good example of this trend is seen in the plastics industry. The chemist and chemical engineer are largely involved in the development of new materials and the processes for producing them, but the application of these new products is spreading into many other industries and supplementing or even superseding traditional materials.

The electrical industry is using more and more plastic and other synthetics; laminated materials are among those finding use in the mechanical field, for such applications as gears, and in the construction industry; and the rapid growth of new textile materials is well known. For these and all the many other existing and potential applications of products of the chemical industry, there is a constant effort to expand —and many engineers are involved in this work.

Other Opportunities

As was mentioned earlier, there is some doubt about where the chemical industry begins and ends. The borders are always expanding, and with them the scope for the talents of the engineer.

In addition to the fields of opportunity for the engineer mentioned so far—design, construction, and operation of plants, research and development, and application of products —there is quite extensive scope within the industry for the engineer in sales work and in administration up to the most senior positions.

The industry includes large organizations covering a wide range of operations and products and also smaller specialist organizations in certain specific fields.

Salary and Benefits

The chemical industry follows the usual pattern of starting salaries for the graduate engineer, based on ability and experience and largely in line with other major Canadian industries.

Paid vacations, health and pension schemes, and other benefits are usually of the high standard that is widely found in industry today.

Training

Most companies take undergraduates for summer work.

Training schemes are generally provided for the graduate engineer who joins an organization, and are designed to develop his knowledge to the best advantage.

NEW "Unionmelt" Welding Assemblies

for greater job versatility- performance dependability

Versatility and dependability are yours at an all time high in an improved new line of UNIONMELT welding assemblies . . . These units embody the greatest variety of machine combinations, job applications, and design features ever offered for submerged arc welding.

Wire feed units are simply constructed and are highly efficient . . . Identical mounting dimensions for heads, brackets, and slides allow for any number of desired assembly combinations.

Welding heads have exceptional flexibility because of sturdy new mounting fixtures which provide for vertical, horizontal, and rotary adjustment. Stationary and self-propelled combinations are also available.

The wide variety of standard and custom UNIONMELT welding assemblies can easily be made to fit your particular applications—at costs lower than many current standard models.

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coupled with sound engineering training, are the principal qualifications required. File No. 5864-V.

ENGINEERING SALES' REPRESENTATIVE required by leading Material Handling Equipment Company with head office and plant located in Montreal. We require a man 25 to 35 years of age with an electrical engineering or technical background to train for a sales and engineering position. The job offers a good future with an expanding company and the employees can participate in group hospitalization, pension and insurance plans. Reply stating age, qualifications, and salary anticipated. File No. 5868-V.

TWO MECHANICAL OR ELECTRICAL ENGINEERS to handle production problems. One of these Engineers would be placed in charge of producing new instrument designs to specifications already established by our United States factory. This would call for occasional trips to the American plant, building initial models and working out production problems with the shop foremen. The other Engineer would be concerned primarily with panel layouts and production. This work calls for the arrangement of Instruments on graphic panels so that the operator can visualize the process and use the Instrument to best advantage. It would also call for liaison work with our United States plant and with our selling agents. While some previous experience with Instruments would be desirable it is not essential. The men would be given training for limited time and should preferably be under thirty years of age. File No. 5869-V.

GRADUATE ENGINEER required by major oil company for Sales Engineering position in Montreal and surrounding territory. Involves broad training in all petroleum products and their application in industry. Experienced and bilingual engineer preferred, between 25-30 years of age. File No. 5874-V.

PROFESSIONAL ENGINEER with broad experience in engineering work including chemical, and mechanical branches, capable of original design and able to exercise good public relations. Required to sell industrial process equipment in stainless steel and nickel alloys to the chemical, pharmaceutical and beverage industries. File No. 5877-V.

SALES ENGINEERS. Well-known Canadian sales and manufacturing organization with Head Office in Montreal has several attractive vacancies for recent engineering graduates with aptitude and interests in technical sales. Company is of medium size with steady record of expansion and sells engineering and industrial equipment to most of Canada's major industries. Successful candidates will undergo a training program with advancement depending only on performance. Please write in full confidence to File No. 5879-V.

TWO GRADUATE ENGINEERS, wanted for permanent positions, involving design and field work on construction and maintenance, one Electrical and one Civil, with a minimum of 1 to 2 years' experience, for engineering staff of expanding paper company, location Ontario. Applicant to furnish complete details of experience, age, marital status, etc. to File No. 5884-V.

ENGINEERS REQUIRED for expanding clay products industry in British Columbia and Alberta. Opportunities available in plant engineering, process engineering, and production engineering. Please reply stating personal information, experience and qualifications, etc. to File No. 5885-V.

MECHANICAL or ELECTRICAL ENGINEERS. Excellent opportunities leading to supervisory positions with large open pit iron ore mining project now in production in Northern Quebec. Please reply stating: age, education, full particulars regarding engineering experience. File No. 5895-V.

ASSISTANT or ASSOCIATE PROFESSOR in Mineral Engineering for appointment January 1, 1957, to give undergraduate and post graduate instruction in mining engineering, mining geology and allied subjects. First appointment will depend upon qualifications and experience. Salary ranges — Assistant Professor $4380 to $5100. Associate Professor $5100 to $6360 with superannuation and hospital insurance. Research and professional employment encouraged. Location Halifax, Nova Scotia Technical College. File No. 5898-V.

HEATING & VENTILATING ENGINEER. To assist in the design of heating & ventilating systems for industrial plants, offices & laboratories. The work will also involve preparation of estimates & selection of equipment. Preference will be given to graduate engineers with 2 to 10 years' experience in similar work. Starting location will be Montreal. File No. 5906-V.

MINING, MECHANICAL OR CIVIL graduate engineer to act as plant engineer, manufacturer in Ontario. The engineer selected should have a limited amount of experience & the duties involved would be general engineering draughting, surveying, estimating & Administration. Production processes involve the quarrying & production of lime products & separate production facilities cover the manufacture of mortar-mix. Applicants must be interested in production. Salary will be commensurate with experience and ability of applicant. File No. 5912-V.

LARGE NEWSPRINT AND SULPHITE MILL located in central Newfoundland requires Mechanical and Chemical Engineers for design, layout and maintenance control work in general and plant engineering departments. Engineers also required to carry out process control development work aimed at increased operating efficiencies and improved product quality in Technical Control Department. Experience in the Pulp and Paper Industry is preferred, but not essential. Salary commensurate with qualifications and experience. Excellent opportunities for advancement. Appplications should be made in writing, giving age, education and a summary of experience. File No. 5913-V.

PLANT ENGINEERING. Openings for senior and junior engineers in the design and construction of buildings and building services, in Montreal. Please apply in writing only including full particulars as to education and experience. Your confidence will be respected. File No. 5918-V.

INDUSTRIAL ENGINEERS required by a leading asbestos producer with an extensive industrial engineering program. Prefer engineering or science graduates. Non-graduates or time study engineers will be considered who have a thorough knowledge of wage incentives, job methods, etc., or high school graduates with mining experience. These positions are interesting and challenging and offer scope for advancement. Attractive starting salary, excellent working conditions, five day week, wide range of employee benefits. File No. 5919-V.

AIRCRAFT INSTRUMENT MANUFACTURER has immediate openings for intermediate & senior engineers & designers for an advanced navigational project involving experience in analogue computer, precision mechanical design, servo controls and associated radar, fire control & positioning systems. Candidates must be Canadian Citizens or British Subjects & positions are available at various levels of responsibility. File No. 5923-V.

ENGINEERING DEVELOPMENT OPPORTUNITY in South-Eastern B.C. Excellent opportunity for a young metallurgist or engineering graduate with the engineering development section of a leading metals & chemical fertilizers producer. Interesting work in the investigation of mechanical & material failures, application testing of metals & alloys, & non-destructive testing of all types can be expected. Previous experience in development work is desirable. Training will be provided if necessary. If this interests you, write giving full particulars of education, experience and approximate starting salary expected to: File No. 5926-V.

GRADUATE ENGINEER required for Industrial Engineering Department of Spruce Falls Power & Paper Co., Ltd., located in Northern Ontario. Young, vigorous department of four requires an additional Engineer. Recent graduate preferred. No previous Industrial Engineering experience required. Opportunities excellent. Starting salary $4,800, on or up, depending on qualifications. File No. 5930-V.

CONTRACT ESTIMATOR. We are looking for an ambitious man of about 35 years of age to be trained for Senior responsibilities in our Contract Estimating Department. The position will lead to the administration of one or more of the functions of analysis of labour and cost performance, and the development of original estimates and projection of future costs for all phases of manufacturing. A graduate in mechanical engineering or commerce with five to ten years' manufacturing experience of some responsibility would be preferred, but persons with equivalent experience will be considered. The position will provide sufficient interest, authority and salary to attract an exceptional man. Response to the advertisement will be treated in the strictest confidence. Location Montreal. Please reply in writing, giving full particulars of academic background and work experience to File No. 5933-V.

CIVIL AND MECHANICAL ENGINEERS. Two openings with challenging opportunities for work related to construction research and housing research are available in Eastern Canada. Requirements: Good academic records with 3 or 4 years' experience in building work. Full particulars will be sent to applicants to File No. 5934-V.

RETIRED ENGINEER required by consulting firm in Montreal to assist in the reproduction department which comprises: filing of blueprints, photographic machine, etc. Construction experience useful. File No. 5937-V.

ASSOCIATION NEWS —British Columbia

(*Continued from page 1561*)

traffic conditions stimulated a lively discussion period.

Equipment Maintenance Costs

F. A. MacLean, mechanical superintendent of the Department of Highways in Victoria, led off on Friday with a paper on "Maintenance of Equipment". He cited records, operation, supervision and mechanical, as the four elements contributing to the cost of maintenance, and outlined specific methods for dealing with each of them.

Keen Interest in Swimming Pools

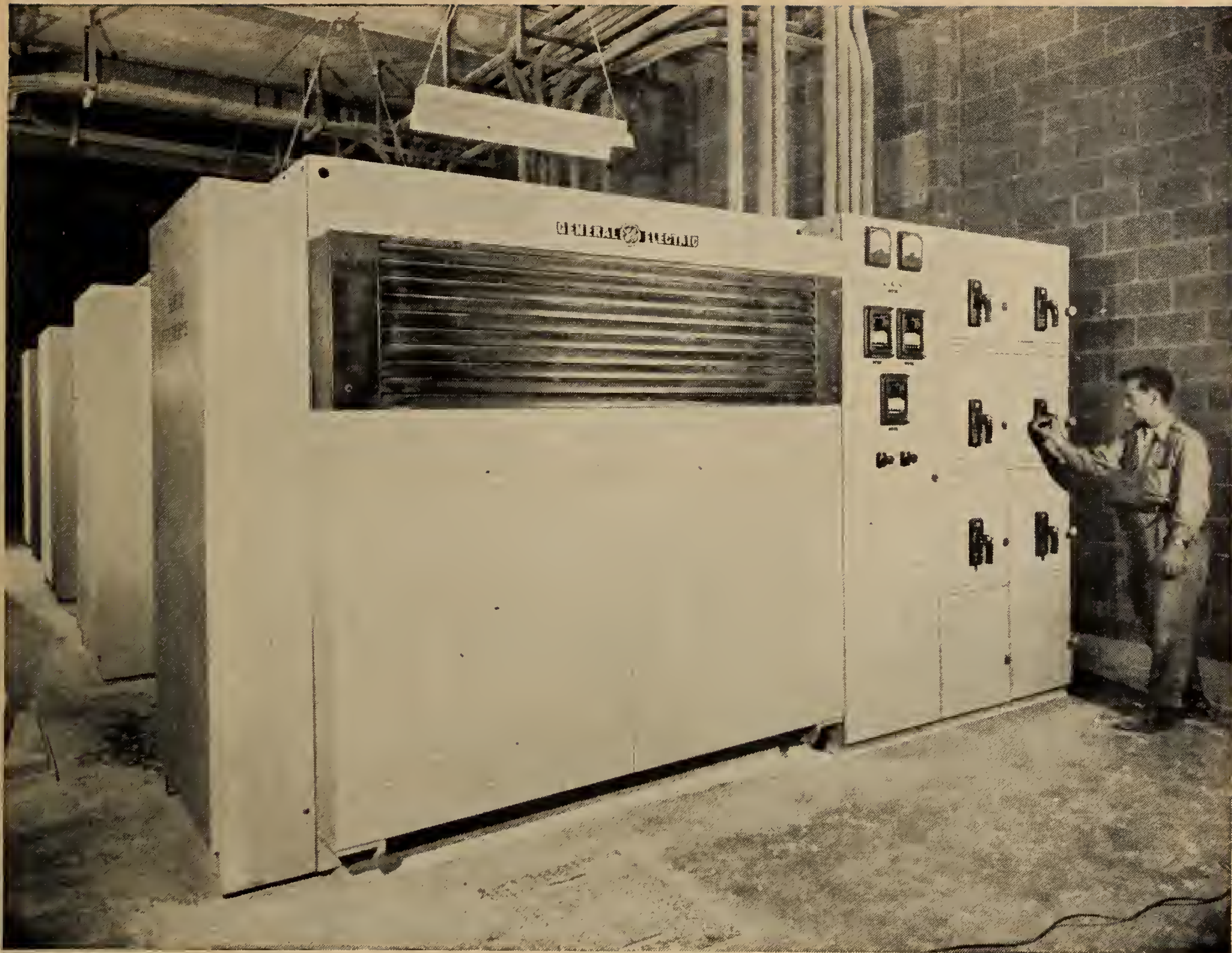
Considerable interest was aroused at the afternoon session by the paper on "Layout and Operation of Swimming Pools", by S. S. Lefeaux, assistant superintendent of the Vancouver Parks Board. He stressed that indoor public pools are expensive to maintain and operate and that recreational swimming for the public can be more adequately and economically provided with outdoor swimming facilities during the summer when the demand is greatest. He recommended a filtered re-circulated type of pool as most satisfactory for water clarity and purity.

Aspects of the New Municipal Act Outlined

J. E. Brown, Deputy Minister of Municipal Affairs, concluded the scheduled sessions with a talk on "Aspects of the New Municipal Act" which is to be submitted to the B.C. Legislature. It will combine into one act applying to all classes of municipalities, the matters now covered by six or seven different acts. Provision is to be made for additional types or classes of local governments, according to size and population, so as to permit an orderly progression of powers and duties from one class to another. The basis of municipal franchise is to be changed and municipalities will be required to prepare and abide by an annual budget.

Guest speaker at the annual banquet was R. P. Walrod, president and managing director of B.C. Tree Fruits, and the social programme included a dinner dance aboard Penticton's famous landlocked steamship "Sicamous".

The convention concluded with a field trip to a fruit packing plant, and a showing of technical films on Saturday morning.



These General Electric Load Centre Unit Substations are installed in an important Quebec mine. They are rated 1000 KVA, 2400 to 600 volts, with dry type 3 phase transformers and drawout, low voltage, air circuit breaker switchgear.

Save on installation costs with . . .
GENERAL ELECTRIC Factory-assembled Unit Substations

You save on installation costs with G-E Indoor Unit Substations because they are factory-assembled and shipped in easy to handle sections.

By specifying General Electric Unit Substations, you save valuable engineering time and obtain equipment which is completely coordinated by one manufacturer . . . enjoy the advantages of undivided responsibility and eliminate multiple component part expediting.

The standardization of manufacture of the component parts permits wide-scale interchangeability . . . makes relocation of a substation relatively simple. This "building block" method means that these dry-type unit substations can be quickly and easily installed anywhere in your mill, mine or plant . . . enables you to carry high voltage power right to the point of utilization with the resulting reduction in conductor sizes. At the same time it makes excellent provision for future load growth.

The compact design of G-E Unit Substations allows for easy access . . . greatly reduces inspection and maintenance costs. It will pay you to standardize on General Electric Load Centre Unit Substations. For further information, contact your nearest C-G-E Sales Office or write to: Apparatus Department, Canadian General Electric Co. Limited, 107 Park Street North, Peterborough, Ontario.

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CANADIAN GENERAL ELECTRIC COMPANY LIMITED

Business and Industrial Briefs

A DIGEST OF INFORMATION RECEIVED BY THE EDITOR

Appointments and Transfers

Canadian Westinghouse appointments — Canadian Westinghouse Company Limited announce the following appointments: R. H. Cairns has been named to head up sales and contract administration for the atomic energy division; F. N. Holdsworth has been appointed head of manufacturing.

Canadian Steel Foundries (1956) Limited — The appointment of G. A. Gowdy as comptroller has been announced by G. L. McMillin, vice-president and general manager of the company.

Monsanto Canada Ltd. — Russell B. Bridges has been appointed to the newly created position of product sales manager, adhesives and resins.

Minnesota Mining and Manufacturing of Canada Ltd. — K. J. Shea, vice-president and general manager, has announced the appointment of John V. Powell as director of sales. It is also announced that E. H. Lill has been appointed sales manager tape and ribbon products for the company.

Electro Metallurgical Company — The appointment of Donald J. MacIntyre and Gordon E. Willey as vice-presidents is announced by G. O. Loach, president of the company (Division of Union Carbide Canada Limited).

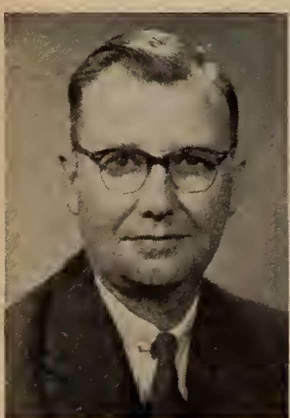
Thomas A. Edison of Canada, Limited —Charles H. Goddard has been elected vice president and a director of the company. Simultaneously was announced the establishment of four district offices with newly-appointed district managers, viz: Toronto — William H. Chalmers; Montreal — R. A. Thomas; Ontario — H. F. E. Smith; Vancouver — Stuart L. Slade.

Shawinigan Chemicals Limited — It has been announced by Dr. R. S. Jane, president, that George A. Donald, assistant secretary-treasurer, has been named treasurer of the company; Percy W. Wright, formerly secretary-treasurer, will continue as secretary and has been made a director of the company.

Surpass Petrochemicals Limited — The appointment of Fred W. Evans as assistant to the president of Surpass Petrochemicals Limited, Scarboro, Ontario, and Alox Corporation, Niagara Falls, New York, has been announced by James E. Shields, president of the two companies.

Linde Air Products Company — David S. Lloyd, president of the company (Division of Union Carbide Canada Limited), has announced the appointment of Whitford S. Wyman as vice-president and general manager.

G. E. Willey



D. J. MacIntyre

W. S. Wyman

R. W. Stevens

Dominion Engineering Company Limited — R. W. Stevens has been transferred from the position of assistant chief engineer, mining machinery and hydraulic presses, to sales manager of the industrial division.

The Canadian Kellogg Company Limited —Henry W. Wurdemann, general manager, has announced the appointment of E. W. B. Kleinsteiber as manager of procurement, and T. L. Lech as manager of accounting.

Collins Radio Company of Canada Ltd. —It is announced that Walter C. Ward has been appointed as resident manager, Ottawa office.

RCA Victor Company Ltd. — The board of directors have appointed Frank R. Deakins chairman, and P. J. Casella president and chief executive officer.

Joy Manufacturing Company (Canada) Ltd. — The following appointments are announced: D. W. M. Ross takes over the active direction in Canada as vice-president and general manager, with his headquarters in Galt; Edgar R. Edwards, previously manager of sales operations in the province of Quebec, succeeds Mr.

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TRANSPORTATION

5613

Ross as general sales manger; M. S Cranston moves from Kirkland Lake to Galt as assistant general sales manager.

James Morrison Brass Manufacturing Company Limited — Gordon B. Harrison has been appointed general sales manager of the company.

Monsanto Canada Limited — The promotion of J. W. Lindsay to the position of group leader has been announced by Dr. A. F. McKay, director of research and development for the company in Montreal.

Federal Wire and Cable Company Limited — Eber Pollard, assistant chief engineer, has been appointed chief engineer in place of Bob Oldham who has gone to England.

E. Pollard

New Equipment and Developments

Crown Property Purchased—The Right Honourable C. D. Howe, Minister of Defence Production, recently announced that Avro Aircraft Limited and Orenda Engines Limited had purchased approximately $18,000,000 worth of Crown-owned machinery and equipment in their Malton plants. Avro's share of this total purchase was $3,768,000 and the Orenda portion $13,954,159. Avro Aircraft now owns its entire plant and facility, including all machine tools and equipment. The main plant was bought from the Government in 1945. Additional facilities were purchased in 1952 and 1953. Orenda Engines Limited bought its main production and engineering plants at Malton from the Government in 1953. The latest purchase of equipment gave Orenda ownership of virtually all facilities within these plants. The terms of purchase included agreement by both companies to maintain, for ten years, facilities for aircraft and jet engines development, manufacturing, repair and overhaul, and to give the Government priority on these whenever needed during that period.

Northern Research Station—President E. W. R. Steacie of the National Research Council recently officially dedicated the new Northern Research Station of the Council at Norman Wells, N.W.T. This station, consisting of a soils laboratory and a residence building for research, staff, has been developed by the Division of Building Research of the Council as a centre for its permafrost research work in Northern Canada. A small station was established in 1951 at Norman Wells, with the co-operation of Imperial Oil Limited.

The Eagle Pencil Company of Canada marked the passing of twenty-five years in Canada this summer by a reception and dinner party. Paul D. Normandeau, manager of the factory, presided at the meeting and the keynote address was given by Alfred C. Berol, president of Eagle Pencil Company, New York, which is now celebrating 100 years in business.

Portable Rotary Compressor—Canadian Ingersoll-Rand Company Limited announces the addition of a new 85 c.f.m. size to its line of GYRO-FLO compressors, now increased to six sizes — 85 c.f.m. through 900 c.f.m. The GYRO-FLO 85 weighs only 1840 pounds ready-to-go, fully equipped with tool boxes, fenders and two-wheel spring-mounted running gear. The light-weight and compactness of this new compressor also make it ideal for truck mounting. As a truck-mounted unit, the GYRO-FLO 85 weighs only 1375 pounds and stands only 42 inches high.

Fluid Cooler Equipment—Trane Company of Canada, Limited, have announced that their fluid cooler equipment (special heat transfer products) for radio, radar and TV Klystron vacuum tube cooling is now available for applications requiring the dissipation of from 1 kilowatt to 100 kilowatts of heat. The fluid cooler equipment is in compliance with commercial and military requirements, and is designed for operation anywhere in the world. (The Klystron tube is an electronic tube that converts direct current into ultra-high frequency current through electromagnetic sorting of electronic velocities.)

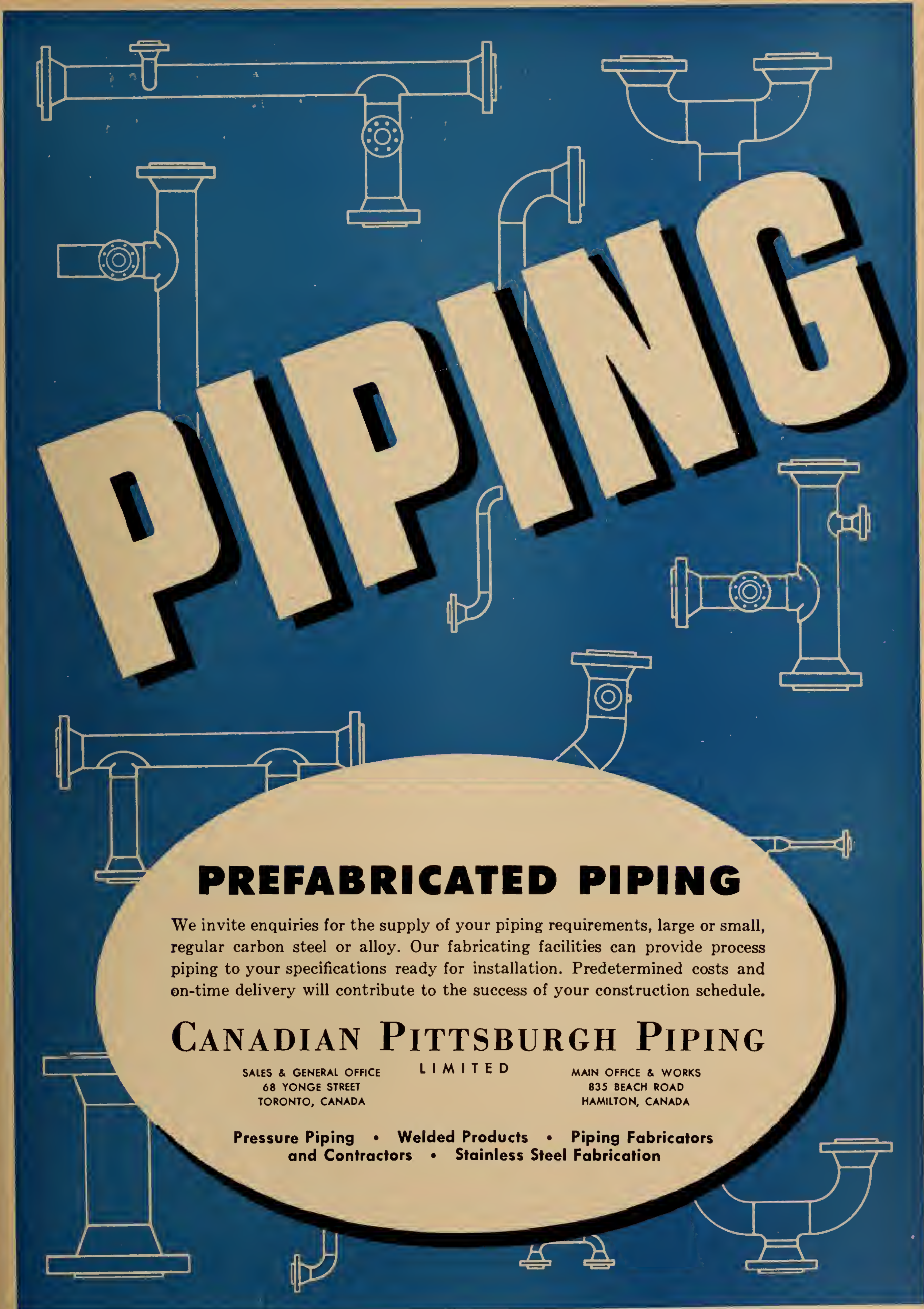
Asbestos Cement Sheet—A newly designed asbestos cement sheet for roofing and siding, made by Canadian Johns-Manville Co. Limited, is for application over skeleton-steel and wood-frame buildings. Introduced under the name "Transitile", this new product was engineered in the Johns-Manville laboratories. Corrugations in this improved design of roofing and siding material, are spaced approximately 13-1/3-in. apart, creating structural lines of a modern decorative appearance. Application economies result from lighter weight with no loss of strength. Among other advantages, the manufacturer stresses Transitile's non-combustible quality, its ability to retard the path of fire, its resistance to gases, fumes and climatic conditions.

B.C. Electric Order—The B.C. Electric Company Limited has placed an order with the Canadian Westinghouse Company for 39 outdoor oil circuit breakers and 4 duplex switchboards. The circuit breaker order is composed of seven type 230 GW 7500, 1200 ampere, 7500 Mva. interrupting capacity, 230/196 kv. oil circuit breakers; eight type BNOB, 15 kv., 1300 Mva. interrupting capacity, 4000 ampere oil circuit breakers and, twenty-four type 150 BJ500, 15 kv., 500 Mva. interrupting capacity 600 ampere oil circuit breakers. The switchboards are for the control, metering and relaying of the Newell and Mainwaring substations and the Clohom and La Joie generating stations.

Seawater Treatment—The second contract this year for more than a million pounds has been placed with G. & J. Weir, Ltd., Glasgow engineers, for seawater evaporating and distilling plant. This will supply 4,000 ton (896,000 gallon) of fresh drinking water daily to the Netherlands Antilles island of Curacao off the coast of Venezuela, with provision for future extensions. Weir's contract also includes power station buildings boilers, turbo-generating sets, pumps and piping. Two sextuple-effect evaporators will be supplied at first, the heating medium being exhaust steam from the turbo-generators at 30 lb./sq. in. The Weir scale prevention system will allow continuous maximum heat transfer in the evaporators, and no operating time will be lost in shut-downs for de-scaling. The power station plant will include two high pressure boilers each evaporating 81,000 lb./hr., supplying steam to the turbo-generators at 775 deg. F. and 650 lb./sq. in.g. Weir pumps are made in Canada by Peacock Brothers Limited.

Control Thyratron—A new control thyratron with three different base connections, is available from Canadian General Electric Company's Tube Section. The tube will give improved performance, yet be less expensive than the GL-5545 which now is superseded. The three new types of this 6.4-ampere negative control characteristic thyratron—GL-6807, GL-6808 and GL-6809 — all incorporate element and envelope construction de-GL-6807 has a pin-type base and can be used interchangeably with the GL-5545. The GL-6808 has flexible "flying" leads and the GL-6809 is made with spade lug terminals extending from the base.

Because they carry high commutation factory ratings they are particularly suited to motor control and other inductive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load circuits without cushioning. Their ability to operate over a wide ambient temperature range (- 55 to + 70 deg. C) and a quick-heating cathode (1 minute) are features of particular usefulness in industrial applications. Maximum average cathode current of these motor control thyratrons is 6.4 amperes and fault current 1120 amperes. Maximum negative control grid voltage before conduction is minus 250 volts and during conduction minus 10 volts. Maximum positive control grid current is 0.20 amperes with the anode positive and 0.10 amperes with the anode negative.

Wagon Drilling — Joy Manufacturing Company (Canada) Ltd. announce new self-propelled Jr. Challenger model (CTM-1). Track mounted, it drills up to 3½ ins. diameter holes to depths of 40 ft. in any formation—vertical bench holes, toe holes, horizontal holes to 7½ ft. height, and angle holes both up and down from the horizontal. Tracks 6" wide are protected by heavy-gauge metal covers. Tramming power is provided by two Joy AM-3 piston air motors (one for each tread), which are direct-connected, thus eliminating drive chains. Drill and feed are mounted on a U-bar, which is raised and lowered by two double-acting hydraulic cylinders.

Silicone Rubber Cloth—A silicone rubber cloth coating compound for ducting which can carry air at temperatures as high as 700 deg. F. and remain flexible at 120 deg. below is available from Chemical Materials Sales, Canadian General Electric Company. Designated SE-701, this compound is of particular interest for such applications as hot air ducts, jet engine starter hose, flexible connectors for metal ducting, and aircraft fire wall seals. In addition to its wide temperature operating range, SE-701 also boasts resistance to flow under clamps, outstanding flame retardancy, and low swell in such fluids as Skydrol 500 and 700, JP4, gasoline, MIL-o-7808, and MIL-5606.

Low Hydrogen Iron Powder Electrode—Air Reduction Canada Limited announces a new all-position, low hydrogen electrode with an iron powder added coating for high welding speeds. The new Easyarc 328 is recommended for welding hardenable steels where no preheat is used. In addition high sulphur-free machining steels, cold rolled steels normally exhibiting excessive porosity when welded with conventional electrodes; low alloy or mild steel when stress relieving normally would be required but cannot be done and weldments to be vitreous enamelled after welding are well suited to Easyarc 328.

The physical properties of the weld deposit (as welded-unaged) are tensile strength 86,200 p.s.i., yield strength 70,-950 p.s.i., elongation in 2" 30.0% and reduction in area 61.8%. Easyarc 328 is an ac. or d.c. reverse polarity electrode.

High-Speed Recording Potentiometers—High-speed self-balancing recording potentiometers for use with analog-to-digital conversion devices have recently been announced by The Bristol Company of Canada Limited. Designed to give full-scale traverse in 0.4 second, the electronic Dynamaster can be equipped with most of the standard digital read-out devices presently available. Ample torque is available for operating retransmitting slidewires, alarm contacts, and other auxiliary devices, without affecting the dynamic characteristics.

Round chart models are also available for such service, for use where prominent indication of the variables is needed while feeding digitized information to data handling equipment.

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WHOLESALE DEPARTMENT

CANADIAN GENERAL ELECTRIC COMPANY
LIMITED

(*Continued from page 1602*)

version. The ramp from barge to wharf is of special interest to engineers with its provision for a smooth surface for trucks under all conditions of tide and stream flow.

Paper Converting Plant

All phases of paper conversion to adhesive tapes, toilet paper and bags, were observed. The use of titanuim dioxide to obtain wax paper opacity was of interest. The largest corrugated paper machine west of Chicago can turn out eight foot wide stock at the rate of 600 feet per minute. This stock is printed, cut and folded into shipping containers for apples, cans, or other uses and a special testing laboratory has been set up for sampling production and testing the strength of new designs.

General

The visitors were impressed with the smoothness of the flow to finished product, all done with a minimum of manual effort, due to the use of automatic machines and miles of conveyors. The company is to be congratulated on its contribution to B.C. industry and its courtesy to visitors.

H. T. Libby Speaks on Natural Gas

Councillor H. T. Libby, M.E.I.C., manager of gas distribution of the B.C. Electric Company, spoke on "How Natural Gas will be Introduced to Vancouver" at the first speaker meeting of the 1956-57 season.

Mr. Libby has an extremely detailed knowledge of his subject but limited time restricted him to a few highlights.

Natural Gas Arrival

Natural gas should reach Vancouver in November, 1956 and will be initially imported from the San Juan fields of New Mexico until the West Coast Transmission line is completed to Peace River. At that time, Peace River gas will flow into Vancouver and also across the border.

Conversion of Appliances

The metropolitan area has been divided into a number of sections and these sections will be converted one at a time from manufactured gas to natural gas. About 300 trained men will work in each section as it is converted to redrill burner and make adjustments. 20,000 drills are on hand for this work on 100,000 appliances.

Gas Pressures

The transmission line pressure will be about 780 lbs. per square inch and this will be reduced in steps until it reaches the appliances at about four ounces of pressure.

Cathodic Protection

Pipe lines in rural areas will have cathodic protection but this is impractical in urban areas where pipes of all services may be in contact.

Reliability of Supply

Reliability of supply to consumers will be assured by the alternative sources of Peace River or San Juan and the provision of a propane plant and an oil gas plant.

Control

A new building will be the center for gas distribution control. Here meters will record pressures telemetered from check points scattered over the metropolitan area. Other telemeters will indicate the ate of consumption of the whole area and remote controls will enable pressure adjustments to be made at key points. With this centralized control using equipment proved elsewhere, the maximum of customer satisfaction should be obtained.

Structural Section

C. P. JONES, M.E.I.C.

The first regular monthly dinner meeting of the structural section, held on September 18, 1956, was attended by twenty-five members.

During coffee Gordon Ellis, M.E.I.C., gave a talk on the deformation of concrete columns under long-time loading.

Keith Douglas spoke briefly on the proposed criteria for prestressed concrete being prepared by the section committee under his chairmanship, for submission to the City building inspector. If these criteria are accepted by the building inspector, it will be possible to do prestressed work within the City of Vancouver.

Following dinner, Otto Safir, M.E.I.C., discussed "precast concrete construction", illustrating his talk with a number of excellent coloured slides. The talk was followed by a half hour discussion period.

NIAGARA PENINSULA

P. L. Climo, M.E.I.C.,
Chairman

P. A. Saldat, Jr.E.I.C.,
Secretary-treasurer

Tour Welland Ship Canal

Thirty-eight members and friends of the Niagara Branch were guests of the engineering and management staff of the Welland Ship Canal for an inspection tour of some of the major works on the canal on September 20. Feature of the day was a trip through the triple flight locks at Thorold aboard the steamer "R. Bruce Angus". Invited to ride the lower foredeck for the trip through the first lock the group later inspected the engine room, which proved to be a model of cleanliness in white paint and gleaming metalwork.

Lock Control Room Visited

Returning ashore when the lower flight of the locks was reached, the guests visited the lock control room. The present Welland Canal which is the fourth in the succession of waterways connecting lakes Erie and Ontario, has been in operation nearly twenty-five years, but it remains as one of the major achievements of Canadian engineering. It is one of the largest and most important artificial waterways in the world. The triple flight twin locks at Thorold, although smaller than the Gatun locks in the Panama Canal, have a total lift of 139½ feet, as compared with 85 feet for the Gatun locks. The latter measure 1,000 x 100 feet while those at Thorold are 820 x 80 feet.

In the lock control room, the gate, valve and guard cable controls were explained and the operations were witnessed as the "R. Bruce Angus" passed on through the lower gate to the reach of the canal below.

Conducted Through Powerhouse

Moving on, the group were conducted through the canal power house at the foot of the locks where three 5,000—kva vertical waterwheel generators are installed to provide power for the operation of the locks and other waterway equipment.

Next point in the tour was a vertical lift road bridge. Conducted to the control room and engine room a routine raising and lowering operation of the bridge was witnessed.

At a dinner meeting following the tour W. A. O'Neil of the St. Lawrence Seaway Authority, D. J. Moon, J. H. Travers and P. E. Ellis of the Welland Canals department were spokesmen for the evening. Mr. O'Neil addressed the group on the subject of the deepening of the canal, being done as part of the St. Lawrence Seaway development. Electrical, mechanical and operational features of the canal were explained by Messrs. Moon, Travers and Ellis.

Chairman of the Branch, P. L. Climo, conducted the meeting. E. C. Little, vice-chairman, was responsible for the arrangements for the day.

E.I.C. Annual General and Professional Meeting 1957

Banff Springs Hotel
June 12, 13, 14

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Treasurer—R. A. Emerson
General Secretary—L. Austin Wright

(A complete list of Officers appears in the issue of September, 1956)

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Indexed in The Engineering Index

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

Contents - December 1956

Current Events

Professional Affairs

Employment and Business

(18,000 copies of this issue printed)

Engineering of Post-War Expansions

at Courtaulds (Canada) Limited

A paper by Courtaulds (Canada) Limited engineering staff under the direction of P. H. Nasmyth, M.E.I.C., *Chief Plant Engineer.*

The Courtaulds Group, which grew up from a family silk weaving business located in a small village in East Anglia, is today one of the world's leading producers of man-made textile fibres, with numerous plants in the British Isles and with manufacturing interests in the U.S.A. and Canada, and many other countries.

Courtaulds Limited pioneered the production of Rayon by the Viscose process in the U.S.A. and the organization which was created developed into the American Corporation. During the late war, Courtaulds Limited sold the American Viscose Corporation in order to provide dollars to the British Government for the purchase of war materials, but since the war, they have re-entered the American rayon industry through their investment in Courtaulds (Alabama) Inc., the youngest of the American viscose staple fibre producers.

A further note about Mr. Nasmyth appears in the Personals section.

THE viscose rayon industry came to Canada in 1925, when Courtaulds built a five-storey mill building in Cornwall, Ontario, and began to produce continuous filament rayon yarns. Twenty-four rayon spinning machines went into operation at this time, and production of yarn was at the approximate rate of one million pounds per year.

Almost immediately, the plant started to expand, in order to keep pace with a constantly growing demand for viscose yarns. In 1926 and 1927, building extensions were added to the original No. 1 mill, and 19 more spinning machines were installed.

In 1932, No. 2 mill was erected, with installation of another 32 spinning machines of an improved type. Only two years later, in 1934, No. 3 mill was built and a further 42 spinning machines of the latest type went into production. Another major plant expansion took place in 1938, when No. 4 mill was constructed to house an additional 88 spinning machines, 50 of which were installed prior to World War II, the remaining 38 being installed progressively between 1942 and 1948.

So it was that Courtaulds (Canada) Limited, from its modest beginning in a single building in 1925, had grown in the short space of 14 years into a large industry occupying four major mill buildings and producing in 1939 at the rate of some 12 million pounds per year. This annual output was almost entirely in the form of continuous filament textile yarn for the clothing industry; for such materials as printed dress goods,

Title picture: Aerial view of whole plant. No. 5 mill, centre; No. 1, 2, 3, and 4 mills in middle background (No. 1 is the large building nearest the St. Lawrence river, background). Boiler house, with stack and coal pile, at right centre, near 100,000 gallon water tower. Four large stacks are for foul air removal.

knitted goods, linings, crepes, and hosiery.

Up to this time, all yarn was produced on box spinning machines (Fig.1). This type of machine spins liquid viscose into a sulphuric acid spinning bath where it coagulates and forms viscose yarn, which is picked up by two godet wheels and deposited, by a sort of batch process, in acid cakes that are formed inside rotating bakelite spinning boxes. These acid cakes subsequently have to be desulphurized, washed, dried, and coned or beamed before the yarn is ready for shipping.

However, expansion of textile yarn production up to 1939 was only the beginning of bigger things to come. In the late 1930's, development by the Courtaulds organization of high-tenacity heavy-denier rayon yarns, opened the way for use of viscose rayon in the industrial field; in automobile and truck tires and in conveyor belting. During the war years, the place of viscose rayon as a superior tire yarn was firmly established, and it became apparent that large scale tire yarn production would be a necessity at the Cornwall plant.

As early as 1943 and 1944, as a part of Canada's war effort, the 32 box spinning machines in No. 2 mill were converted for box production of tire yarn. This conversion consisted largely of the addition of hot water stretch baths to the machines, and installation of tanks, pumps, and piping required to circulate hot water (about 200 deg. F.) through

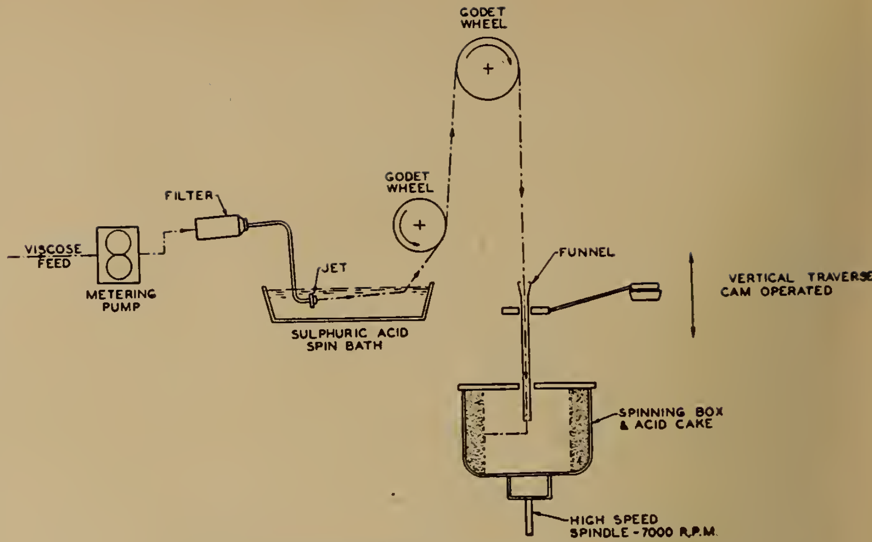


Fig. 1. Schematic diagram of box spinning machine.

the new bath sections on all machines.

Simultaneously, the Courtaulds organization and the textile industry were developing and perfecting new uses for viscose staple fibre, many of them depending on blends of viscose staple with the natural fibres of wool and cotton. These blends with other textile fibres proved so acceptable to the Canadian market that, by 1945, a large demand existed for a variety of deniers and lengths of rayon staple fibre.

So it was that the years immediately following World War II found Courtaulds (Canada) Limited, now producing textile and tire yarns at a combined rate of 14 million pounds a year, engaged in planning a large-scale expansion program that would answer the new and growing demands for tire yarn and staple fibre.

Main requirements were as follows:

(a) Production of high tenacity tire yarn by a process new to the Cornwall plant, called continuous spinning, and involving installation of a number of rayon spinning machines of an entirely new type.

(b) Production of staple fibre, on another new type of spinning machine similar to those recently developed in both the United Kingdom and the United States, and involving the installation of cutting, washing, drying, opening, condensing, and bal-

Fig. 2. Aerial view of No. 5 mill. Staple fibre plant at left, with foul air stack (15 ft. dia., 225 ft. high). Three-storey structure behind stack is the staple fibre acid preparation building. Central viscose plant adjoins, right centre, with churn house (five storeys) at far end. CS_2 storage building behind top of stack; sulphuric acid tanks at right centre.

ing machinery; all of them new to the Cornwall Plant.

(c) A new viscose plant, that would completely replace the old viscose producing unit, already outmoded and of inadequate size, and that would supply viscose for all three major products; textile yarn, tire yarn, and staple fibre.

(d) Supply of services for these three proposed plant expansions, involving extensive additions to all the important services installations; steam, water, electric power, refrigeration, and compressed air.

Expansion projects that evolved from full study of these requirements were:

(a) Construction of a large new building, to be known as No. 5 mill, which would house the new central viscose plant, the new staple fibre plant, and also the new compressor room, and which would also provide for greatly expanded facilities for handling and storage of raw materials.

(b) Installation of new tire yarn machines in the east end of No. 2 mill, where they would replace the old acid reeling and bleach departments, already obsolete.

(c) Expansion of the acid recovery department to provide for recovery of the greatly increased volumes of spin bath that would be in use.

(d) Installation of additional yarn processing machinery.

(e) Services expansions to provide for the requirements of these new projects.

Each of these projects was to be carried out in a way that would provide for further expansion in the future.

Construction of the New Plant

Construction of No. 5 mill was started in the spring of 1946. The central viscose plant and the staple fibre plant went into production progressively between the summer of 1948 and the autumn of 1949.

Originally it was intended to locate No. 5 mill directly west of the other four main mill buildings. However, the load-bearing capacity of the subsoil in this area, which lies over an old stream bed, was found to be so small that the entire building would have had to be supported on piles. It was found that the cost of piles, in comparison with the value of the buildings themselves, would have been prohibitive. Accordingly, the new plant was established in its present location, farther north than originally planned (Fig. 2). In this new location, only about one third of the structure, at the east end, still lies over part of the old stream bed, and is supported on piles. Steel piles were considered, but the subsoil was so soft in places, being a slippery blue clay, that the number of steel piles would have been excessive, and because of this it was decided to use compressed concrete piles. These are reinforced concrete piles poured in place by a special process, and have more load bearing capacity than steel piles.

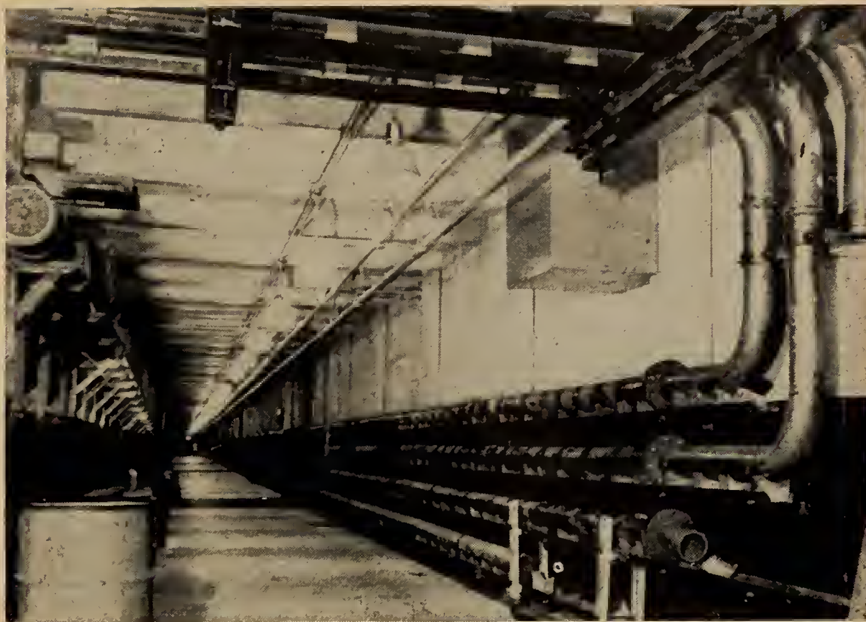


Fig. 3. One of the underground tunnels interconnecting major buildings. Four lead pipes carrying spin acid (right wall and across ceiling) are carried on wood blocks evenly spaced in steel channels supported on brackets from the wall.

The eastern third of No. 5 mill is supported on approximately 1400 concrete piles varying in depth from 10 to 40 feet. Piles are placed so as to give direct support to every steel column and all load-bearing foundation walls, and in some places are spaced at intervals of six feet in both directions under the basement floors. In the case of the new churn house, at the extreme east end of the new mill, where soil conditions were very poor, the basement floor is a reinforced concrete slab carried on a network of reinforced concrete beams spanning the distances between pile caps. In other words, the basement floor in this case rests entirely on the piles and does not depend on additional support from the soil.

All the major buildings of the Cornwall plant are interconnected by underground tunnels which serve as pipe corridors as well as for personnel traffic (Fig. 3). Three such tunnels were constructed to link No. 5 mill with the boiler house, the acid recovery building, and with No. 4 mill.

Design and installation of parapet walls around the roofs of the new plant presented an interesting problem. Less than a year after the buildings were completed, broken flashing blocks were noticed where the roof membrane was flashed into the parapet walls. It turned out to be impossible to repair these blocks properly without dismantling most of the parapet walls. In addition, soft spots appeared in the roof areas adjacent to the parapets, indicating presence of moisture in the insulation.

Tests were made over a considerable period of time, and it was found that water easily penetrated the artificial stone coping and found its way into the wall. (Fig. 4.). Also it became apparent that the through-wall flashing, consisting of two-ply tarred cotton fabric, was not effective in stopping this entry of moisture into the wall behind the flashing blocks. Freezing of this moisture in cold weather caused spalling and disintegration of the flashing blocks.

The original parapet walls would have been satisfactory if the through-wall flashing had been made of an impermeable material such as lead. Addition of counter flashings over the through-wall flashing and roof flashings would have assured good construction.

After many repair methods had been considered and investigated, it was finally decided that the condition would be best corrected by completely removing the parapet walls. This was done, and a new cant strip was poured around the perimeter of the building. A 2 in. x 10 in. fascia board was then bolted to the outer face of the cant strip and flashed with sheet aluminum, and the top of the cant strip and inner edge of the aluminum flashing were covered with 4-ply tar and gravel roofing. This method of construction has proved satisfactory in every way. All subsequent building additions have been constructed without parapet walls, their roofs being finished around the building perimeters as described above, with cant strip and fascia board flashed with sheet aluminum.

Drainage System

The biggest problem in economical design of a drainage system for the new plant was the long distance to be travelled by the effluent lines from the plant to the river. Also, it was necessary to carry different chemical effluents in separate pipes. The drainage system consists of four sewer pipes, all laid on gravel-fill in the bottom of the same trench, and backfilled first with gravel, then with earth. To obtain proper flows in the pipes, it was necessary to excavate in some places to a depth of almost 30 feet. Manholes are spaced approximately every 200 feet on each line, the manholes on all four sewers being grouped together at each location into single reinforced concrete structures. Manholes are lined with trowelled-on asphalt to protect the concrete from chemical attack.

The four sewers consist of:

(a) One 48 in. reinforced concrete storm sewer, carrying storm water, floor drains, roof drains, and non-corrosive chemical effluents.

(b) One 24 in. viscose sewer, constructed of vitrified tile pipe poured solid in concrete, carrying diluted viscose waste, caustic soda, soap, bleach, and other alkaline chemical effluents.

(c) One 18 in. acid sewer, constructed of acid-proof vitrified tile pipe poured solid in concrete, carrying all acid effluents.

(d) One 8 in. cast iron sulphide sewer, carrying sulphide wash effluent from staple fibre washing area.

Raw Materials Handling and Storage

Following are the principal raw materials used in manufacture of viscose rayon. Approximate annual consumptions are shown at the 1955 level:

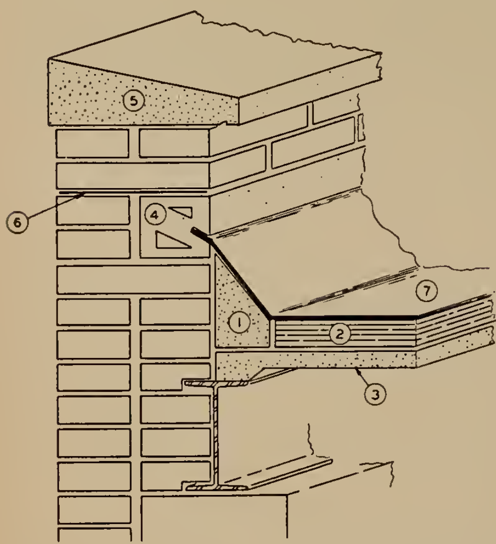
	million lb.
Wood pulp	85
Caustic soda	70
Carbon bisulphide	30
Sulphuric acid	120

Approximately ten days' to two weeks' supply of each of these materials is kept in storage in the plant.

Raw materials arrive at the Cornwall plant by road transport and by rail; the majority by road transport. Rail service is by electric locomotive over a rail spur entering the plant on the north side from the main Cornwall switching yards of the C.N.R. and C.P.R. Road transports have direct access to the plant through the main gate on No. 2 Highway about two miles east of downtown Cornwall. Materials entering the plant by road are weighed over a large road scale at the plant entrance.

Wood pulp is received in 500-pound bales loaded in rail box cars. Pulp bales are removed from the box cars by battery-operated high-lift fork trucks which carry them, 4 bales at a time, to the pulp storage room where they are stacked 8 bales high. Several different types of pulp are used, and these are stacked in different areas of the storage room (Fig. 6). When needed for use, pulp bales are removed from storage by fork truck, 4 bales to a load, and deposited on a mechanical pulp tilter which feeds them on to a long live roll conveyor which carries them into the pulp blending room. Here the bales are manually transferred to a series of gravity roll conveyors that permit the correct blending of different types of pulp in preparation for loading into steeping presses.

Caustic soda is received at 50 per cent concentration by road tank transports and by rail tank cars. These are unloaded through flexible pipes by gravity into a soda receiving tank from which the soda is pumped to a battery of 20,000-gallon storage tanks. When needed for use, the soda is pumped from storage tanks to special make-up tanks where it is diluted with water or with recovered soda. In this diluted form it is pumped through steel pipes to the steeping presses.



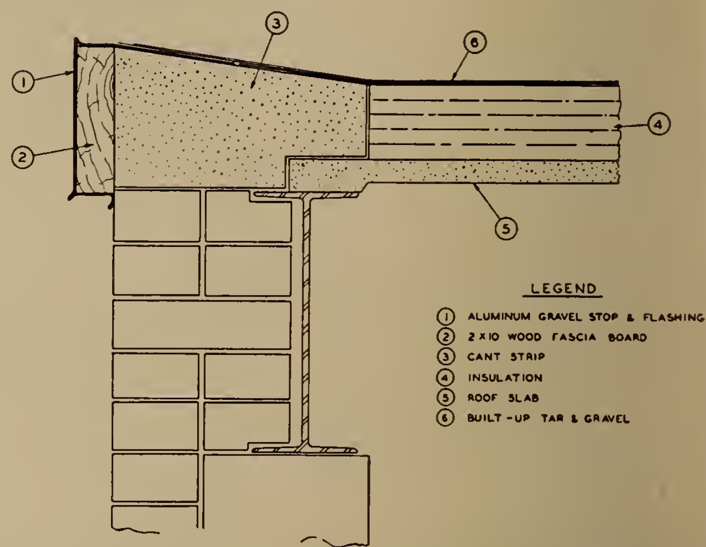


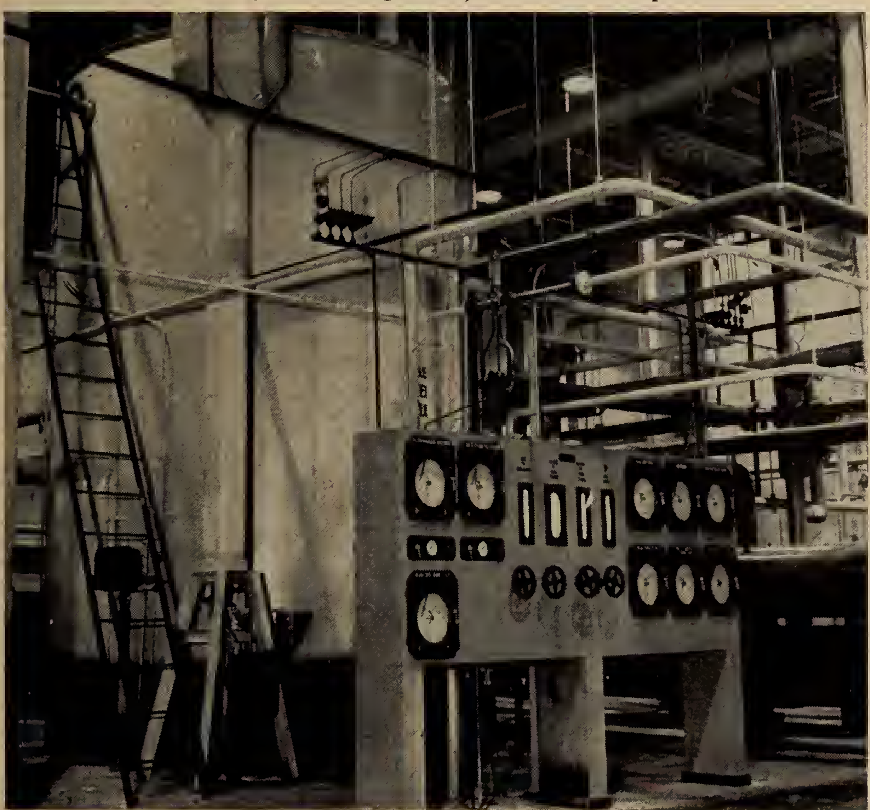
Fig. 4 (left). Flashing at parapet wall. Reference legend: (1) cant strip; (2) insulation; (3) roof slab; (4) flashing block; (5) stone coping; (6) through-wall flashing; (7) built-up tar and gravel. Fig. 5 (right). Flat roof detail.

Carbon bisulphide is stored in a separate CS_2 storage building located some 300 feet north of the central viscose plant. No other buildings are permitted in its vicinity. This precaution is necessary because of the highly inflammable nature of the liquid and the highly explosive nature of vapour-air mixtures. CS_2 is received in rail tank cars, from which it is removed by displacing its volume with water. By water pressure, it is piped into a batterv of speciallv-constructed 11,000-gallon storage tanks which are kept submerged in water within the storage building. CS_2 is a liquid which is heavier than water (specific gravitv is 1.3) and which does not mix with water. This makes it possible to do all moving of the liquid with water pressure.

When kept in tanks, it is sealed from contact with air bv a laver of water. At every step in the handing if this liquid, great care is taken to prevent static sparks by electrically grounding tank cars and all handling equipment. The CS_2 storage building is specially ventilated with a continuous supply of fresh air in order to ensure that no pockets of vapour can collect. CS_2 is circulated by water pressure through nickel pipes from storage tanks to churn house. These pipes are carried overhead on a line of steel posts joining the two buildings. In the churn house the CS_2 passes through a specially constructed heat exchanger which provides automatic temperature control, to a head tank where it remains until drawn off in automatically measured batches for use in charging the churns.

Fig. 6. Stacking 500-lb. bales of wood pulp in the pulp storage room of the central viscose plant. Battery-operated high-lift fork trucks are used.

Fig. 7. One of the automatic control panels in the soda preparation department. At left is one of the large soda storage tanks, insulated for temperature control.



Sulphuric acid is received at 94 per cent concentration in both rail tank cars and road tank transports. These are unloaded by air pressure and the acid is piped to a battery of 14,000-gallon storage tanks located just south of No. 5 mill. A single 6 in. extra heavy steel pipe, running horizontally close to the ground, connects the bottom of each storage tank to a small acid well located outside the wall of the strong acid pump room in the main building. Inside the pump room, four vertical, self-priming, centrifugal pumps are located about ten feet above ground level. Each pump has its own suction pipe dropping into the acid well outside the wall. These pumps deliver strong acid to the acid preparation areas for each of the three main spinning departments; textile, staple fibre, and tire yarn. The pumps are started and stopped electricallv by float switches on the strong acid supply tanks, one in each acid preparation area.

Viscose Manufacture

First step in production of viscose (Fig. 8) takes place in steeping presses. Here the pulp sheets are steeped in caustic soda. After steeping, excess soda is removed bv hvdraulic ram which moves forward and exerts a total pressure on the sheets of over 100 tons. The steeped pulp sheets are discharged through the press ends into shredders where they are broken into small white particles called crumbs, similar to breadcrumbs in appearance. The complete steeping cycle, after manual loading of pulp into the press, is controlled automatically by cycle timers, relays, and limit switches. Shredders are jacketed for temperature control of the crumbs during the shredding operation. Temperature is controlled by automatic regulation of the flow of chilled water through the jackets.

Crumbs from the shredders are dumped into large cylindrical crumb cans, where they are lightly consolidated by pressing on a crumb can press. Battery-operated low-lift platform trucks move the crumb cans to mercerizing rooms. Here the crumbs are stored, or mercerized, for a number of hours at constant temperature automatically regulated to within ± 0.5 deg. F. This close control of room temperature is obtained by using a large number of conditioning units throughout each room. A conditioning unit consists of a fan and two sets of coils, one for cooling with chilled water, the other for heating with low pressure steam. Automatic control of flows of chilled water and steam gives very accurate regulation of room temperature.

From mercerizing, the crumb cans are moved by battery-operated, low-lift platform trucks to crumb can elevators which lift them to the fourth floor of the churn house. They are removed from the elevators by special battery trucks with spark-proof electrical construction, and placed over the churn chutes, through which the crumbs fall by gravity into churns on the floor below.

In the churning operation, carbon bisulphide is mixed with crumbs to form cellulose xanthate. This operation is hazardous, and elaborate precautions are taken to minimize both the possibility of explosion and the damage that would result if an explosion occurred. Churns are evacuated by a separate vacuum system in order to vaporize the CS_2 as soon as it enters. This improves the reaction between crumbs and CS_2, and also provides for removal of CS_2 fumes and reduces explosion hazard. After crumbs and CS_2 have reacted for a time, charges of water and caustic soda are dropped into the churn to form a coarse slurry with the xanthate. Large, slowly rotating paddles in the churns give a thorough churning action to the crumbs, xanthate, and slurry throughout the churning operation. The entire churn cycle is automatically controlled by cycle timers, relays, and limit switches. Churns are jacketed for automatic control of temperature during the churning operation. Temperature control is obtained by automatic regulation of the flow of chilled water through the jackets.

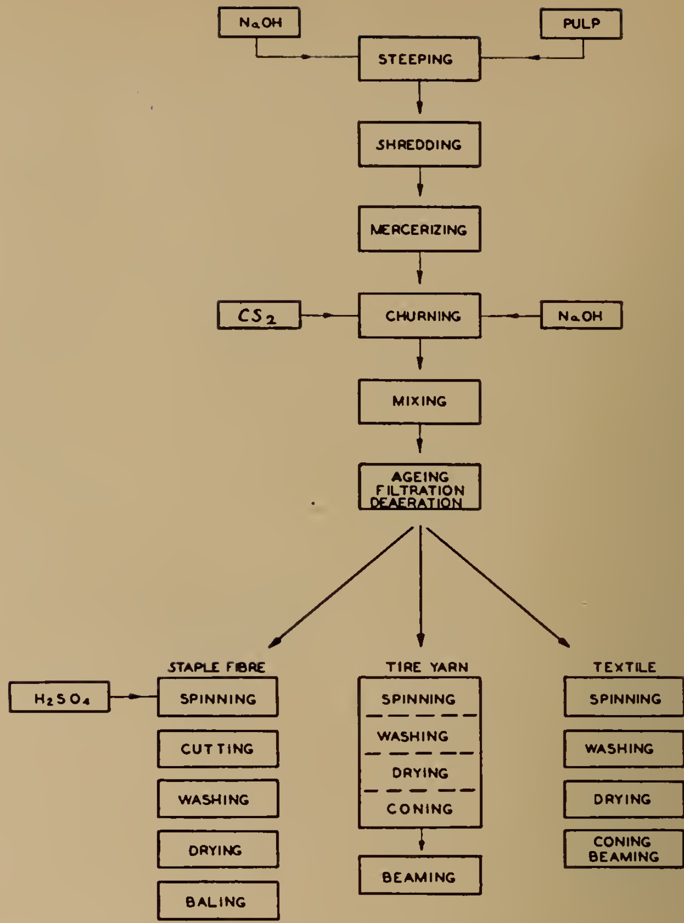


Fig. 8. Flow sheet of the viscose rayon process.

Xanthate slurry drops from the churns into mixers. These are vessels fitted with large slow-moving paddles. In the mixers, all remaining solid particles in the slurry become dissolved, and the resulting amber-coloured, syrupy liquid is known as viscose. Mixers are also jacketed for automatic temperature control of viscose during the mixing operation. Temperature control is obtained by automatic regulation of the flow of brine at 15 deg. F. through the jackets.

The churn house building is fitted throughout with double explosion sash. The entire electrical installation, except within the switch rooms, consists of explosion-proof fittings and materials. All lighting circuits, and the electrical intercommunications system, are explosion proof. To avoid additional high cost of explosion-proof switchgear, the switchrooms were isolated and pressurized so as to make entrance of combustible fumes impossible. All conduits leaving or entering the pressurized switchrooms are sealed to prevent passage of gas.

Viscose from the mixers is collected in tanks and pumped to the three viscose caves, located near the staple fibre, textile, and tire yarn spinning departments. All pipe lines carrying viscose are covered with three inches of cork insulation to maintain constant viscose temperature. Viscose caves are equipped with automatic temperature control to ± 0.5 deg. F. in the same way as mercerizing rooms. In the caves, the viscose is aged, and then passes through plate-type filters dressed with cotton batting and other fabrics. It then passes to de-aerating tanks where all entrained air is removed in preparation for spinning. De-aerated viscose is pumped through another bank of plate-type filters dressed with fabric, and thence to the spinning machines where the cellulose is regenerated by action of sulphuric acid, and filaments of viscose yarn are formed.

Staple Fibre Plant

On staple fibre spinning machines (Fig. 9), viscose is extruded through multi-hole jets into a sulphuric acid spinning bath, where acid reacts with soda in the viscose, permitting regeneration of cellulose into a continuous filament from each hole in the jet. Staple fibre jets contain from 2500 to 10,000 holes each. The holes are approximately 0.003 in. diameter. Jets are made of an alloy of platinum and rhodium. Filaments from each jet are drawn out of the spin bath by glass godet wheels. Yarn from many godet wheels converges along the machine to form a large tow containing up to one million filaments. All parts of the spinning machines coming in contact with acid or acid fumes are constructed of or covered with lead, neoprene, hard rubber, porcelain, or other acid-resisting material.

The yarn tow is drawn away from the spinning machine by large lead-covered tow drums located over the staple fibre cutters. From the tow drums it drops into the cutters which cut it off into staple lengths which can be varied from ½ inch to 6 inches. A cutter consists of a rotating horizontal disc around the periphery of which several knife blades are evenly spaced. The tow enters the disc through an axial opening at the top centre, and passes outward through the disc by centrifugal force through a radial hole connecting with the centre opening and emerging at the disc periphery. As tow emerges from the disc it is cut off into staple lengths by the cutter knives. All materials used in disc and knife construction are acid resistant. The area surrounding tow drums and cutters is lead covered. Heavy concentrations of carbon bisulphide and hydrogen sulphide fumes are liberated in spinning and cutting operations, and an elaborate system of foul air extraction is always in operation in these areas. Both spinning machines and cutters are enclosed by windows in order to make fume extraction more effective.

Cut tow from the cutters falls into stainless steel bowls from which it passes on to the staple fibre washing machines. Washing machines move the product forward in blanket form by the walking beam principle. Through the length of the machine, the staple receives many types of washes, rinses, and chemical treatments, each requiring use of materials that will satisfactorily withstand corrosive attack by the chemicals being used. Materials of construction include lead, wood, reinforced plastics, stainless steels 304, 316, and 317, Carpenter 20 stainless alloy, rubber, polyvinyl chloride, and Teflon. A pair of squeeze rolls extracts excess moisture from the blanket before its entry into the staple fibre driers.

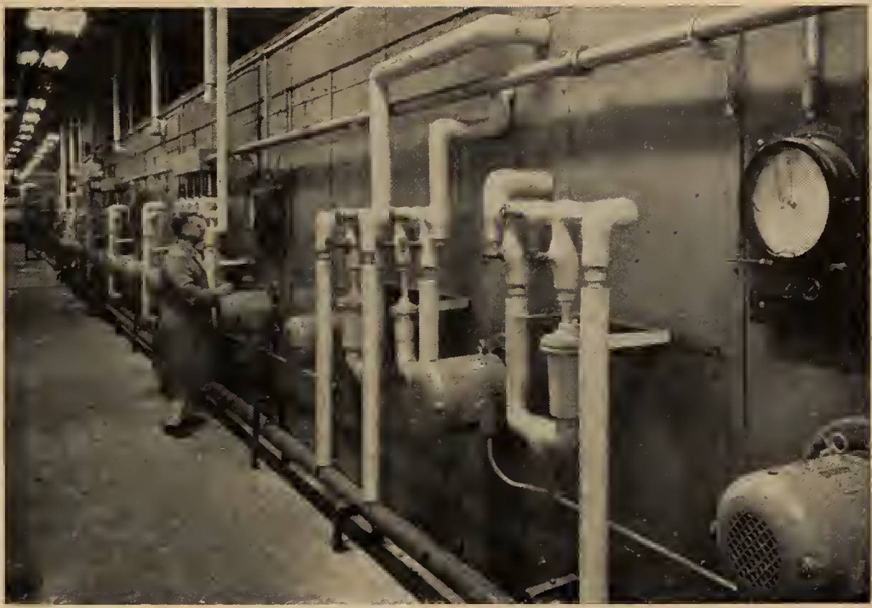


Fig. 8A. A staple fibre drying machine. Electric motors (seen projecting from side of the machine) circulate hot air; temperature recording and controlling instruments are also shown. The insulated pipes carry steam and condensate.

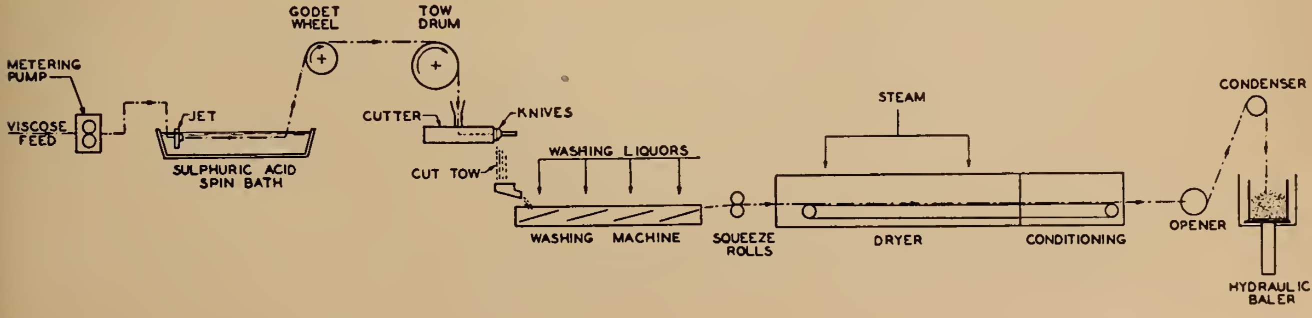
The blanket from the washing machine squeeze rolls is broken up by a beater as it enters the drier. The broken pieces are then re-distributed into another blanket on the drying machine conveyor. This conveyor carries the blanket slowly forward through successive drying stations, each of which is automatically temperature controlled. The dryers use steam heated coils and forced air circulation in each drying section. (Fig. 9.)

When it leaves the drying machines, the staple is opened by conventional textile openers, and then is carried pneumatically into textile condensers, from which it falls as staple fibre into large vertical baling presses. Staple fibre balers are hydraulically-operated presses. They compress the staple into 500 pound bales ready for shipping. Bales are carried away to storage and shipping, four bales to a pallet, by battery-operated, high-lift fork trucks. Staple fibre is shipped by road transport and by rail.

Tire Yarn Expansion

Up to this point, all the expansions and installations that have been discussed have been located in or near the new No. 5 mill, and have involved erection of new equipment in new buildings. As previously mentioned, the tire yarn expansion involved in-

Fig. 9. Schematic diagram of the staple fibre production process.



stallation of new equipment and machinery within older, existing buildings. This fact resulted in very different types of engineering problems. Space available for new installations was very often insufficient for straight-forward planning. Sometimes there was not enough headroom to allow proper sloping of pipe runs; sometimes there was not enough area, or the area available was not the right shape. Installations and layouts had to be trimmed and altered to fit, and to function properly, in spaces that could be made available. In several cases, reinforced concrete basement floors had to be broken up, excavated, and re-poured some four feet lower than their original level. This was usually necessary in order to provide correct slopes on acid return lines that must flow by gravity. In some cases, even lowering the floors was not sufficient to obtain correct gravity flows, and entire acid circulating systems had to be modified so that liquids could be pumped under pressure instead of flowing by gravity.

Another type of problem resulted from overloading of existing column footings caused by excessive weight of the new installations. In some of these cases it was possible to add new structural steel members within the building so as to distribute the new load over more columns. In other cases, the column footings had to be excavated and strengthened. In still other cases, additional steel columns resting on new footings were added.

As already mentioned, the tire yarn machines were of an entirely new type, representing a new concept in the spinning of viscose rayon yarns. They are known as continuous spinning machines. They are distinct from box spinning machines used to produce textile yarn in that the continuous machines, as their name implies, spin the viscose into yarn in a continuous operation, there being no interruption of the spinning process in the manner of box machines, where spinning is stopped every few hours to allow removing of acid cakes of yarn from spinning boxes. On continous machines, viscose is coagulated or spun through spinning jets into an acid spin bath, and the resulting yarn is picked up on glass godet wheels which carry it into hot stretch baths. The yarn is stretched through these hot baths and then passes over bakelite drums where it is washed acid free with warm soft water. From the wash drums, the yarn passes through a finish bath, down through drop tubes to the floor below, where it passes over steam-heated dryer drums, and is finally wound on to cones. All this happens in one continuous operation. Full cones are doffed and new cones are started without interrupting the flow of yarn through the machine.

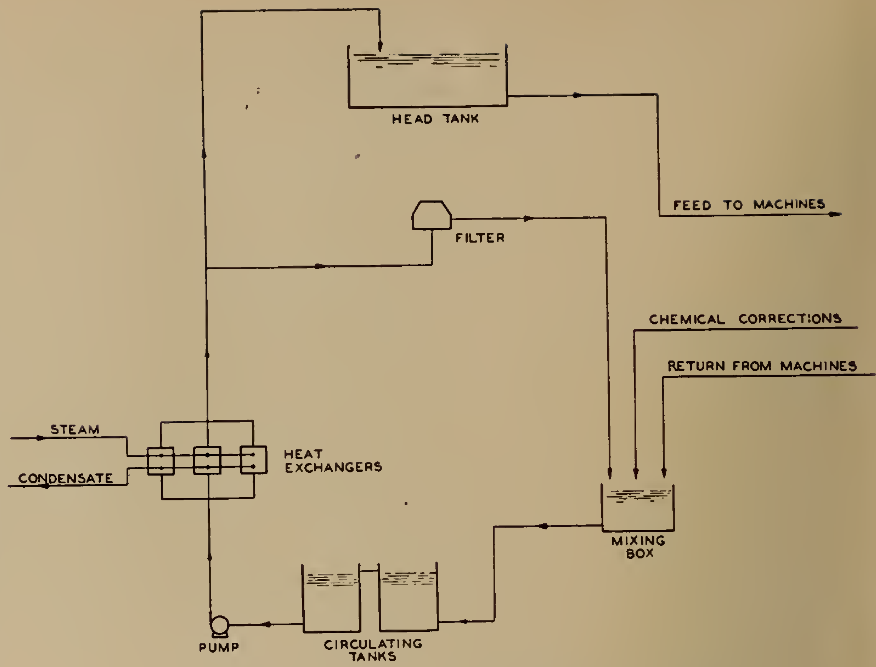


Fig. 10. Schematic layout of a typical spin acid system.

First installation of continuous spinning tire yarn machines involved erection of eight of these machines, together with acid and fluid systems and various services facilities in the east end of No. 2 mill. This project was started in 1946 and completed in 1949. Almost continuous further expansion of this installation has taken place during the succeeding years.

The tire yarn machines themselves have some interesting features. Viscose pumps, bottom godets, top godets, wash drums, dryer drums, and coning machines—all these rotating groups — must be driven at different speeds, and all speeds must be independently variable so that different qualities of yarn may be produced. All the rotating elements on each machine, except the coning machines, are driven by a single 10 h.p. main drive motor housed at one end of the machine. This motor transmits power through a specially designed series of variable speed drives to give a separately controllable speed to each of five shafts that run the length of the machine. From these shafts, the individual pumps, godets, wash drums, and drier drums are driven through gear trains at speeds that may be adjusted to give various linear volocities to the yarn.

Coning machines are driven independently of the main machine. Each coning head is driven by its own individual motor.

Godet and wash drum drive shafts are carried in fabricated steel housings extending from end to end of the machine, and these housings constitute the framework or backbone of the machine. This entire framework, together with the acid bath, is completely covered with sheet lead to protect the mechanism from corrosion by acid attack. All parts coming into contact with the acid, or even with acid vapour or fumes, are made of such acid resistant materials as glass, bakelite, polyvinyl chloride, porcelain, lead, and hard rubber. The spinning jets themselves are made of an alloy of platinum and rhodium, and they are carried by rounder ends made of stainless steel and covered with hard rubber or p.v.c.

The ever-present problem in designing, building, operating, and maintaining viscose rayon spinning machines, is to find materials and methods that will better withstand acid corrosion and that will give better means of sealing the driving mechanisms from entry of acid in liquid form or as vapour.

Acid Preparation Systems

A typical acid system (Fig. 10) is located in an area, usually two or three floors in elevation, in the vicinity of a group of spinning machines. The purpose of acid systems is to supply spin acid, hot stretch fluid, and soft finish solutions to the machines at correct concentrations, flows, temperatures, and clarity. Equipment installed in these areas includes pumps, tanks, filters, clarifiers, mixers, heat exchangers, air blowers, and associated control equipment. (Fig. 11.)

All pieces of equipment handling spin acid and hot stretch solutions are made of acid-proof or acid-resistant materials. New materials are constantly being developed, tried, and installed that will better withstand the corrosive attack of acid solutions. Hot stretch liquors are the most corrosive, because of their high temperature and low acid content. Tanks are lined with sheet lead or with hard rubber. Rubber lining gives good service on spin acid tanks, but is not suitable for the high temperature of hot stretch solutions. Pipes carrying these liquids have traditionally been made of lead. However, of recent years, hard-rubber-lined and Saran-lined steel pipes have been replacing lead pipes in spin acid systems, and double-tough glass and reinforced plastic pipes have been replacing lead pipes in hot stretch systems. Soft finish solutions are carried in stainless steel pipes. Lead valves are used extensively for all acid solutions. Rubber lined diaphragms are also suitable for most of the highly corrosive liquors.

Choice of suitable pumps for spin acid and hot stretch services is very important. High speed centrifugal pumps fail from corrosive attack faster than low speed pumps. Almost all pumps used are designed for operation at less than 1800 r.p.m., many of them operating at speeds of 1200 r.p.m. and 900 r.p.m. Lead bodied pumps with lead or high nickel alloy impellers are used successfully for spin acid. Pumps made of stainless alloys are used for moving hot stretch solutions. Other pumps that are used in smaller numbers in acid systems are: carbon pumps, reinforced plastic pumps, porcelain pumps, and glass lined pumps.

Traditionally, standard practice in heating spin acid called for installation of large, lead lined steel acid heating tanks on the top floors of acid preparation areas. From these heating tanks, acid flowed by gravity, sometimes through quartz filters, to the spinning machines. Heating the acid was done by hot water circulating through lead coils immersed in the tanks. The water in turn was heated by steam in conventional shell-and-tube heat exchangers. This was the acid heating system installed for the first eight tire yarn machines in No. 2 mill. It so happened that there was ample room to install this equipment on the upper floor, directly above the machines; and this acid heating system was expanded in subsequent years to serve a total of 22 machines.

However, when it became necessary to build another complete acid system for more tire yarn machines, enough space for acid heating was not available on the top floor, and a very different type of acid heating system was necessary. In this case, the entire acid heating system had to be constructed in the basement area. A solution was found in the use of cubic carbon heaters. This type of heater consists of a cube of impervious graphite, held in compression by two end plates bolted together. (Fig. 12.) The graphite block is perforated by two series of holes running through the block in successive layers, each layer of holes at right angles to those on either side. Thus the cube is like a honey comb, with the liquid to be heated flowing through one series of holes in one direction, and the heating medium flowing through the other series of holes in the other direction, the heat transfer taking place through very thin walls of highly conductive impervious graphite.

Steam is used directly to heat the acid in these heat exchangers,

Fig. 11. Two settling tanks in one of the spin acid preparation departments. Sediment is drawn off from the conical bottoms; clear acid through the side connections. Steel plate tanks are lined with sheet lead burned in place after installation. Lead pipes at ceiling are supported on wooden blocks in steel channels.

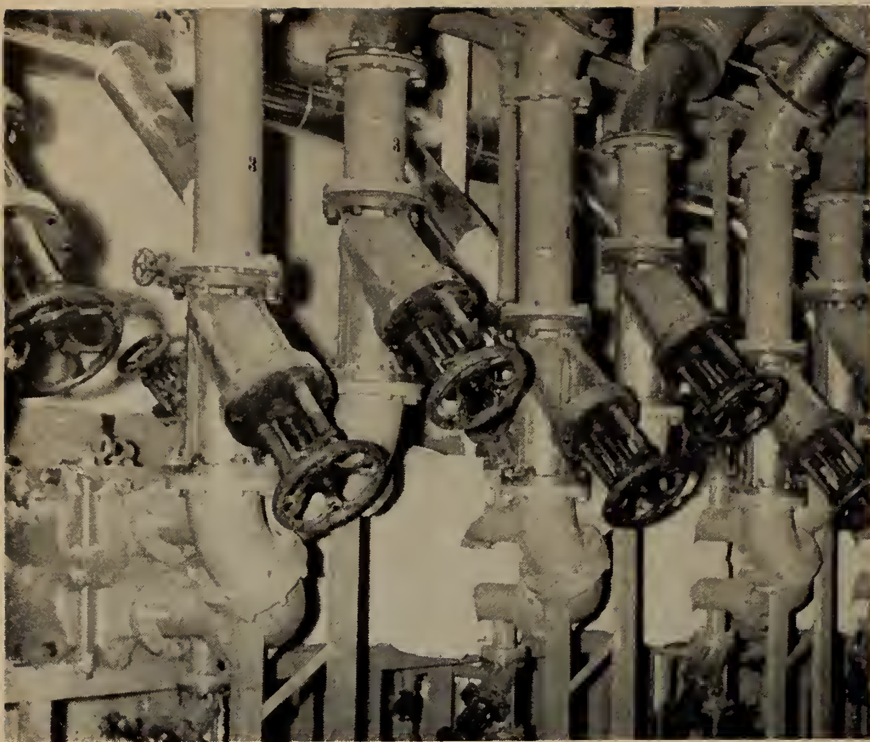


Fig. 12. A battery of cubic carbon heat exchangers in one of the spinning acid heating installations. Spinning acid enters through bottom front and leaves through top front connections. Steam enters through ports on sides of units. Exchanger at left is not lagged; others are insulated by removable asbestos bags filled with rock wool. Rubber-lined steel pipe and lead valves carry acid.

thereby eliminating the use of water as a middle agent, and greatly increasing the efficiency of the heating operation.

In this installation, 14 cubic heaters do the same job as was accomplished in the more conventional system by: nine 1500-gallon tanks, 54 lead coils, two shell-and-tube heat exchangers, and two centrifugal water pumps, together with all associated piping. Initial cost of the cubic heater installation was much lower than that of the heating tank system, and the efficiency was higher. This was a case of necessity being the mother of invention. The modified heating system necessitated by acute lack of space turned out to be a much better system, lower in cost, lower in maintenance, and higher in efficiency.

Ventilation

Adequate supply of fresh air to spinning and acid preparation areas and to other process departments, and effective removal of fumes from spinning machines and acid tanks and other areas, are very important considerations in every viscose rayon plant. Fresh air is required for personnel comfort and safety. Also, fresh air at controlled temperature and controlled humidity, is required by many parts of the process. Foul air extraction is necessary for removing chemical fumes and excess heat that are liberated from many processes, particularly from the spinning machines themselves and from tanks and heaters in the acid systems.

Hydrogen sulphide and carbon bisulphide, both highly toxic and dangerous gases, are liberated when viscose is coagulated in the spin bath. For this reason, design of every spinning machine incorporates a large foul air duct, running the length of the machine, which removes these gases as they are given off. It is important that these ducts be located and branched in such a way that fumes are collected as close as possible to the points where they are released, and also that movement of air from room into machine be such that a stream of fresh air is always passing inward past the operators' heads as they do their work. Foul air systems are designed to give a static suction of 2½ to 3 inches of water in the exhaust ducts in the spinning areas. Fresh and foul air systems are designed to ensure that H_2S and CS_2 gases are never present in the atmosphere of any part of the plant in quantities more than ten parts per million. Normally, maximum gas concentrations in spinning and acid preparation areas are held below five parts per million.

Part of the H_2S and CS_2 gases liberated in the spinning operation becomes dissolved in the spin acid and circulates around in the acid system to be released into the atmosphere at places where the acid is agitated and exposed to air. For this reason it is highly important to extract fumes from all acid tanks and launders, and to ventilate properly and remove foul air from all acid preparation areas. Foul air removal from these areas also serves the purpose of removing excess heat that escapes from the system in spite of considerable thicknesses of lagging applied to all hot equipment.

Corrosion conditions are very severe in foul air ducts, especially in ducts drawing from spinning machines and acid systems. Here high temperature, high acid content of the extracted fumes, and heavy condensation of moisture within the ducts. combine to give the most corrosive conditions found in ventilation systems. Lead ducts stand up very well under these conditions, but are very expensive because of large size of the ducts and the large amount of reinforcing required. Steel ducts lined with plasticized p.v.c. or hard rubber are now being used to replace lead ducts in areas where condensation is heavy.

Aluminum ducts are used in locations where the extracted fumes are drier, or where they already lost much of their moisture. Main ducts leading to large foul air fans are usually constructed of reinforced concrete lined with acid proof brick or with trowelled-on asphalt. Corrosion is not so severe in these main ducts because the extracted fumes have already lost much temperature and much humidity while passing through the branch ducts. In most cases these main exhaust ducts, because of their large size, form an important part of the building structure. In buildings used for spinning and acid preparation, footings, foundations, and building framework are conformed to suit the layout of main foul air ducts.

Main foul air ducts in each major production unit converge into a large plenum chamber adjacent to one of the foul air fan rooms. Here the main foul air fans are mounted. Before 1950, large centrifugal fans were installed on foul air service. They had capacities up to 150,000 c.f.m. and produced in the ducts static suctions up to 2½ and 3 inches of water. They were driven through V-belt drives by

75 h.p. and 100 h.p. electric motors. Most of them had steel casings that were lined with trowelled-on asphalt after installation. Fan wheels were of steel construction, painted with asphalt once or twice a year. These asphalt-painted wheels had a life of 12 to 18 months on the more severe services. Specially constructed steel wheels, lined with 1/16 in. and ⅛ in. sheet neoprene, are now used in these fans and give good service for a number of years.

Foul air fan rooms constructed since 1950 have been fitted with large axial-flow fans. These are lower in initial cost and require less maintenance than centrifugal fans of the same performance. Axial-flow fans are mounted directly in the airstream. They do not require large plenum chambers. This means that they can be mounted in simply constructed fan rooms. Sometimes they can be mounted in the foul air duct itself, thus requiring no fan room at all. They can be mounted either horizontally or vertically, in this respect being much more adaptable to different conditions than are fans of the centrifugal type. Axial flow fan casings are constructed of aluminum for small sizes and of fabricated steel for larger sizes. Steel casings are asphalt-painted for service under mild corrosive conditions, and are lined with sheet neoprene or hard rubber when required to withstand severe corrosion. Fan impellers are made of cast aluminum. This material gives good service even under fairly severe conditions. Neoprene or rubber covered steel impellers are used where corrosive conditions are very severe.

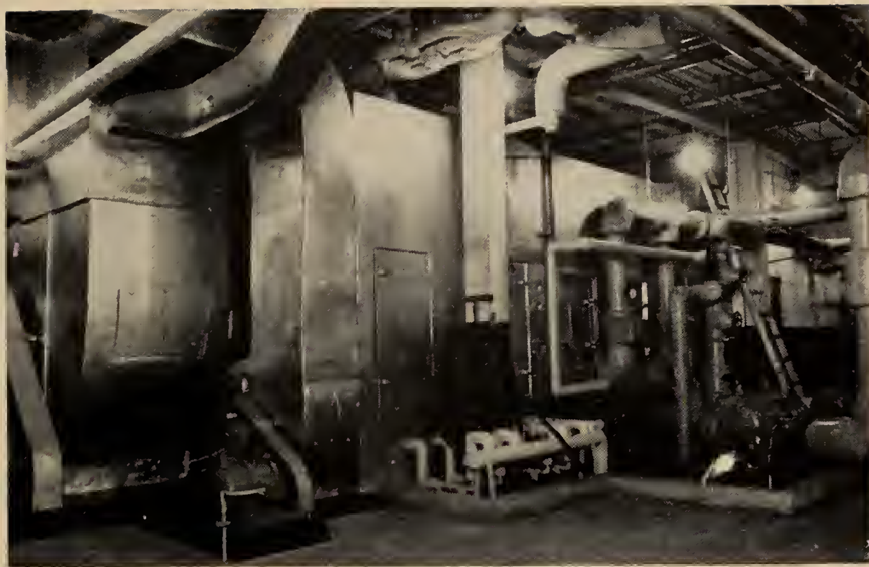


Fig. 13. A large air conditioning unit which supplies spinning and other process departments. Fresh air fan at left; air heating and washing compartments, centre and right; water circulating pumps at extreme right. Unit and ducts are insulated.

Small foul air fans, located close to the source of acid fumes, must stand up under the worst corrosive conditions. Large main foul air fans, located at considerable distances from spinning machines and acid tanks, and handling cooler, drier fumes, are not so subject to corrosive attack.

All main foul air fans discharge through underground or overhead ducts into one of the fume stacks. These are brick chimneys, acid-proof brick lined, having inside diameters of about 15 feet, and rising 225 feet or more above the ground. One foul air stack serves the entire continuous spinning tire yarn installation. Into it a total of five main foul air fans discharge acid fumes at a total rate of approximately 500,000 c.f.m. Three other such stacks carry away foul air from the other spinning and acid preparation areas throughout the plant. Total volume of foul air being exhausted continuously through the stacks is in excess of one million cubic feet per minute. A total of 12 main foul air fans discharge into the foul air stacks.

Fig. 14. High speed tire yarn beamer, with creel. Partially-filled beam, foreground, is fed from cones of yarn on the creel, right background.

Fresh air, with controlled temperature and humidity, is supplied to spinning and acid preparation areas and to all process departments, in amounts approximately equal to the volumes of foul air being extracted. Fresh air fans are similar in size and numbers to the foul air fans already described. Both centrifugal and axial-flow fans are used on fresh air services. All main fresh air fans draw in outside air through heating coils, air washers, and humidifiers. Fresh air distribution ducts are made of sheet aluminum or galvanized sheet steel. (Fig. 13.)

Acid Recovery

The process of spinning viscose rayon involves a chemical reaction that takes place between sulphuric acid in the spin bath and sodium hydroxide in the viscose. This reaction results in formation of sodium sulphate and water. Water thus formed dilutes the remaining acid in the spin bath solution. In order to maintain the necessary acid concentration in the spin bath, every acid preparation area includes a continuous correction of strong sulphuric acid. This results in gradual formation of an excess volume of spin acid and an excess of sodium sulphate. These excesses are removed in the acid recovery process.

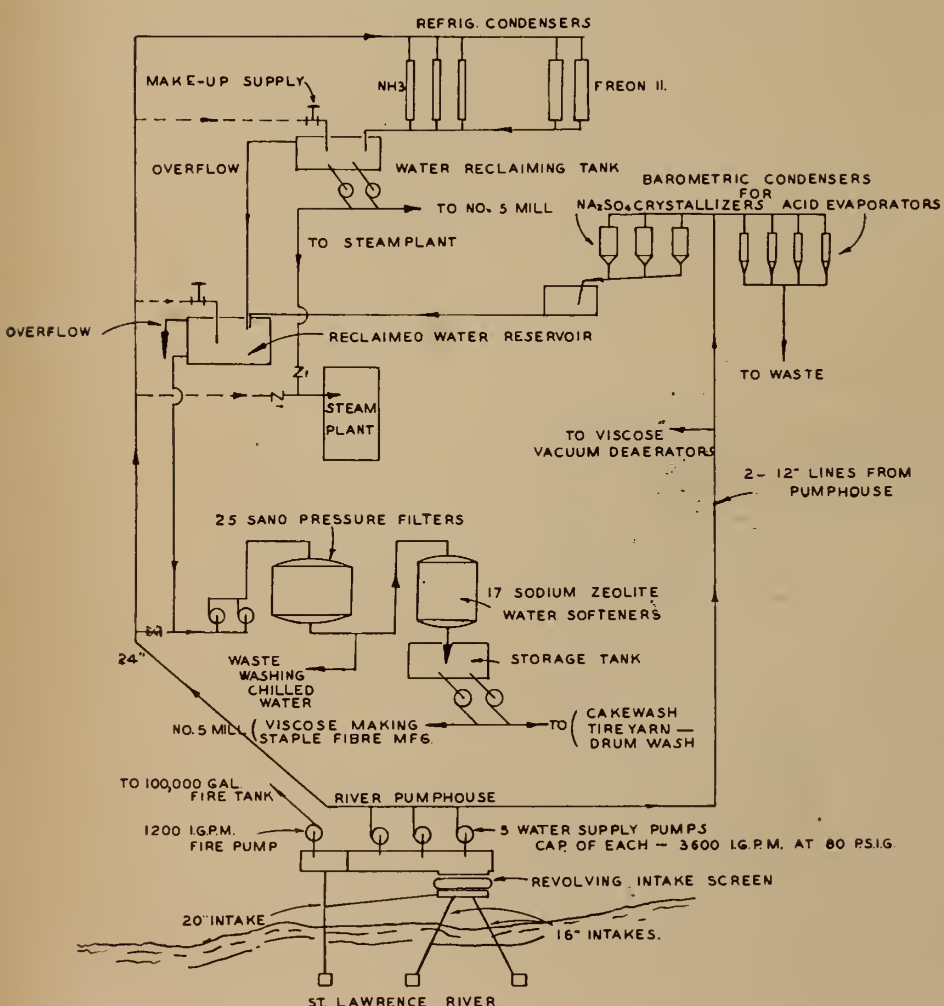
From each acid preparation area, there is a continuous flow of excess acid back to the acid recovery building, where it gathers in large acid collecting tanks. From these tanks it is pumped to head tanks on the top floor, from which the acid flows by gravity into crystallizers and evaporators. In the evaporators, excess water is boiled off and the acid increases in strength until it can be returned to the spin acid circulating system from which it came. In the crystallizers, acid is cooled by evaporation so that excess sodium sulphate crystallizes and forms a magma with the cool acid. This magma drops by batches into large magma tanks from which it is pumped to rotary vacuum filters where Glauber's salt crystals are removed, making the acid suitable for returning to the spin acid system from which it came.

Staple fibre and tire yarn expansions have greatly increased the total volume of spin acid in circulation throughout the plant. Consequently, large expansions to acid recovery installations have been required. Each major phase of expansion in spinning has necessitated a corresponding increase in acid recovery service. The job of keeping the acid recovery process in step with expanding spinning operations has been complicated by the fact that there are now three separate products, acid from each one of which must be treated separately in the recovery processes. In order to obtain reasonable flexibility of operation under these conditions, it has been necessary to arrange recovery piping so as to cross-connect between many pieces of equipment, so that such units as evaporators and crystallizers can readily be changed by valving from one product to another.

Since 1945, three separate extensions have been added to the acid recovery building. In them have been or are being installed five additional crystallizers, ten more evaporators, and three more rotary filters. The staple fibre plant alone, because of its long distance from the acid recovery building, required installation of approximately 8000 feet of five-inch lead pipe in the tunnels joining the two departments. Large quantities of lead pipe, hard rubber-lined steel pipe, and saran-lined steel pipe are installed in the acid recovery building itself. Crystallizers are hard rubber lined, and have acid-resisting bronze or homogeneously lead lined evactor heads, and acid-resisting bronze or pure nickel venturi throats. Evaporators are hard rubber-lined and have heating elements fitted with carbon tubes mounted in lead or pure nickel tube sheets.

Before 1954, Glauber's salt, or hydrous sodium sulphate, removed from the acid by the rotary filters, was sluiced into the plant drainage system and wasted. A small portion of it was retained in bins for use in acid correction stations and for sale as Glauber's salt. In 1954, another extension was added to the acid recovery building to contain a new anhydrous sodium sulphate recovery process. Belt and oscillating conveyors were installed in the existing buildings to carry wet Glauber's salt from the rotary filters to the new building. Here, in the new process, the hydrous salt is circulated in the form of a thick slurry through two new evaporators which remove water of crystallization, thereby further concentrating the slurry, until it is ready for final filtering. Filtration is done by a large rotary vacuum filter, which is fed by hot air at 750 deg. F. from an oilfired furnace, and which removes the salt from the slurry, thoroughly dries it, and deposits it, in the form of a hot dry white powder, in a screw conveyor as anhydrous sodium sulphate. The hot salt passes through an attritor into the boot of a bucket elevator which carries it to the top of large reinforced concrete storage bins, into which it is distributed by another screw conveyor. From the bottoms of the storage bins, the salt is removed by twin-screw conveyors, lifted by bucket elevator, and falls by gravity either into box cars and hopper cars for shipping as bulk salt, or into bagging

Fig. 15. Schematic arrangement of the water system.



machines where it is prepared for shipping in paper bags.

Yarn Processing

The final step in manufacture of yarn is to package the products in forms suitable to the requirements of the industries that will use them. Tire yarn is shipped almost exclusively on beams. Textile yarn is shipped on cakes, cones, or beams. Yarn processing machinery is installed in No. 1 mill, from which the original spinning machines have long since been removed. Since 1948, to keep pace with constantly increasing output from the spinning departments, a number of new tire yarn beamers, new textile yarn beamers, and new slashers have been installed (Fig. 14). Beams of yarn weigh approximately 1200 pounds each. They are lowered from the beaming and slashing departments and stored on specially constructed beam racks located at the east end of the ground floor of No. 1 mill. A beam transfer elevator is used to move beams between racks for storage. Battery-operated forklift trucks remove them from the other end of the storage racks and place them for shipment on steel racks built into road transport trailers. All beams are shipped by road transport.

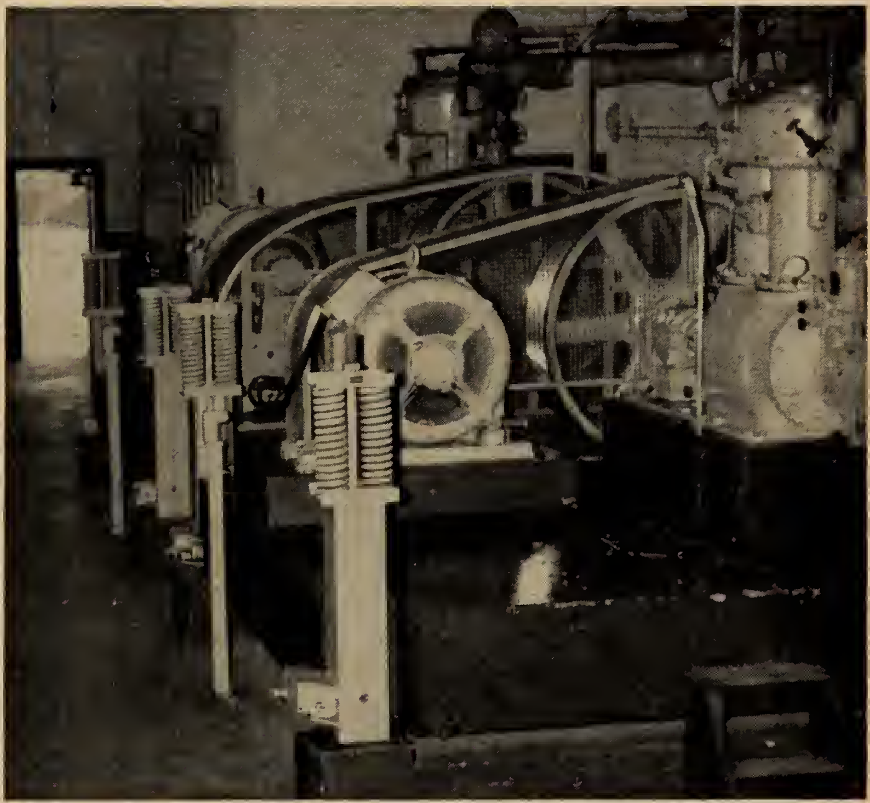


Fig. 16. Two V-belt driven ammonia compressors mounted on reinforced concrete inertia blocks. The entire block, carrying motor and compressor, is suspended from four vibration isolators (each a pair of coil springs in compression). Cylindrical neoprene blocks under compression, at bottom of the spring pedestals, limit motion of the inertia blocks. Piping connections are flexible.

Services

Power, heat supply, and heat removal together account for a considerable portion of the cost of manufacturing viscose rayon. This portion is largely made up of the following services. (Figures are approximate consumptions for 1955.)

Water	5000 x 10^6	Imp. gal.
Coal	115,000	tons
Refrigeration	150,000	tons
Electric Power	88 x 10^6	kwh.

The size of these figures, together with the necessity of controlling temperature within ± 0.5 deg. F. in many parts of the plant and process, requires continuous effort to improve and control services, if viscose rayon is to be manufactured efficiently and at top quality.

Expansion of services installations has been almost continuous through the years since 1945. One building extension has been added to the

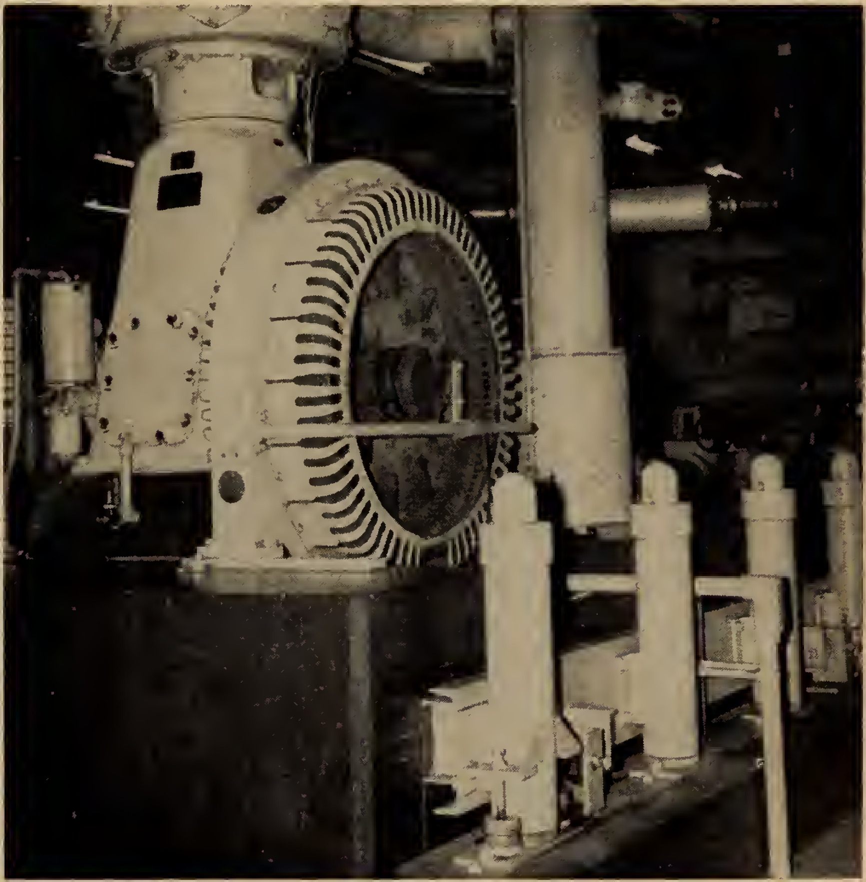


Fig. 17. Double-cylinder L-type air compressor with 100 h.p. synchronous motor; intercooler stands at right of motor. Entire unit is mounted on a concrete inertia block suspended by eight springs in compression. Cylindrical neoprene blocks at bases of two end isolators, on each side, limit motion of the inertia block. Flexible connections are used.

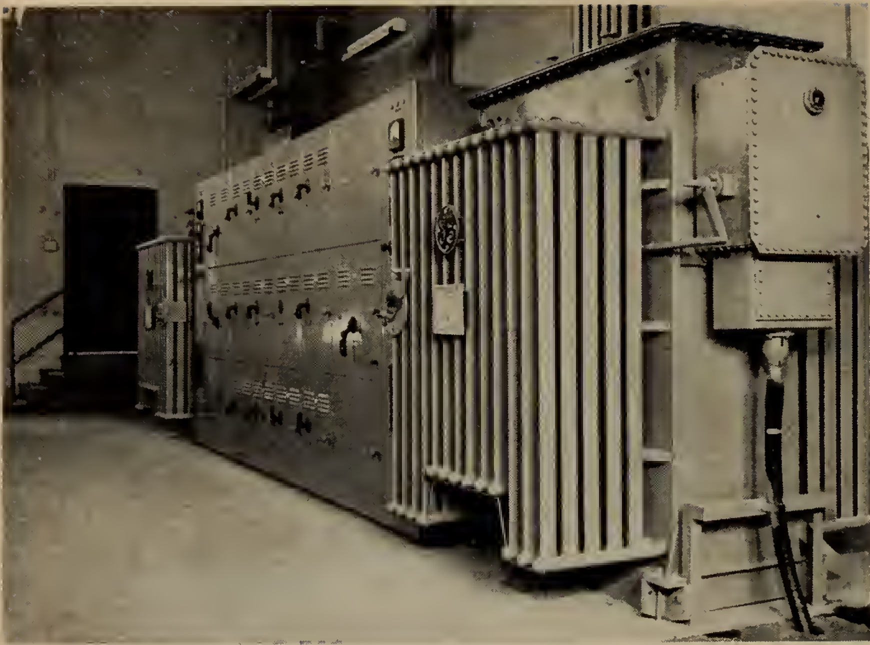


Fig. 18. No. 4 substation supplies electric power to the staple fibre plant. The two 1000 kva., 11,500/575 volts, pyranol-filled transformers flank the feeder control panel, which contains two bus-couplers to supply secondary power to any feeders from either transformer. Transformers are mechanically interlocked.

river pump house, and all new pumps and completely new pump discharge piping have been installed.

A completely new compressor room has been built and put into use; a new electrical distribution system has replaced the old outmoded and inadequate system; and many other changes and improvements to services equipment, too numerous to mention here, have been completed.

A constant problem in all this work has been to design and carry out the projects without interrupting supply of services to the plant. Since viscose manufacturing and all spinning processes are continuous, and since shutdowns are very expensive, it has been necessary to plan all plant changes so that they could be completed with the absolute minimum of interruption and disturbance of operating departments. Many of the services expansions have been carried out without interruption of the service involved. In cases where this has not been possible, final end connections for new installations have often been delayed until they could be made at a plant or departmental shutdown scheduled for other reasons, or at the annual plant holiday shutdown in July.

Water Supply System

Water is used throughout the factory in three general forms:

(*a*) Direct river water for general cooling.

(*b*) Filtered water for cooling where algae growth may be troublesome.

(*c*) Softened water for viscose manufacture and product washing.

Approximately 300 million gallons per month are pumped from the river. This water flows into the pump house suction well by three intakes, passing through an automatic, revolving, debris-removal screen in the process (Fig. 15). The water enters the river intakes from the top. Each intake is protected by a six foot by six foot grid having 1¼ inch openings. These grids have to be cleaned twice a year.

Five 3600 g.p.m. pumps supply water to the factory, taking their suction from the intake well directly below them. This water is used for direct cooling in refrigeration shell-and-tube condensers and in barometric condensers of the acid recovery evaporators and crystallizers.

Cooling water from the refrigeration system and the crystallizers is reclaimed. This amounts to approximately 200 million gallons per month, and this reclaimed water is used to supply all other factory requirements.

Water from the reclaiming reservoir is pumped through 25 sand pressure filters, and from the filters through 17 sodium zeolite pressure softeners. From the softeners it drops into collecting tanks and is then distributed throughout the factory. The amount of softened water used is about 60 million gallons per month. Water enters the softeners at approximately 130 parts per million of calcium carbonate hardness, and the effluent has a hardness between 5 and 8 parts per million.

About 100 million gallons of filtered water is used each month. This includes the softened water. The turbity of Saint Lawrence River water varies between 5 and 10. After filtration it becomes about 3 to 5. These values are based on Hellige turbidity meter readings. Because of the reclaiming system the water taken direct from the river is reduced by two fifths. Heat pick-up amounts to approximately 10 deg. F. Both these points assist plant economy.

So far seaway and power developments, although much activity has taken place within a few miles of the plant, have not seriously affected the factory water supply system. Dredging and resulting current changes have re-distributed the areas of ice jamming. This caused some difficulty in 1955 but may well be a passing phase. To-date, no noticeable increase in turbidity or colour of the water has been noted. There should be none when construction is finished. Just what the effect will be when coffer dams are removed and when dredging starts in the vicinity of the factory remains to be seen.

Steam Generation and Distribution

In winter months, total steam load is about 400,000 pounds per hour. Steam is generated at 200 p.s.i.g. One-half of it is used at this pressure and the remainder at about 20 p.s.i.g. This reduction in steam pressure provides a potential for economical by-product power generation. Although this is not done at present at Courtaulds (Canada) Limited, because of an economical power rate, it is done in other Courtaulds plants.

Steam is generated by six water-tube, chain-grate, stoker-fired boilers. Five of the units are equipped with economizers. Overall steam generating efficiency is 80 per cent. The following points in the steam distribution system are of interest: —

(*a*) All auxiliary steam is measured. This includes soot blower steam and steam used for the creation of turbulence in the furnace. By measuring auxiliary steam, it has been found that the boiler house uses 6 per cent of total steam generated.

(*b*) Arrangement of the steam distribution system is such that pipe line difficulties in the boiler house never necessitate a complete shut down of the factory.

Constant effort is required to bring back condensate to the boiler house. Thirty per cent of the steam is used directly, so that condensate returns cannot exceed 70 per cent of total steam produced. Condensate returned from the factory generally runs between 62 and 68 per cent of steam supplied to the factory. Condensate is a problem because from some processes it can be highly acid, from others highly alkaline. Acid and alkali contaminated condensate is handled in a special three-tank batch system. This system provides for automatic dumping of the condensate to drain before it reaches the batch tanks if pH becomes too low. Each tank is again checked for pH before it is emptied into the main condensate collecting tank. Automatic caustic injection, controlled by a pH meter, guards against low pH values.

Refrigeration System

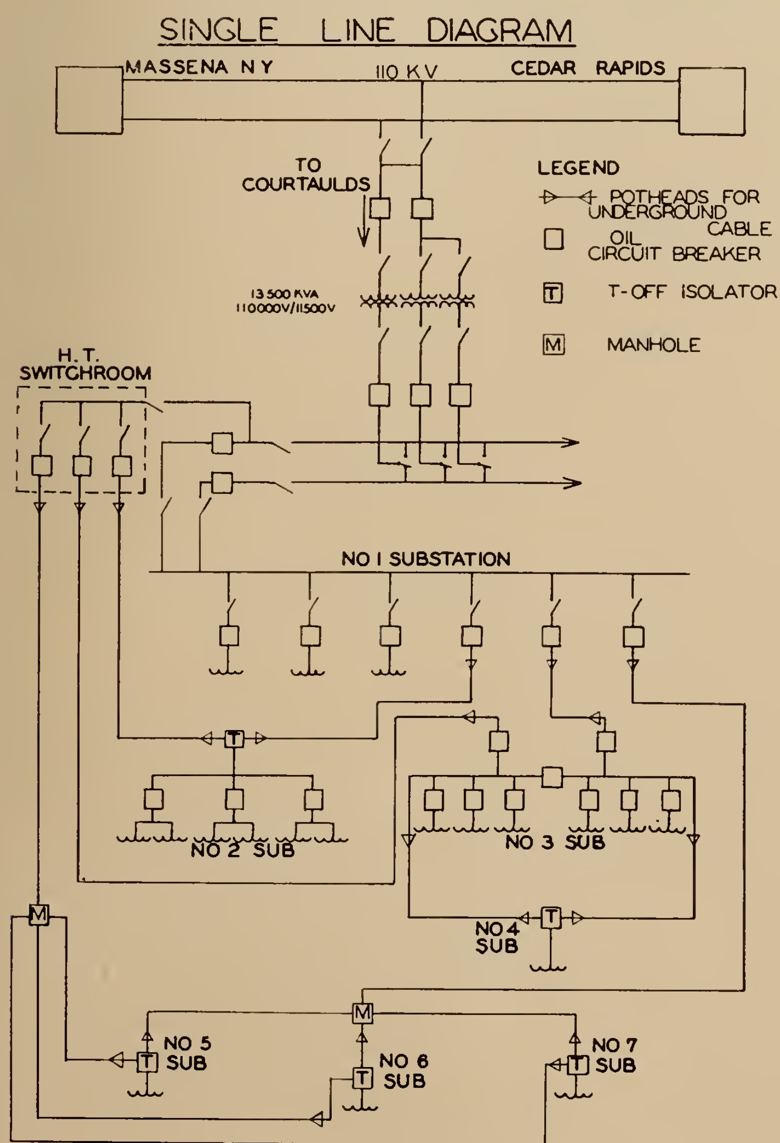
In the manufacture of viscose rayon, speeds of chemical reactions, and consequently properties of the product, are materially affected by temperature. To control process temperatures, two independent refrigeration systems are used at Courtaulds (Canada) Limited. These consist of:

(a) A 375-ton ammonia system, using calcium chloride brine as the refrigerating medium.

(b) A 1200-ton Freon system, using chilled water as the refrigerating medium.

Originally the factory had ammonia-brine refrigeration only. However, when No. 5 mill was built in 1946-48, it was decided to obtain the additional capacity required by the expanding plant by installing centrifugal refrigerating machines, using Freon as refrigerant. These were mounted in the new compressor room that was built as part of No. 5 mill. Also installed in the new compressor room were most of the ammonia units, air compressors, and vacuum pumps from the old compressor room.

Fig. 19. Single line schematic layout of electrical distribution system.



The ammonia-brine system, having a standard capacity of 375 tons, consists of five single-acting vertical compressors, discharging into ten shell-and-tube condensers. (Fig. 16) Ammonia collects in a receiver, from which it is piped to five brine coolers. Rate of cooling is controlled by float operated expansion valves. Calcium chloride brine is pumped through the coolers by the main brine circulating pumps. It enters the coolers at about 18 deg. F. and leaves at about 10 deg. F. Brine from the coolers is piped to all parts of the plant. Temperature control throughout the factory is maintained by threeway loop control valves in departments, and by flow regulating valves at individual pieces of equipment. The three-way control valves are automatically positioned by differential pressure so that they permit some brine to flow through the departmental loops to the equipment requiring it, and allow the remainder to by-pass back to the brine circulating tank. This arrangement ensures a constant pressure differential across the individual flow regulating valves, and also ensures that cold brine is always available whenever the temperature controllers call for it.

The Freon-chilled water system consists of three centrifugal refrigerating machines, each having a capacity of 400 standard tons. Each unit is complete in itself, having its own two-stage centrifugal compressor, condenser, and cooler. These machines were installed in 1948. They are driven by 2300 volt, 1200 r.p.m. synchronous motors. Through speed increasers, the compressors rotate at 4700 r.p.m.

Chilled water is pumped through the Freon coolers by the factory chilled water circulating pumps. Water enters the coolers at 50 deg. F. and leaves at 45 deg. F. In the chilled water system throughout the plant, temperatures are maintained by three-way loop control valves and individual flow regulating valves, in the same way as in the brine system. However, whereas in the brine system output of the ammonia compressors is varied to meet demand by manually stopping and starting com-

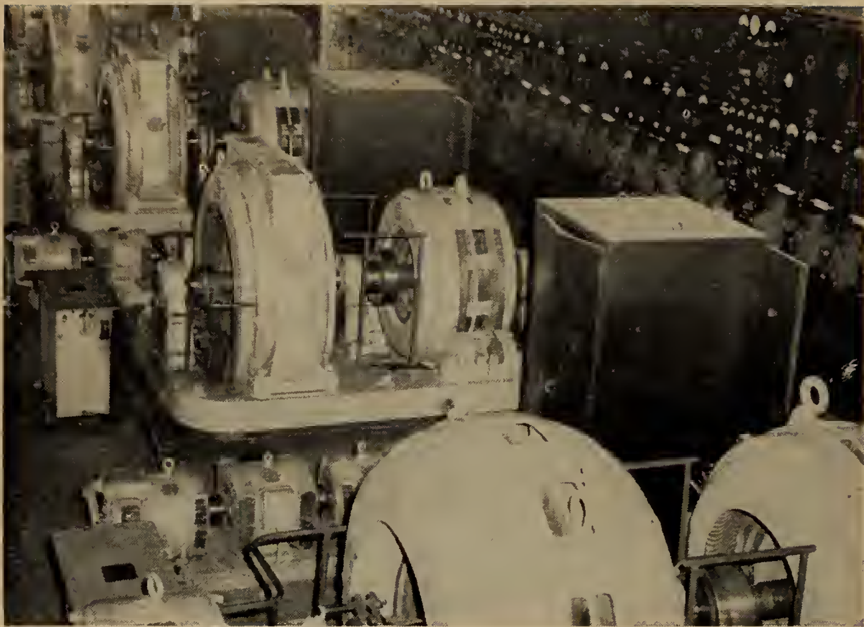


Fig. 20. Frequency changing equipment in the alternator building. Automatic controls for alternator output are on main switchboard, right. Full voltage magnetic starting controllers are beside frequency changers (centre) directly in front of motor generator excitation sets. Reactors, left, act as current limiting devices.

pressors, in the chilled water system output of the centrifugal machines is varied automatically. This is accomplished by dampers in the compressor suction lines, which regulate gas flow in accordance with temperature differential between chilled water entering and leaving the coolers.

Anti-corrosion protection is necessary in the refrigeration systems. Both brine and chilled water are closed systems. In making up the brine, calcium chloride inhibited with sodium bichromate is used. This has been found satisfactory, and no further steps against corrosion are taken. In the chilled water system, corrosion and algae growth are guarded against by maintaining the following conditions:

(*a*) Sodium bichromate concentration of 475 to 500 p.p.m.

(*b*) pH of water of 8.3 to 8.4.

Compressed air is supplied to the factory from five reciprocating compressors discharging at a pressure of 70 p.s.i.g. One of these units is an old one with twin horizontal cylinders, moved from the old compressor room when the new compressor room was built. The other four are modern, double cylinder, L-type compressors.

Compressor room installation is unusual in that all the compressors are mounted on an upper floor and not in the basement, thus necessitating protection of the building from vibration of the heavy reciprocating machines. The compressor room floor is a structural concrete slab designed for a live load of 750 pounds per square foot, carried on structural steel beams and columns, with column footings being integral with pile caps. Reciprocating compressors are mounted on large reinforced concrete inertia blocks, each block weighing between eight and twenty tons depending on relative size and frequency of unbalanced forces (Fig. 17). Vibration of the inertia block and machine assemblies is isolated from the building by means of mechanical spring type vibration isolators that permit movement of the inertia block and machine up to ¼ inch in any direction. Excess motion of the inertia blocks is dampened by snubbers made with Neoprene, cork, or mechanical springs. The 'floating' machines are connected to suction and discharge piping by flexible pipe connections.

Electrical Power and Distribution

Electric power is received from Hydro Quebec's Cedar Rapids power plant on two 110,000 volt transmission lines. These lines terminate at Courtaulds' No. 1 substation, where three 13.500 kva. transformers reduce the voltage to a plant distribution level of 11.500 volts. Switching is arranged to allow parallel operation of two or more of the transformers on either incoming line. The two secondary circuits supply the main 11.5 kv. distribution switchboard by underground cables, with switching available at this point. This provides for changeover from one incoming circuit to the other without interruption of power supply to the plant.

The secondary system, operating at 11.5 kv., incorporates an underground ring main that takes a circuitous route around the plant, covering a total area of some 75 acres. and feeding seven substations ranging in capacity from 1,000 to 8,000 kva. (Fig. 18.) Substations are located near strategic load centres throughout the plant. (Fig. 19.) T-off isolators at underground cable terminals in each substation provide flexibility for maintenance and testing. Since the ring main is energized at both ends, this system ensures a stand-by alternative source of power for each substation, and hence for each important section of the factory.

Since any unplanned shutdown of one or more of the spinning departments is a very costly event, every precaution is taken to ensure that there will be no electrical power failures caused by faults in the plant distribution systems.

Box spinning machines contain large numbers of spindle motors, one to rotate each spinning box. These spindle motors operate at 7200 r.p.m. They require current at 120 cycles, 45 volts. Approximately 14,000 spindle motors are in use. Electric power to drive these spindle motors is supplied from five frequency changer units located in the alternator building (Fig. 20). Each frequency changer is rated at 840 kva., 120 cycles, 528 volts. They operate in parallel. Operation of these units is made fully automatic by an impulse regulator system which holds electrical output from the machines constant at a set value.

Power factor correction is obtained in three different ways:

(*a*) Several old and unused frequency changer sets have had their alternators removed, and their large synchronous motors have been converted to operate as synchronous condensers. These are connected into low-power-factor feeders.

(b) Induction motors of sizes over 100 h.p. have capacitors connected at the motor terminals.

(*c*) Air and refrigeration compressors in the compressor room are driven by synchronous motors varying in size from 100 h.p. to 300 h.p.

As a result, overall plant power factor is maintained constant at 94 per cent.

Highway Turbine Interchanges

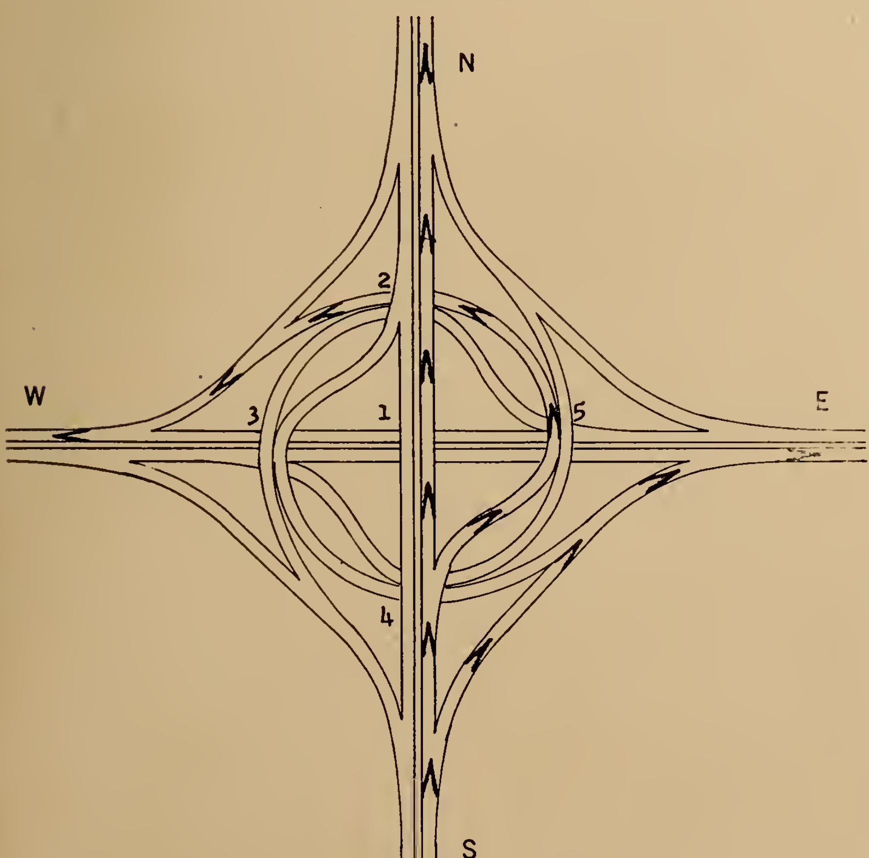
S. M. Breuning, M.E.I.C.*

INTERCHANGES are defined in the "Highway Capacity Manual" as: "A system of interconnecting roadways in conjunction with a grade separation or grade separations providing for the interchange of traffic between two or more roadways or highways on different levels".

This definition is rather general; it does not refer in any way to possible interferences between different traffic streams. It obviously assumes that the grade separations eliminate at least the most serious interferences in an intersection at grade. The degree to which interferences of traffic streams are eliminated determines the efficiency of the interchange.

Interchanges of highways with limited access must be designed according to some fundamental rules. Exits and entrances from the through roadways must be provided at the outer, right-hand side of the roadway so as to keep the inner, left-hand lanes undisturbed by turning vehicles. Exits and entrances also must be designed in such a way that the turning vehicles, either leaving or entering the main roadway, may manoeuvre without unduly affecting the through traffic, and especially without accident hazard. In addition all streams of turning traffic, considered as the minor traffic streams, should interfere as little as possible with each other.

Fig. 1. Turbine interchange.



Comparison With Cloverleaf and Rotary

The turbine interchange (Fig. 1) can best be explained in comparison with the cloverleaf and the rotary interchanges.

The cloverleaf is the most commonly found interchange on highways. It is simple except for the left-turning movements, yet even these are by now well accepted by the motorists. Left-turns are accomplished by making a three-quarter right turn. This is sometimes a little confusing to the driver, who easily loses the sense of direction. It also requires rather sharp curves which can be negotiated only at speeds much lower than used on the open highway. This required reduction of speed definitely is one of the drawbacks of any interchange, especially the cloverleaf. Its correction would be possible only with prohibitively large layouts which are not economically justifiable. Another drawback of the arrangement of the left-turning movements in a cloverleaf is the weaving of each left-turning path with two other left-turning paths. This problem, demonstrated in Fig. 2A is of no importance, as long as the volumes of traffic of the turning movements are low. When the turning volume gets heavy, as it often

*Post-graduate student in transportation engineering at Massachusetts Institute of Technology.

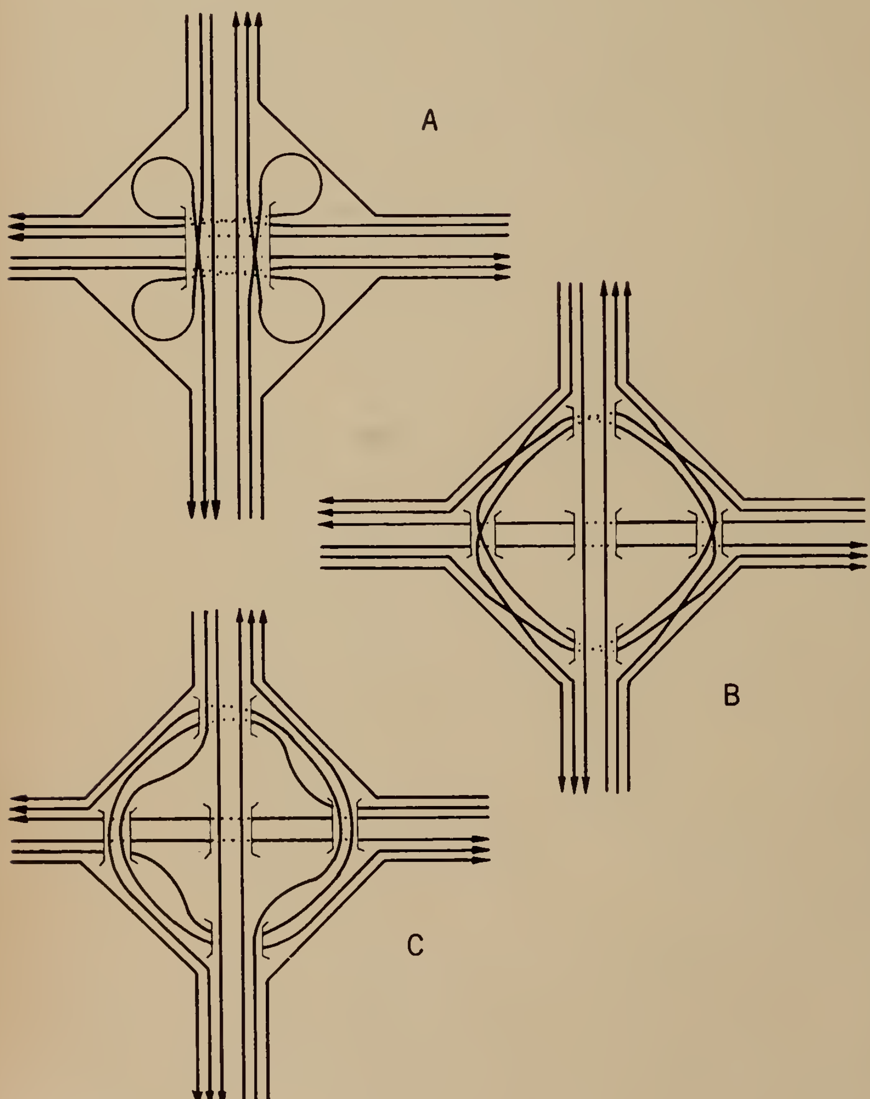
does in suburban intersections, vehicles negotiating conflicting left-turning movements will no longer be able to weave, and a bottleneck will result.

The rotary interchange is less often found on modern superhighways. It is developed from a surface rotary intersection by addition of one (or two) through highways with grade separations. The rotary roadway is a circular one-way roadway, driven in a counterclockwise direction. Traffic enters it and leaves it from the outer, right-hand side. All movements except right-turns therefore must weave with some other traffic streams. Thus the capacity of the rotary also is limited by the volume of the two largest weaving traffic streams. In Fig 2B a rotary is shown with two through highways. Only the turning vehicles enter the rotary, and the right-turning traffic streams do not have to weave. The left-turning movements, however, have to weave four other left-turning traffic streams. Thus the rotary is limited by the volume of the two largest conflicting left-turning volumes.

The curves necessary for a rotary are not quite as sharp as for a cloverleaf covering the same area, but five bridges are required instead of one for the cloverleaf.

The turbine interchange is similar to the rotary described above, except for the entrance of the left-turning movements into the rotary. Instead of coming from the outside of the circle, the left-turning traffic first crosses the rotary along with the main highways and then enters from the inner, left-hand side of the rotary roadway. By this simple change, left-turning movements no longer cross each other, although they may run parallel for some distance on the rotary.

Fig. 2. Flow diagrams.



The structural requirements for the turbine are essentially the same as for the rotary discussed above. The entrance lanes for left-turning movements are the only fundamental difference. These must be built with somewhat sharper radii in order to provide a smooth S-curve from the through roadway to the rotary. Therefore the speeds permissible for left-turning traffic are lower than in the rotary, but still as high or higher than in the cloverleaf, occupying the same area.

Principle

The layout of the turbine, as shown in Fig. 1, consists of

the intersecting main roadways (SN,NS,WE,EW),

the right-turning roadways (SE, EN,NW,WS),

the left-turning roadways (SW, ES,NE,WN).

The main roadways and the right-turning roadways are essentially the same as in any conventional interchange.

The left-turning roadways have given this type of interchange its name, because as in a turbine, the left-turning traffic enters the rotary from the inside, gradually proceeding to the outer edge in the course of accomplishing the left-turn, and finally leaving in its new direction. Traffic making left-turn SW for instance enters upon a sharp S-curve right after it has crossed the rotary at point 4, Fig. 1. The roadway then proceeds to join the rotary which, in this case, is a circular roadway made up of pieces of left-turning roadway. SW follows the rotary from point 5, where it crosses over the main highway (EW) until point 2, where it crosses under the main highway (SN). After point 2 the roadway leaves the rotary and enters into the main highway (EW).

Naturally, the left-turning roadways can also be led through the rotary entering from the outside and leaving from the inside (Fig. 3), a complete reversal of the previous design. This would be advantageous for fast traffic because the sharpest curves occur towards the end of the turning roadway rather than towards the beginning.

In the foregoing designs the right-turning roadways determine the outer limit of the whole interchange. In cases of extreme scarcity of land it might be preferable to put the right-turning roadways within the circle (Fig. 4).

The obvious disadvantage of this design is a crowding of exits and entrances of turning lanes from the open highways to the structures. Such arrangement requires generous layouts of the bridges in order to provide ample visibility and room for the necessary manoeuvres of the vehicles.

Vertical Arrangement

There are three possibilities for the vertical layout of the roadways in a turbine interchange.

(1) Rotary *over* intersecting highways

(2) Rotary *under* intersecting highways

(3) Rotary *over* one and *under* the other intersecting highway.

Only the left-turning vehicles must change grade in the first two arrangements. The left-turning roadway has an ascending (or descending) slope in the first quadrant, then it stays at the elevated grade and descends (or ascends) in the last quadrant.

The disadvantages of this arrangement are the rather steep slopes or long ramps required, which tend to govern the size of the interchange as a whole. The advantage of appearance can be disputed. The use of the grades as aids for deceleration and acceleration is doubtful, because of the curvature and the restrictions at the entrance into the other roadways.

Leading the rotary roadways in turn over and under the main highways provides a more versatile solution (Fig. 1). It may be assumed that the two intersecting highways are at different grade, thereby facilitating a grade separation. All turning vehicles stay at their initial elevation throughout the first quadrant, and change grade in the second, remaining at the new grade in the third.

This arrangement has grades in less critical locations, where vertical curves can be fitted easily and no driver distraction occurs. It also should provide greater versatility for adaption to existing topography.

Driver Acceptance

Highway interchanges are no longer instinctively understood by the driving public. Elaborate route and directional signs and familiarity on the part of most drivers are necessary to enable large volumes of vehicles to flow through an interchange without delay for orientation. Nevertheless, it is always desirable to maintain a logical layout of the roadways so that drivers do not get the feeling that they are on the wrong road. Making a three-quarter right-turn instead of a one-quarter left-turn still is rather confusing to many drivers.

The turbine intersection provides in its rotary roadway a common focus which should enable drivers to orient themselves more easily within the layout. The entrance on to the rotary from the inside may be a disadvantage because it is somewhat hidden immediately after the crossing of the rotary roadways.

The rotary roadway of the turbine offers the additional advantages of crossovers at the locations of the crossings with the through roadways. These crossovers provide for drivers who take the wrong turn and would like to continue straight through and, more important still, for traffic turning around.

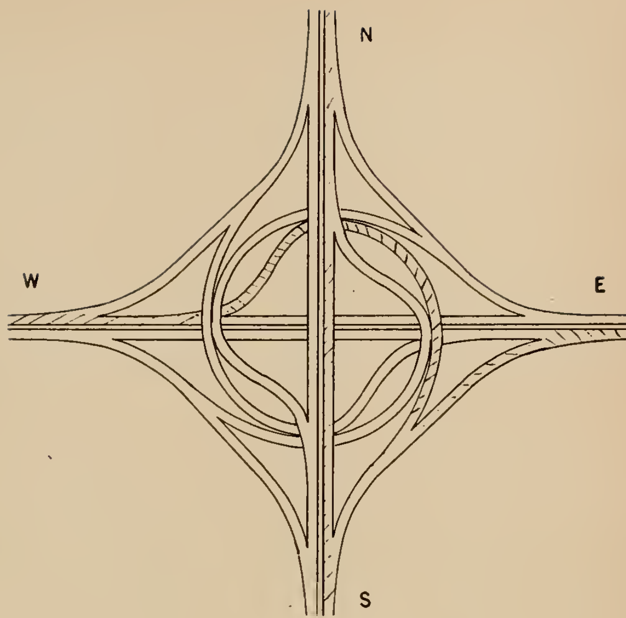


Fig. 3. Turbine interchange (reversed).

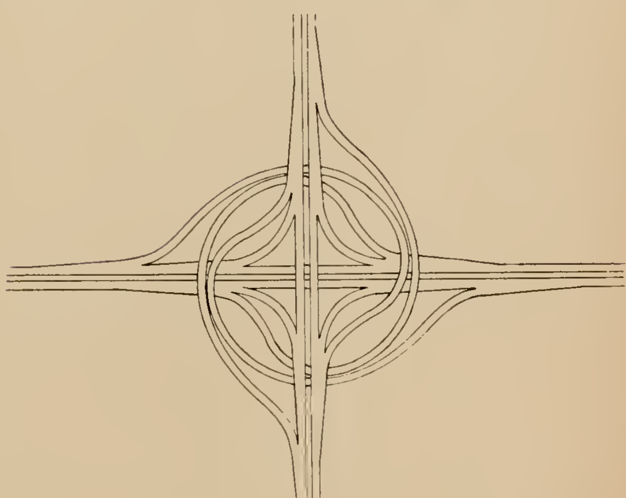


Fig. 4. Turbine interchange with right turning roadways within the rotary.

Structures

For the turbine interchange as outlined here five structures are required: one crossing structure for the crossing of the main highways (Pt. 1 in Fig. 1), the same basic structure that would be provided for a cloverleaf; and besides this, four smaller bridges to lead the rotary roadways over or under the main intersecting roadways.

Geographic Adaptability

The larger number of structures required for this interchange and the necessity to make these structures as simple as possible make it desirable to have fairly flat land at least within the area of the rotary roadway. The possibility of varying the relative elevation of the crossing roadways with the requirements of the topography make the design more flexible than it may seem at first.

Feeder Roads

A special application of the turbine principle to intersections of a superhighway with a feeder or other secondary road is shown in Fig. 5. The feeder road is not handled as a separate through roadway. Its through traffic (SN) enters the rotary roadway together with the left-turning traffic (NW) at the crossover (4) to the left-turning roadway (WN) from the main highway. This provision for crossing over has been pointed out before as an advantage for drivers who lose their way. In the case of the feeder road, however, the crossover eliminates one structure and reduces two more structures to cross one instead of two roadways.

Considering through traffic as the main traffic stream this layout no longer provides entrances and exits from the outer, right-hand side of the roadway on the feeder road.

There are however still no weavings or hidden intersections within the interchange.

Curved Main Road

It is not absolutely necessary that the main road be straight through. It could be curved (for instance SE). Such layout still requires two large and two small bridges, yet it eliminates one left-turning roadway which is led through the centre as the through road.

This design mainly serves to illustrate how versatile interchanges of the turbine principle can be if special requirements are considered.

Simplified Feeder Road

In order to eliminate two of the four bridges that were necessary in the previous designs, some interfering traffic may be required to weave.

In Fig. 6 there are four weaving sections. (These could be reduced to two with little change in the design, yet the number of weaves would remain the same.) As demonstrated on the flow sketch, the left-turns from the feeder road each have to weave with three other traffic streams, the through traffic on the feeder road and the left-turns from the main road each have to weave once.

This layout therefore has little advantage over the cloverleaf in terms of weaving. The separation of the structure into two one-way bridges and the necessary curvature for the through traffic of the feeder road are definite disadvantages of this design. Provision of a continuous rotary provides somewhat more flexibility to the layout.

Turbine Rotary

As a last design in this series the turbine rotary without through roadway should at least be mentioned. In contrast to the standard turbine this design leads all entering roadways into the centre, thereby eliminating all weaving. This rotary has an unlimited capacity as long as the roadways are sufficiently wide.

Its main advantage is the possibility of converting existing rotaries which are very inadequate into turbines by adding the separate entrance roadways.

Conclusions

The turbine interchange is an improved rotary interchange. The left-turning traffic enters the rotary from the inside and leaves it from the outside, thereby eliminating all weaving or crossing of traffic streams.

This design, although expensive in construction, is especially adaptable for intersections with large volumes of turning traffic, such as suburban intersections, connections of feeder roads with superhighways, and one-way street intersections in cities.

The turbine is more versatile than it seems at first. It can be built in stages or existing rotaries can be converted into turbine rotaries by adding the entrance ramps and grade separations.

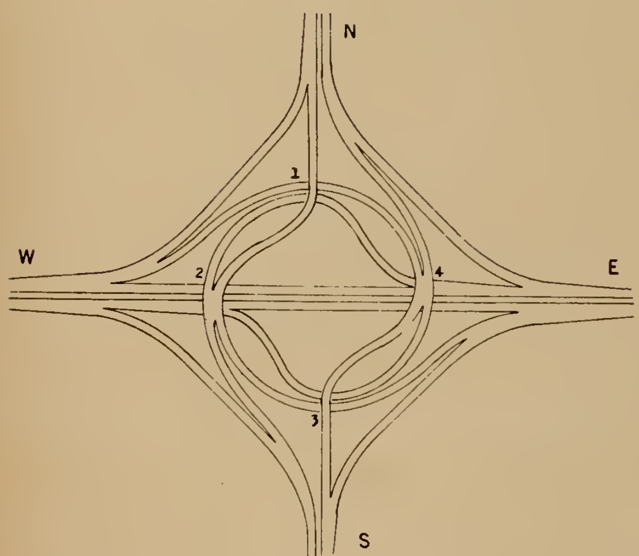


Fig. 5. Feeder road turbine interchange.

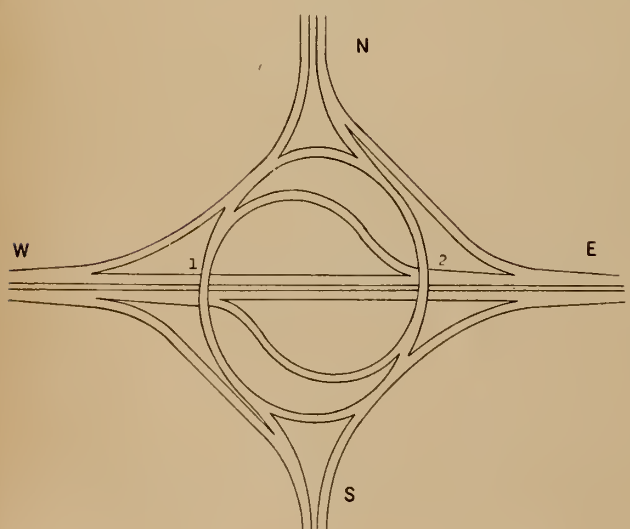


Fig. 6. Simplified feeder road turbine interchange.

X-Ray Techniques

Ursula Martius

Research Fellow, Ontario Research Foundation

IT IS THE PURPOSE of this paper to give a brief survey of X-ray techniques, stressing general principles rather than practical details.

Nature of X-Rays

X-rays are electromagnetic radiation, just as light, but their wave length is 100 to 1000 times shorter than that of visible light. Consequently, the human eye cannot see X-rays, but a photographic plate is sensitive to them as it is to light.

X-rays are produced when electrons of high energy impinge on a solid surface. The electrons are absorbed and most of their energy is transformed into heat, but about 5 per cent is converted into X-rays. The wavelength of this radiation depends on the energy of the electrons (which can be varied by varying the tube voltage) and on the material of the solid surface, the "target". Since most of the energy of the electrons produces heat, the major limiting factor in the design of high intensity X-ray tubes is the dissipation of this heat. Tubes are water, air or oil cooled; common target materials are copper, tungsten and molybdenum.

Interaction of X-rays with Matter

The comparison between X-rays and light will help to illustrate what happens when X-rays interact with matter. In the case of light we are used to distinguishing between materials that are transparent and substances that absorb light or reflect it. We know that this classification is very approximate and that in reality all three things happen simultaneously; for instance, even in a transparent substance a certain fraction of the light is absorbed and a certain fraction is reflected.

X-rays are similarly transmitted, absorbed and "diffracted". Depending on experimental conditions one of these types of interaction will be predominant. We will discuss the different X-ray techniques according to the type of interaction on which they are based.

Just as in the case of light, different materials are more or less transparent to X-rays. It depends on the atomic weight of the material how strongly X-rays of a given wavelength are absorbed, (not, as in the case of light, on state of aggregation, state of binding, crystallographic properties). The absorption of X-rays is roughly proportional to the fourth power of the atomic weight (actually the atomic number) of the absorber. Thus, substances of different atomic weight can show striking differences in their capacity to transmit or absorb X-rays.

This article presents a brief review of X-ray techniques and gives an insight into the possible use of X-rays. These techniques are finding increasing application both in research and industry.

Radiography

These laws of transmission of X-rays are the basis of all medical X-ray work and of industrial radiography. The reason why an X-ray film of a hand can show the structure of the bones and joints is that the X-rays are absorbed much more strongly in the calcium of the bones than in the light elements of the tissue. It is really the "shadow" of the bones in the X-ray beam that appears on the film.

Industrial radiography is mostly concerned with the detection of defects, cracks, etc. in commercial products. These techniques are used widely in inspection and control, although today radioactive isotopes begin to take over some of the functions of X-rays in this line of applications. But, be it X- or gamma-rays, all radiographhic techniques are based on the selective transmission of these radiations.

Micro-radiography is a refinement of radiographic techniques, based on the above mentioned relation of absorption and atomic weight. By means of micro-radiography it is possible to detect regions of different composition in, for instance, an alloy on account of their different X-ray absorption coefficients. Fig. 1 shows the microradiograph of a 70-30 Cu-Pb alloy. The black dendrites are the copper - rich phase, the white background is lead.

This technique works best when the components to be distinguished have very different atomic weights. The severe drawback of this method, since it is based on the transmission of X-rays, is the fact that only sections of a few thousandths of an inch thickness can be used.

To overcome this difficulty we have recently tried to develop a technique which works in "back reflection" rather than in transmission, using strictly monochromatic X-rays. We can use standard metallographic specimens and will be able to compare directly microscopic and micro-radiographic observations.

X-Ray Diffraction

Though the straight transmission and absorption of X-rays and light are in many ways similar, the "diffraction" of X-rays and the reflection of light cannot be compared directly.

X-rays can be "diffracted" from a crystalline substance to form a diffraction pattern, which can be recorded on film or by means of a

Geiger counter. The type and the dimensions of these diffraction patterns are determined by the distance between the atoms of the crystal and wavelength of the X-ray beam. This means that the wavelength of X-rays can be determined from the diffraction pattern of crystals of known interatomic distances. Conversely, the structure of a crystal can be established by investigation of the diffraction of X-rays of known wavelength on this crystal. Many techniques have been developed for the latter type of work, using single crystals or crystalline powder, employing monochromatic or polychromatic beams. Figure 2 shows the diffraction pattern of ZnO powder.

In the course of the last thirty years a very large number of crystal structures have been established and tabulated. These data are readily available in form of a reference file to which supplements are issued every year or two. This information makes it possible to identify an unknown substance by its diffraction pattern because an X-ray diffraction pattern is something like a fingerprint of a compound. This type of identification work can be carried out with a very small amount of material; these X-ray techniques are non-destructive and can also be applied to mixtures of a number of compounds. The limitations of these methods are: (a) the lack of data on the crystal structures of less common substances like silicates, organic compounds, special alloys, etc.; and (b) the complexity of the pattern of a mixture, which limits the number of components that can be identified unambiguously.

It should be stressed that identification by means of X-ray diffraction always yields the compounds, not the ions. For instance, a mixture of rock salt and magnesium sulphate would be identified as $NaCl$ and $MgSO_4$, whereas chemical analysis would only find Na, Mg, Cl and SO_4.

Another field of X-ray application, which makes use of known diffraction patterns and known interatomic distances, is the study of deviation from normal crystal structures and dimensions.

Let us assume, for instance, that an X-ray photograph is taken of a

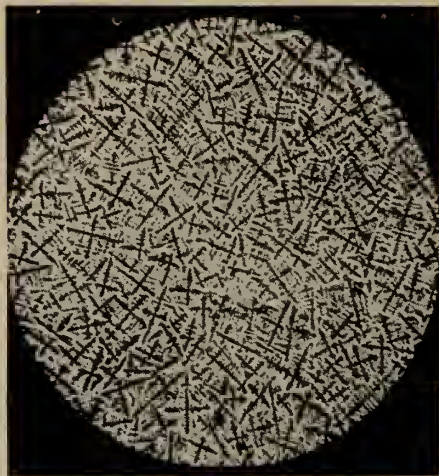


Fig. 1. Microradiograph (100x) of 70-30 copper-lead bearing lining: copper-rich dendrites, black; lead, white.

highly stressed metal. If the interatomic distances of the unstressed material are known, then the difference between this and the corresponding value of the stressed material is directly related to the magnitude of the stresses in the material. A number of techniques have been developed for stress determinations by means of X-rays; all of them precision determinations of the lattice constants.

Precise determinations of lattice dimensions are also frequently used in the study of phase diagrams where the solid solution of one constituent in the other may change the lattice dimensions, rather than produce a second phase (which would appear as a second pattern and could also be detected by means of X-rays).

The lattice dimensions of a crystal do not only change under stress or in case of solid solution, but they also change with temperature. There are today techniques available which record X-ray diffraction patterns as a function of changing specimen temperature, both at high and at low temperatures. Data on thermal expansion are also obtained in the course of these investigations.

An X-ray diffraction pattern of a polycrystalline substance records not only the lattice dimensions, but also the relative orientation of the grains with respect to each other. In other words, from a diffraction pattern we can see whether the grains are randomly oriented or whether certain orientations occur with higher than average preference.

The study of preferred orientation is of great importance if one is concerned with the working of metals or with the properties of fibres. Without X-ray techniques it would have been impossible to establish today's knowledge of the deformation and annealing textures of metals or of the mechanical behaviour of fibres and polymers.

When we speak about "deviations from normal crystal structures and dimensions" we have to realize that the "normal" or "perfect" crystal is only a theoretical concept and that all real crystals are more or less "imperfect". The study of crystal imperfections and their relation to mechanical and electrical properties has been of greatest interest to physicists and engineers during recent years. Very precise measurements of the small changes in diffraction pattern (both in dimensions and intensities) which are produced by different degrees of imperfection have added much to our knowledge of the processes of plastic deformation, grain growth, and solidification. It is in this field that we may expect a number of new developments in the near future, both along the lines of more specialized experimental techniques and in the field of new applications.

Since X-ray diffraction patterns with the characteristics outlined above are produced by crystalline substances only, X-ray diffraction techniques are useful to determine the degree of crystallinity, for instance in glasses, ceramics, and fibres. X-rays are also diffracted from liquids and from amorphous substances, but the character of these diffraction patterns is different and will not be discussed here. However, it may also happen that crystalline

Fig. 2. X-ray diffraction pattern of ZnO.

particles are too small to give rise to a well defined diffraction pattern. Particles of less than 50 microns will produce diffuse diffraction patterns, and methods for the determination of particle size are based on this fact.

X-Ray Spectroscopy

This third group of X-ray techniques is based on a different physical phenomenon than X-ray diffraction or radiography.

We have seen above that all X-rays are more or less strongly absorbed by matter. In radiographic techniques we are interested in the fraction of the X-ray beam that is not absorbed but transmitted, because this is the fraction of the beam we record. Now, however, we should ask, "What happens to the absorbed X-rays?" Most of their energy is transformed into heat, but a portion is used to excite new X-rays in the material of the absorber analogous to the processes in the target-surface of an X-ray tube. These new X-rays are of distinct wavelength which are characteristic of the material of the absorber. They are, therefore, called fluorescent or characteristic X-rays. Every element has its characteristic X-ray spectrum which consists of only a few lines of distinct wavelength, just as an element has a characteristic optical spectrum. But, in contrast to optical spectra, X-ray spectra are characteristic of the atom only; they are independent of the state of binding and aggregation; in other words, the X-ray spectrum of iron is the same regardless of whether the sample is a sheet of steel, iron oxide powder or a solution of iron sulphate. There is no X-ray analogy to "molecular spectra".

It is thus possible to identify an element by exciting and recording its X-ray spectrum. In practice this is done by absorbing an intense X-ray beam of high energy in the specimen and measuring the wavelength of the characteristic radiation which is emitted by the sample. The wavelength measurement is accomplished by diffracting the characteristic radiation from a single crystal of known lattice dimensions — the "analysing crystal". Rock-salt, lithium fluoride, mica or quartz are frequently used as analysing crystals. In an X-ray spectrograph the analysing crystal fulfills the function of the prism in an optical spectrograph. Figure 3 shows schematically the principal components of a spectrograph.

The fundamental properties of X-ray spectra have been known since 1912, but only recently improvements in high energy X-ray sources and in high sensitivity recording equipment have made X-ray spectroscopy a feasible routine technique. The first X-ray spectrograph of the type now commercially available was built during and after the second world war and only during the last five years has X-ray spectroscopy found large-scale industrial applications. Whereas there is a very large amount of reference literature available for X-ray diffraction problems, few data and no books exist as yet dealing with X-ray spectroscopy.

Today X-ray spectroscopy is mostly applied to analytical problems. X-ray spectra are simple and their identification is comparatively easy; the technique is non-destructive and solid or liquid samples can be used. These, together wth the high speed of operation are the main advantages of X-ray spectroscopic analysis.

X-Rays + Matter

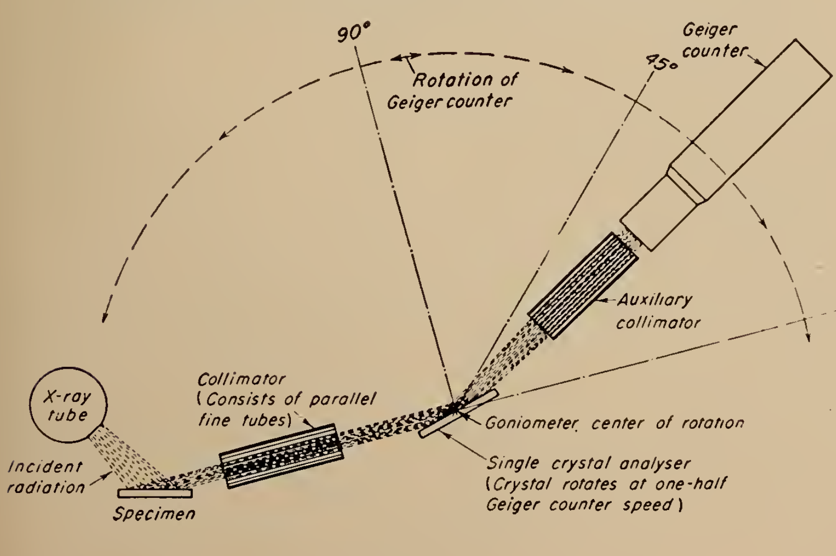
transmitted	absorbed	diffracted
Radiography	**X-Ray Spectroscopy**	**X-Ray Diffraction**
macro-	Analysis	Crystal structure
micro-	Absorption coeff.	Identification
	Segregation	Stress determination
	Surface composition	Preferred orientation
		Textures
		Crystal imperfections
		Particle size

Every element has its characteristic X-ray spectrum. However, the spectra of the light elements are "soft", i.e. their wavelength is long and these spectra are usually absorbed in the air path between the specimen and the counter, or in the window of the counter. That is why today only elements that are heavier than phosphorus or sulphur can be detected by their X-ray spectra, even if the air in the path between specimen and counter is replaced by helium. New experimental developments to overcome this limitation can be expected soon.

Though analytical work is the main field of application of X-ray techniques it is by no means the only one. Studies of composition changes due to segregation, measurements of absorption coefficients and investigation of surfaces can well be carried out with an X-ray spectrograph.

The applications mentioned in the preceding paragraphs are summarized in the accompanying table. They are grouped according to the type of interaction principally involved.

Fig. 3. Diagram of basic geometry of fluorescence-analysis method.



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Progress in the development of

The Energy Resources of Canada

Compiled by the Water Resources Branch, Department of Northern Affairs and National Resources and the Dominion Coal Board

Paper presented before the Fifth World Power Conference, Vienna, Austria, 17-23 June 1956

THE ENERGY RESOURCES of Canada and their development were reported in a paper presented at the Fourth World Power Conference in London in 1950. There have been significant changes since that time in the discovery and development of new oil and gas fields and the harnessing of large supplies of hydro-electric energy while the combination of recent discoveries of uranium with the technical developments in the production of atomic power shows promise of major growth in resources of atomic energy.

Report of Progress

Energy Sources — There has been a gradual change in the sources of energy as petroleum has taken over more and more of the market formerly supplied by coal. In Fig. 1 there is a graphical record of the supply of all but one of the various forms of energy from 1927 up to and including 1955. The exception is wood which supplies a proportion of the energy requirements. Accurate data on which any estimate could be based are not available in the earlier part of the years covered by this graph.

Water Power

Water power constitutes one of Canada's great natural resources and has provided the principal source of energy for the rapid industrial development of the country. The extent of water-power resources and their development were reviewed in detail in papers presented at the First and Second World Power Conferences and also a brief review was given at the Fourth Conference. However, during the period 1949 to 1954 inclusive, development has been very rapid; also, there has been a certain amount of revaluation of resources, particularly for the Province of Quebec. Total potential and developed resources, as of the end of 1954, are shown in Table I.

The figures in this table were computed on the standard bases of stream discharge and power rating as adopted for the Statistical Year Book of the World Power Conference. The totals of available power may be said to represent only minimum power possibilities as explorations are incomplete. However a considerable proportion of the remaining available power lies in rather inaccessible regions, although frontiers are being extended and feasible transmission line distances increase.

This paper was prepared late in 1955 for discussion at the World Power Conference Plenary meeting in Vienna in June 1956. Since its preparation, energy requirements in Canada have expanded at increasing rates, and it may be expected that the energy requirement forecasts herein should now be revised upwards.

During the six-year period 1949-1954 inclusive, developed capacity increased by 4,146,500 kilowatts, being 50 per cent greater in 1954 than in 1948. This increase was widely distributed across Canada but the larger developments were made in the Province of British Columbia, Ontario and Quebec. A brief review of major projects is given below.

One of the high lights of hydro-electric construction during the period was the successful completion in British Columbia in 1954 of the first stage of the great Kemano-Kitimat project of the Aluminum Company of Canada. Water is diverted through the Coast Range and the three Pelton wheels each of 112,000 kv. operate at 2485-foot (757-metre) head in the first Canadian underground power house. The fourth unit is under installation and ultimate capacity is about 1,500,000 kw. Power is transmitted at 300 kv. to Kitimat for operation of the new aluminum smelters.

Other major additions to capacity in British Columbia in the period were: (1) the British Columbia Electric Company increased its Bridge River Plant installation by 139,000 kw. to its present capacity of 185,000 kw., added a total of 127,400 kw. at three other sites, and had under construction in 1954 two new plants totalling 111,000 kw.; (2) the British Columbia Power Commission with plants on Vancouver Island and the mainland increased its capacity by 135,800 kw.; (3) Consolidated Mining and Smelting Company of Canada Limited added 27,600 kw. to its Brilliant plant and completed the first half of a 358,000 kw. ultimate installation at its Waneta plant on the Pend d'Oreille river.

In the Province of Alberta, Calgary Power Limited, which serves a large part of the southern part of the province from hydro - electric plants in the Bow River basin, increased its hydro capacity by a total of 112,900 kw. through construction of four new plants and additions to two existing ones.

The Province of Saskatchewan is

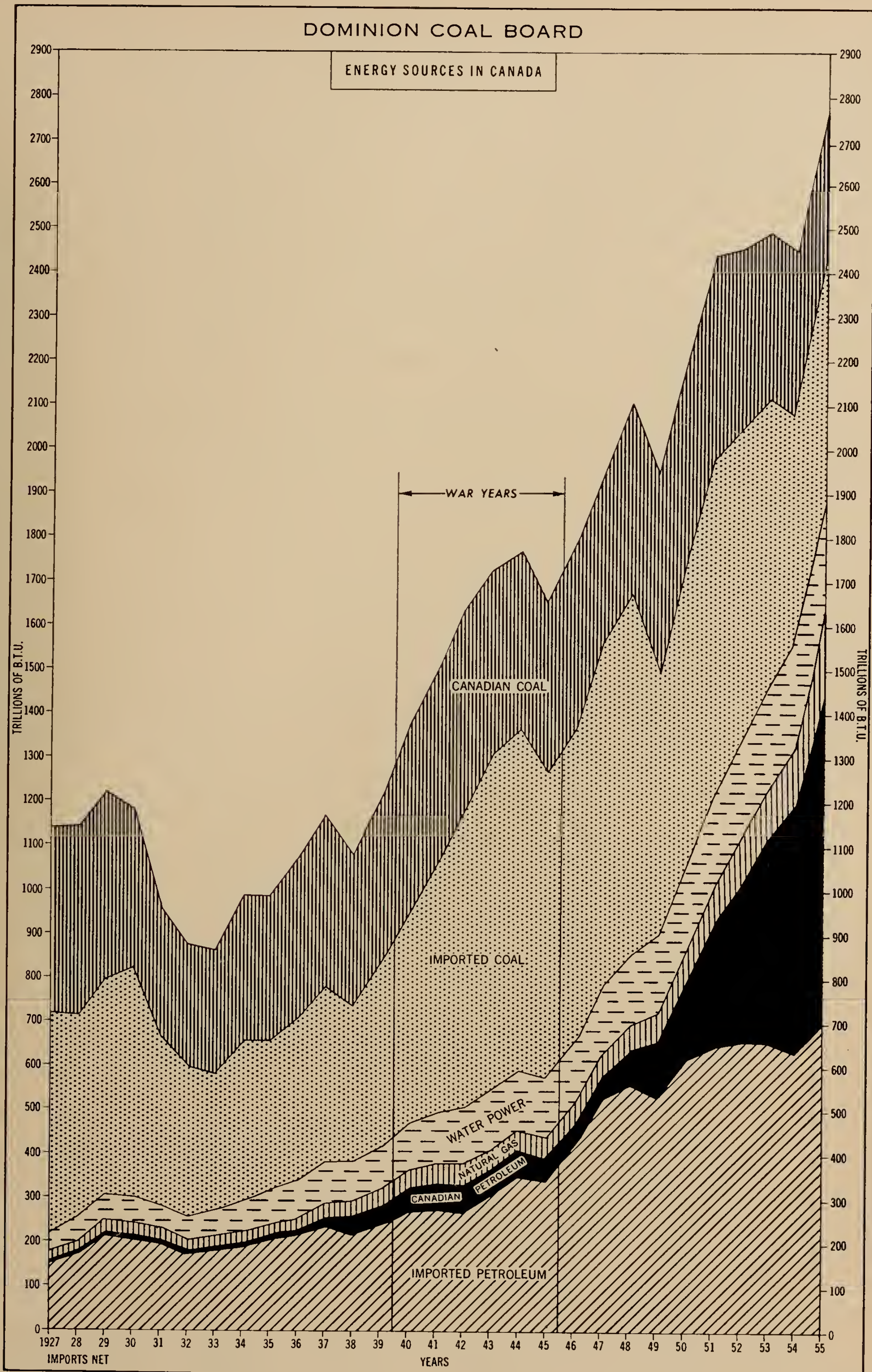


Fig. 1. Chart of energy sources in Canada over the period 1927-1955.

served principally by fuel plants and no new water-power developments were made.

In Manitoba the Manitoba Hydro-Electric Board increased its capacity by 211,200 kw. in two new projects and redevelopment of its Seven Sisters plant, all on the Winnipeg river. In the more northerly area of the province a 5200 kw. development was made by Sherritt-Gordon Mines Limited.

In Ontario, with its very diversified industries and heavy domestic and rural power demands, electricity is supplied principally by the Hydro-Electric Power Commission of Ontario, which increased its hydraulic capacity by nearly 1,500,000 kw. in the period. Three large plants were completed on the Ottawa river totalling 698,300 kw. At Niagara Falls a new major development involving a pumped storage scheme and a total capacity of 1,370,000 kw., which was initiated in 1951, had reached an installation of 548,000 kw. at the end of 1954 in a continuing construction program. In Northern Ontario the Commission added 171,600 kw. in new plants on the Nipigon and Mississagi rivers and initiated construction on a plant on the English river. The Great Lakes Power Company which serves the Sault Ste. Marie area increased its capacity by 36,000 kw. in two new plants and an addition to an existing plant on the Michipicoten river.

It may be added here that by 1955 the Hydro-Electric Power Commission of Ontario had started construction of the works for its power project on the international reach of the St. Lawrence River which is designed to add 900,600 kw. to Ontario's installed capacity. This represents the last of that Province's large remaining hydro power potentials.

The orderly development of the great water-power resources of the

Table I. Available and Developed Water Power in Canada at end of 1954

Province	Available Gross Capacity 100% efficiency at Q 95 (thousands of kilowatts)	Available Gross Capacity 100% efficiency at Q 50 (thousands of kilowatts)	Developed Capacity (Turbine) (thousands of kilowatts)
British Columbia	6,549	12,101	1676.2
Alberta	474	1,384	193.0
Saskatchewan	513	1,232	81.9
Manitoba	3,108	6,120	564.6
Ontario	5,042	7,990	3614.7
Quebec	10,160	22,497	5799.8
New Brunswick	115	368	122.4
Nova Scotia	24	172	127.5
Prince Edward Island	.	3	1.4
Newfoundland	894	3,030	241.1
Yukon and Northwest Territories	357	895	24.2
	27,236	55,792	12,446.3

Province of Quebec was continued during the period and capacity was increased by more than 1,500,000 kw. principally to serve the metallurgical and forest-product industries.

The Quebec Hydro-Electric Commission completed the Beauharnois No. 2 Plant of 497,000 kw. on the St. Lawrence river and constructed two small plants totalling 36,000 kw. on the Upper Ottawa river. Moreover, in 1953 the Commission started construction of a project of 895,000 kw. capacity on the Bersimis river. This plant which is rapidly nearing production stage involves a 17½ mile (28.2 km.) lined tunnel of 31½ feet (9.6 m.) diameter which will convey the water to turbines operating under a head of 875 feet (266.7 m.) in an underground power house. In the latter part of 1955 it was announced that the Commission would proceed immediately with construction of a second plant of nearly 400,000 kw. on the Bersimis river.

Other major additions to capacity in Quebec were: (1) The Shawinigan Water and Power Company added two new plants, totalling 387,500 kw. on the St. Maurice river and in 1954 had work under way on a total addition of 118,000 kw. at these plants; (2) The Aluminum Company of Canada in 1952-53 built two new plants totalling 418,000 kw. on the Peribonka river; (3) The Manicouagan Power Company brought into operation the initial 83,600 kw. of a 251,000 kw. ultimate development on the Manicouagan river. Other important additions by Price Brothers and Company, Northern Quebec Power Company, Gatineau Power Company, and Gulf Power Company totalled 122,600 kw.

In New Brunswick the New Brunswick Electric Power Commission constructed a new plant of 20,000 kw. on the Tobique river and started construction of a plant on the St. John river for an initial installation of 68,000 kw.

The Nova Scotia Power Commission added 15,700 kw. in two plants and the Nova Scotia Light and Power Company increased its capacity by 16,800 kw. at four sites.

In Newfoundland the Newfoundland Light and Power Company added a total of 25,300 kw. to its capacity at four plants on the island while Iron Ore Company of Canada installed 9,000 kw. in a plant on the Ashuanipi river in Labrador.

Although there has been a considerable increase in primary production of electricity from fuel-powered

Table II. Supply of Coal to Canadian Requirements (Metric Tons)

	Canadian Production				Imports (Entered for Consumption)			
	Bituminous	Sub-bituminous	Lignite	Total	Anthracite	Bituminous and Lignite	Total	Grand Total
1945	10,681,522	2,902,635	1,390,733	14,974,890	3,096,037	19,639,807	22,735,844	37,710,734
1946	11,658,758	3,117,949	1,382,109	16,158,816	4,201,594	19,482,312	23,683,906	39,842,722
1947	10,036,045	2,934,846	1,425,345	14,396,236	3,884,342	22,326,417	26,210,759	40,606,995
1948	12,402,984	2,892,877	1,441,697	16,737,558	4,758,116	23,250,697	28,008,813	44,746,371
1949	12,815,711	2,833,089	1,696,906	17,345,706	3,579,026	16,556,468	20,135,494	37,481,200
1950	12,350,907	3,013,331	1,998,764	17,363,002	3,888,607	20,564,809	24,452,416	41,816,418
1951	12,123,356	2,721,615	2,016,994	16,861,965	3,495,833	20,818,402	24,314,235	41,176,200
1952	11,502,753	2,554,798	1,890,119	15,947,670	3,533,420	19,085,673	22,619,093	38,566,763
1953	10,414,107	2,177,256	1,833,727	14,425,090	2,711,670	18,394,829	21,106,499	35,531,589
1954	9,381,007	2,228,286	1,920,307	13,529,600	2,499,229	14,356,537	16,855,766	30,385,366

Note: 1 metric ton = 2204.62 lb. = 0.9842 long ton plants, and there is a trend in Ontario towards auxiliary steam plants for peak loads, water power remains the principal source of electricity for central stations which produce power for sale in Canada or for export to the United States. In 1954, 95 per cent of central-station power was generated from water power and the total hydraulic production amounted to 65,846,000,000 kilowatt hours, an increase of 52 per cent since 1948. Of hydraulic installations in Canada, 86.9 per cent are central stations, 5.6 per cent are exclusively for pulp and paper production, and 7.5 per cent are for other purposes, principally metallurgical production in British Columbia. It may be noted that the plants serving the aluminum industry in Quebec are classed as central stations for the reason that they are owned and operated by separate (although subsidiary) companies; however, this is not the case in British Columbia where the larger plants producing power for metallurgical purposes are directly owned by the power consuming companies. As of 1954, Canada was exceeded only by the United States in total water-power installation and only by Norway in average installation per capita, the Canadian rate being 0.82 kw. per head of population.

Coal

There have been no significant increases in the reserves of coal since the last report to the World Power Conference and the decline in requirements for coal does not offer much inducement for further exploration at the present time. The increasing competition from oil and gas in the house heating and industrial markets and the conversion of railway locomotives from coal steamers to diesels have all combined to cut seriously into the market. This change to other fuels has been particularly marked in Western Canada where the greatest proportion of Canadian coal reserves are located.

Canada, by reason of geography, has for many years depended upon imports of coal from the United States to supply a substantial portion of the overall requirements. No picture of coal supply is complete unless imported coal is included and there is reported in Table II the supply of coal for Canadian requirements over the last ten years.

Coal in Canada has never been of the same order of importance as a prime mover fuel in industry, as it has in many other countries. Industrial production has been largely concentrated in the central provinces of Ontario and Quebec and it is in these areas that hydro-electricity has been most fully developed. Almost all the major prime movers have therefore, been driven direct by hydro-electricity. Coal has been used mostly as a fuel for space heating and for process heating in industry. In fact, secondary electricity has occasionally been used in large quantities in electric boilers as a cheaper source of process steam than coal and is being so used at present although in limited amount.

There has been a growing shift in the production and consumption of coal. The decline in railway and household requirements has affected the supply of anthracite and bituminous coal. The development of strip-mining in Western Canada has, however, led to an increasing production of sub-bituminous and lignite coals at a price low enough to find increasing markets in the industrial field. This trend will probably continue and plans are being carried into effect that will call for increasing supplies of these coals for the production of thermal power. This change in the types of coal produced and imported appears clearly in Table II which shows the total available by varieties.

The last five years, therefore, have been years of decline and change in the position of coal. These changes are still in progress and will probably continue for some years to come. On the other hand, the available resources of undeveloped hydro power within practical range of the large consuming centres have been declining. The Prairie region is largely dependent upon thermal plants for electric power while the Maritime provinces are also facing the exhaustion of their cheaper hydro resources. There is, therefore, a growing development of thermal power stations in which coal, gas or oil are the prime mover fuels. This trend will probably increase substantially over the years.

Table III. Estimate of Wood Used as Fuel

	Cords Wood	10^9 k. Cal. @ 5,040,000 k.Cal./cord
1945	11,220,000	56,548
1946	11,000,000	55,440
1947	10,780,000	54,331
1948	10,560,000	53,222
1949	10,340,000	52,114
1950	10,120,000	51,005
1951	9,876,000	49,773
1952	9,520,000	47,981
1953	9,170,000	46,217
1954	8,820,000	44,453

(1 cord = 128 cu. ft. = 3.62 cu. metres)

Note: 1 k. Cal. = approx. 3.97 B.t.u.

Oil

It is in this field that substantial changes have taken place, changes that have had effect upon other fuels as well as on the overall national economy.

In 1950, the consumption of petroleum and petroleum fuel products was approximately 21,268,000 kilolitres. This quantity was supplied by a native production of 4,629,000 kl. of crude oil and the import of 12,749,000 kl. of crude and 3,890,000 kl. of oil products. In other words, only 22 per cent of the total oil requirements was of Canadian origin. (1 kl. is approximately 220 Imp. gal., or 6.275 bbl.)

In 1954, the consumption had increased to 33,458,000 kl. or by 63 percent. The supply has also shifted so that 15,392,000 kl. of crude were produced from Canadian wells, 12,534,000 kl. of crude oil were imported and 5,532,000 kl. of products were supplied from sources outside the country. In the four years, therefore, the proportion of our total oil requirements originating in Canadian wells rose from 22 to 46 percent.

Even this record does not tell the whole story as the production of crude has had to be held down by government regulation to fit in with available refinery and distribution capacity. The production possible in 1954 from existing wells would have been approximately 24,000,000 kl.

This advance has been the result of the discoveries of major oil fields in the Prairie regions of Western Canada. These discoveries have been the basis of a wide and expanding programme of exploration for other fields which is at present in full progress. It was estimated as at December 31st, 1950, that there were reserves of oil available in proven fields of some 191,000,000 kl. in the form of either petroleum or the lighter natural gas liquids. It is reported as at December 31st, 1954, that the reserves established as proven amount to 385,000,000 kl. or twice the amount reported only four years previously. These reserves are growing at the the rate of almost 64,000,000 kl. per year and it is confidently expected that the increasing fund of knowledge of the types of occurrence wedded to the expanding programme of exploration will maintain this rate of growth for many years.

The largest consumption of oil and oil products is in the heavily industrialized areas of Ontario and Quebec. The major concentration of refineries has therefore been in the central Ontario area using oil from the United States and Ontario fields and in the Montreal area of the St. Lawrence valley processing oil from South America and the Middle East. There have also been refineries in the Vancouver area taking oil from California and South America by sea and supplying the coastal market. Smaller refineries situated in the Prairies consumed both local oil and crude from the United States, while the Maritime market was supplied with oil from South America to refineries at Halifax and Saint John.

This distribution was not adapted to the use of oil from the Alberta discoveries and it has been necessary to restrict the production of crude oil to the limits imposed by the available transportation and the delays in building new refineries.

Over the past four years a pipe line has been built from the major oil fields in Alberta to Vancouver that will not only supply the whole Canadian market in that area but will also carry oil to refineries in the Seattle Puget Sound area of the United States. At present, the Vancouver refineries are operating entirely on Canadian crude. A second pipe line has been built from the Alberta fields to Sarnia and Toronto which carried some 10,800,000 kl. in 1954 or practically the whole requirement of the refineries in the area. The capacity of this line is being increased by adding new loops and pumping stations to meet the growing demands in the market area.

Projected increases in distributing and refining capacity will reduce and possibly eliminate the present demand for imported products. There will, however, remain for some years need for imported crude oil for the refineries on the Atlantic and St. Lawrence.

Natural Gas

There has been a major development in natural gas concurrent with that reported for petroleum. In this case, however, neither the market nor the distributing facilities have been developed on the scale evident in the oil field.

Although natural gas has been used extensively in Alberta and in Central Ontario for many years, the market has been limited to the local areas. The distribution facilities have been correspondingly limited and the supply or production has been held down to the capacity of these facilities.

The expanding programme of exploration for oil in Western Canada has resulted in the discovery of a series of major gas fields both independent from, and associated with, oil. These fields supply the local fuel market in Western Canada, and in 1954 the total production (exclusive of field waste and gas for repressurizing oil wells) amounted to 3,424,593 thousand cu. metres, of which 3,036,286 was produced in Alberta, 97,721 in Saskatchewan, 284,611 in Ontario and 5,975 in other sections. The production over the five years to 1954 was as follows:

1950	1,920,495	thousand cu. m.
1951	2,250,073	thousand cu. m.
1952	2,511,295	thousand cu. m.
1953	2,859,590	thousand cu. m.
1954	3,424,593	thousand cu. m.

(Note: 1 cu. m. = approx. 35.3 cu. ft.)

The sales of gas in 1954 have been reported as:

Domestic	1,050,550	thou. cu. m.
Industrial	857,996	thou. cu. m.
Commercial	560,671	thou. cu. m.
Misc.	8,495	thou. cu. m.
Total	2,477,712	thou. cu. m.

The remainder amounting to 946,881 thousand cu. metres is unaccounted for in the present statistics and is probably largely distribution loss.

The increasing production has been accompanied by a much greater increase in the reserves. It was reported that there were reserves in 1946 of 153 x 10^{14} cu. m. which increased by 1952 to some 306 x 10^{14} cu. m. It is now reported that proven reserves in 1954 totalled some 612 x 10^{14} cu. m. and that these reserves are being increased every year by some 4.2 x 10^{14} to 5.5 x 10^{14} cu. m.

Table IV. Energy Requirements by Types of Use (k.Cal. x 10^9)

	Domestic	Industrial	Railway & Bunkers	Air & Road	Transformation Losses	Total
1945	169,022	125,179	113,487	41,575	11,610	460,873
1946	175,751	121,360	106,459	47,530	12,568	463,668
1947	182,920	140,844	112,992	53,560	11,001	501,317
1948	186,438	151,022	111,887	58,919	15,157	523,423
1949	183,595	150,078	107,690	65,579	17,502	524,443
1950	197,541	151,701	102,924	71,366	15,933	539,465
1951	196,249	166,933	106,879	78,572	14,946	563,579
1952	192,890	171,052	102,436	90,809	17,422	574,609
1953	189,452	176,188	90,234	95,711	18,245	569,830
1954	193,335	174,860	78,847	100,699	15,018	562,759

Note: 1 unit is equivalent to approx. 3.97 x 10^9 B.t.u.

The major problem has been to develop a remunerative outlet for this vast store of energy. The energy consumers in Western Canada where this gas is so abundant have at their disposal cheap local oils, coals and to some extent relatively inexpensive hydro-power. There is, therefore, no immediate large scale market in sight although increasing population plus growing development of the petrochemical market will gradually provide wider outlets.

The large energy consuming areas of the Pacific Coast and of Central Canada and the United States are being considered as future outlets and much work has been done on planning pipe lines to serve these markets. At present it seems assured that a pipe line will soon be built from the gas fields to serve the Pacific Coast area both in Canada and the United States. The larger proposition of a major pipe line to bring Alberta gas to Ontario and possibly the central region of the United States is still under consideration. The economics of the proposal are not yet firmly established and, though the project is physically possible, there apparently remains some doubt that the proposal for a Canadian supply only would be financially remunerative.

It is probable that a decision will

be reached in the near future and that this line will be built to supply some 10,336,000 cu. m. of gas per day to Eastern markets although whether these will be entirely Canadian or not remains to be decided.

Wood

No report on energy in Canada can be fully complete without including wood. It is true that wood is of little importance in the industrial field but it does supply a substantial proportion of the househeating requirements. In this northern area, househeating is one of the major outlets for energy. Statistics on wood consumption are incomplete, particularly since a large proportion is cut and used by individuals. There is, however, a reasonable base for estimates in the census reports of household equipment and it can be estimated that the amount of wood used as fuel in the last ten years has been as reported in Table III.

Atomic Energy

Discussion of progress in the development of the energy resources of Canada would be incomplete without noting the important advances that are being made in the atomic energy field. New finds of fissionable ores, notably uranium, have been commonplace in recent years over widespread sections of the country. The reported finds indicate that Canada possesses very large but unmeasured resources of this new-found energy.

In order to stimulate production of the uranium finds the Canadian Government has announced a policy whereby it has undertaken to purchase the output of all acceptable uranium concentrates which are offered under a published price schedul up to March 31, 1962. August 1955 saw two uranium mining companies come into production with total milling capacity of 2,250 tons daily, while Eldorado, Canada's original producer, was increasing its mill from 700 to 2,000 tons daily, and other companies were approaching production stage. Much of Canadian production is exported through arrangements with the United States Atomic Energy Commission under which Canada may divert production for use in Canada when needed.

Opportunity for economic utilization of atomic energy for power purposes in Canada varies sharply between different parts of the country. Atomic power will not compete with existing economic sources of hydro and thermal power but may be expected to supplement Canada's requirements in those areas where economic sources do not now exist or are not likely to exist in the future. British Columbia, Manitoba, Quebec and Newfoundland have large resources of undeveloped hydro power. Alberta and Saskatchewan have very great reserves of oil, gas and low-cost coal. On the other hand, highly industrialized Ontario is now developing the last of its large hydro power sites, and thermal power in this province is dependent on imported fuels. Nova Scotia also has utilized practically all of its hydro sites and thermal power costs there and in New Brunswick are high.

While Ontario's large and growing market appears to offer the most fertile opportunity for the introduction of large scale atomic energy units the expanding needs of the Maritime Provinces may be expected to present power markets favourable to atomic energy developments. Much smaller and isolated markets for atomic energy are possible in the high cost power areas of the far north. The proportion of the expanding Canadian market for power that can be supplied from atomic sources will grow rapidly if and when atomic energy can be produced at a price to compete with existing sources of supply.

The peaceful use of atomic energy has been the subject of much quiet research by Canadian scientists, principally through the use of reactors built at Chalk River, Ontario. A promising development from this research is embodied in the project of Atomic Energy of Canada Limited, Canadian General Electric Company, and the Hydro-Electric Power Commission of Ontario to build an atomic power plant of 20,000 kw. capacity in Ontario. By means of this experimental plant, which is known as Nuclear Power Demonstration, it is hoped to prove the economic feasibility of nuclear plants, to obtain practical data on the economics of power production with nuclear plants, to gain experience and to train personnel in the design and operation of such plants, all with a view to the development of larger economic units.

Forecast of Future

Forms of energy have become more and more interchangeable in Canada as the years have passed. Process steam is produced from wood, coal, coke, oil, gas and electricity. Electricity is produced from coal, gas, oil and falling water. The energy of oil, through the internal combustion engine, or of electricity, through the electric motor, is directly productive energy of motion without an intermediate medium such as steam. All these variations make any attempt to sum up the total energy used or produced a matter of difficulty in selecting a proper unit that is common to all.

For the purpose of such studies the British Thermal Unit has been adopted in some papers but for this

Table V. Energy Consumption by Source of Energy (k.Cal. x 10^9)

	Coal and Coke		Wood		Petroleum		Natural and Artificial Gas		Electricity		Total
	Units	%	Units	%	Units	%	Units	%	Units	%	Units
1945	280,042	60.8	56,549	12.2	76,896	16.7	15,264	3.3	32,122	7.0	460,873
1946	272,117	58.7	55,440	11.9	88,539	19.1	14,189	3.1	33,385	7.2	463,668
1947	286,191	57.2	54,331	10.8	108,774	21.7	16,624	3.2	35,397	7.1	501,317
1948	298,925	57.2	53,222	10.1	118,441	22.6	18,837	3.6	33,998	6.5	523,423
1949	286,924	54.8	52,114	9.9	130,492	24.9	19,278	3.6	35,635	6.8	524,443
1950	278,289	51.5	51,005	9.5	148,915	27.5	22,418	4.3	38,839	7.2	539,465
1951	273,312	48.5	49,773	8.8	173,295	30.8	23,650	4.2	43,549	7.7	563,579
1952	260,055	45.3	47,981	8.3	194,288	33.9	24,876	4.3	47,409	8.2	574,609
1953	239,072	42.1	46,217	8.1	207,691	36.3	26,402	4.6	50,448	8.9	569,830
1954	213,243	38.0	44,453	7.8	222,135	39.4	29,689	5.3	53,239	9.5	562,759

Note: 1 unit of 10^9 k. Cal. = approx. 3.97 x 10^9 B.t.u.

paper the equivalent metric unit, the large calorie (k. Cal.) will be used. The energy contents of the fuels are readily available from published reports while in the case of electricity 1 kwh. of electricity will be taken as equivalent to 3,412 B.t.u. or 861 k. Cal.

Energy requirements in Canada for ten years to 1954 by types of use have been as reported in Table IV.

The heading "Transformation Losses" defines the energy consumed in the transformation of a primary energy to other forms such as from coal to coke and gas or from fuel to electric power. It does not include energy consumed or lost in the production or the refining of the primary energies such as that used in coal, oil or gas production, consumed or lost in oil refining, and so on.

The decline in the last three or four years in the energy consumed by railways and bunkering may be noted. This decline is due in large measure to the changeover from steam to diesel power. Since the diesel is from three to four times as efficient as the ordinary steam locomotive the change in the amount of energy used does not reflect a corresponding change in traffic.

These requirements have been met in the past by coal, oil, gas, wood, and hydro electricity. As noted earlier, the supply and consumption of wood fuel is, by necessity, largely an estimate. In calculations of this order, however, it is believed that the scale of error is not significant. The sources of the energy consumed over the ten years have been as set out in Table V.

The supply and consumption of energy has followed the increases in population both by birth and by immigration and it is assumed that this present rate of increase will continue for the forecast period. It is recognized that, concurrent with an increasing population, there will probably be some increase in the energy requirements *per capita* due to new developments in power uses and higher standards of living. This factor is difficult to define and appears mostly in the increasing demand for electricity. In the estimates presented later, this use increase is taken into account in the estimate of electricity but is omitted in the case of the fuels.

The fact that Canada is a northern country imposes a heavy demand for fuel energy for space heating purposes. Civilized life would be impossible in most of the country without heat in the winter months. Several of the larger industries such as pulp and paper also require large volumes of process heat. Both these demands are supplied by the direct combustion of fuels in various types of furnace and burner equipment. Energy for motion, however, whether driving machinery or for transportation is nearly all supplied by either electricity or by the use of fuel in the internal combustion engine. There are many locomotives still in operation using direct combustion and steam but these are decreasing in number and will probably be all gone in the next fifteen or twenty years. There are, therefore, two distinct types of use of energy.

It is possible on the record of the past to make an estimate of future energy needs. It is, however, necessary to lay down certain basic assumptions. It will be assumed for this purpose that

(a) the population of Canada will increase to 19,367,000 in 1965 and 23,287,000 in 1975.

(b) there will be no world war or other large scale disturbance in the period.

(c) the demands of the estimated population for goods, services and fuels will continue at approximately the present rate of growth.

On these bases an estimate has been made of the prospective consumption of energy in 1965 and in 1975. This is reported in Table VI.

Table VI. Forecast of Canadian Energy Requirements

(Units used are k. Cal. x 10^9 or approx. 3.97 x 10^9 B.t.u.)

	1965	1975
Fuel Energy		
(a) Domestic use	261,012	313,622
(b) Industrial use	183,676	230,657
(c) Railway & bunker use	65,833	65,873
(d) Air & Road use	146,318	212,704
(e) Transformation losses	31,852	65,735
(f) Sub-total	688,691	888,591
Electric Energy		
(a) All Uses	109,721	179,837
TOTAL ENERGY	798,412	1,068,428

For comparison, the total energy required for these purposes was in 1945, 460,873 units at 10^9 k. Cal. and in 1954, 562,759 units of 10^9 k. Cal.

Under present shifting conditions, it is not possible to state the sources from which this energy may be supplied. There are, however, certain definable fields or areas. The atomic power field is uncertain, but it is assumed that in the period noted there will be no *net* addition of energy from atomic sources. Though there will be developments in the production of energy from atomic sources in the form of useful heat or electricity, the amount of energy from other sources that will be needed to mine, process, and refine the atomic fuel and to build and maintain the reactors and produce the accessory materials, such as heavy water and special metals, will be approximately equal to that derived from the atomic fuel in the reactors.

The liquid fuels by 1965 are expected to carry all road and air transportation and all but some 6 per cent of the railway and bunker requirements. By 1975, it is expected that all transportation will be supplied with energy in liquid form.

Domestic heating currently uses 32.5 per cent coal, 24.4 per cent wood, 34.1 per cent liquid fuel, and 9.0 per cent gas. Over the forecast period, there will probably be a continuing trend away from the solid fuels. In this field, cost and convenience are the determining factors and there could be developments in combustion equipment or in competive costs that might reverse the trend.

Industrial requirements are now partly supplied by heavy residual oil. There is some disagreement as to whether this trend will continue or whether the prospective increase in the demand for gasolines and light fuel oils will be so profitable that the heavy residuals would be reprocessed to produce more of the lighter fractions. In the gas producing areas,

(*Continued on page 1696*)

Fundamental Concept of Education

G. E. Hall

President, University of Western Ontario

Presented at the joint ASME-E.I.C. Engineering Education Conference, London, Ont., 18-19 October, 1956

"PROGRESSIVE universities are an index to a progressive society, stabilized universities to a stabilized society, stagnant universities to a stagnant society. Flourishing universities cannot exist in a community folding its hands to sleep."

These words spoken many years ago with respect to European universities should be reminders to us in this generation. We, in Canada, are not in a stagnant society; we are not in a stabilized society. We are in a progressive society!

We are in a period of exciting development. We are seeing our forbidding frontiers being pushed back by science, by engineering, by the determination of enterprising, pioneering people. We are seeing the impossible being made possible. We are experiencing the twentieth century rediscovery of Canada. Our population is increasing, our standard of living is increasing and our responsibilities are increasing. The complexity of our society heightens — the challenges to education are made greater. These are stimulating, impelling, changing times, demanding forthright thought and courageous action.

Last year I had the opportunity of addressing a section of the Engineering Institute of Canada and selected as my subject "The Tide and Crisis." It was a subject of concern to us all. It dealt with the specific, new concrete problems facing the universities during the next ten years—the simple problems of economics coincident with a growing nation, the problems associated with a doubling of the numbers of university students during that period. I stated at that time, "more and permanent facilities will have to be provided; more university teachers will have to be prepared and appointed. Higher salaries will have to be provided for the members of the staffs—so that they too may share in the material benefits of an increasing standard of living experienced already by most groups in Canada but largely denied to university teachers."

This was a dinner address by Dr. Hall at the ASME-E.I.C. Engineering Education Conference, held this fall at the University of Western Ontario, with the theme "The Continued Education of the Graduate Engineer". Further comment on the conference will be found in the Month to Month section.

A crisis, by the way, simply means "a turning point in the progress of anything"; "also a state of affairs in which a decisive change for better or worse is imminent." The crisis to which many have referred is not "for worse"; it is, I believe, "for better." Better because thousands more young men and women will be given the opportunities of higher education, of sharing in the greater responsibilities coincident with our expanding economy, of making Canada a finer place for their having lived in it, and of bringing to further realization our hopes of equal opportunities for all.

The economic expansion of Canada has been rapid. It has outrun the available manpower. The manpower shortage, so often considered as temporary and referable chiefly to scientists and engineers and technicians, is anything but temporary. It would appear to be continuing and long-ranged in its implications. And it is not limited in its pattern—it is a total manpower deficiency. The so-called "Tide and Crisis," being faced by the universities and other educational institutions, should therefore be considered as our great hope, as the real rainbow in Canada's economic horizon, as the sunshine after the storm. The "crisis" is a great opportunity for Canada.

There are problems to be sure, the greatest of which, I think, is the scarcity of teachers—particularly science and mathematics teachers at the secondary school level. But from the vast reservoir of young men and women can come the brains and the skills which can not only overcome our manpower shortage but provide a constant and even an ever increasing supply of talented young people upon whom the future of this country is, in such large measure, dependent. These young men and women, able as the majority are, gifted as many of them are, must be brought along to the extent of their capacities, stimulated towards higher levels of education in whatever line of endeavour they choose—Canada can utilize all of them. Those who graduate in the humanities and social sciences — those who, one day, will solve the great social problems of our industrial and scientific civilization—are just as vital to this country as are the presently and urgently needed graduates in engineering and the natural sciences. The same attention has not been focused on this aspect as much as it should be. In directing our attention to the whole problem we should not lose sight of any single portion.

But at the moment let us focus our thoughts on engineering education — the theme of this conference.

The professional engineer to-day is fulfilling a role in to-day's economy, somewhat different than that of 25 or 50 years ago. Important as he was then he is an even more important figure to-day in directing the course of our industrial and economic development. He is, to a large extent, management. Speaking generally, of course, the "leather britches" have been replaced by the striped trousers; the transit and chain have been exchanged for the golf club and caddy cart; the high leather boots have given way to polished shoes; the drafting board has given way to the mahogany desk, tracing paper to financial statements and blue-prints to annual reports. Ten years after graduation the largest single group of engineers are in managerial positions. They are not civil engineers or electrical engineers or mechanical engineers. They are businessmen and business leaders with an engineering background. They are management in a scientific world. In other words, the engineer has become the manager of men, money and materials in his efforts to utilize science. These efforts, it is hoped, are for both the immediate and future benefit of mankind.

Change is Slow

The changing of a concept is slow. The changing of an educational pattern is slow. In many instances this is a good thing; it minimizes changes simply for the sake of changes; it sponsors a deal of thinking, of planning and of careful action. But it would be a denial of education itself if changes did not occur — minor changes with some degree of frequency, major changes perhaps less frequently.

And in the field of engineering education we see changes being implemented — changes which are based upon changing concepts, changing objectives and changing philosophies. Such changing objectives and philosophies are accepted by many charged with responsibilities of curricula planning and indeed by many interested in the broad aims of higher education. On the other hand there are, naturally, some who oppose any major alteration of the basic organization of engineering education and maintain the validity of the status quo. Let us have a look at the situation as a whole.

The universities on this continent have become, in general, a collection of relatively independent faculties, schools and training centres, rather than as originally conceived, and more than ever necessary, a unity of purpose in education. University education, in my opinion, can no longer be thought of as a collection of detached parts, of courses, of subjects, each growing and functioning in isolated splendour. Consequently, I feel that the exposition of one part of knowledge cannot logically be delegated to and subsequently designated as the exclusive prerogative of one department or group of departments. Education is bigger than that. A greater degree of integration of courses, a more purposeful and sympathetic appraisal of curricula is no longer just an intellectual abstraction; it is in the interest of education; it is relevant to the progressive society in which we live; it is common sense.

Specialization

The programme of engineering education is perhaps consistent in its present degree of specialization with historical trends in many fields. But, I feel, the intellectual and physical separation of the different phases of engineering instruction gives the student the deceptive impression of departmental completeness and tends to breed further specialization. Civil, mechanical, electrical, chemical — this departmentalization, at undergraduate level, suggests self-sufficiency. This, I think, is not entirely warranted. I say this, knowing full well that many will not agree with me and many will challenge my right even to express an opinion. But may I remind all of you, and I consistently try to keep this in mind myself — progress is unusual in any situation where everyone agrees! The forces which influence social changes do not leave untouched the fundamentals of education.

Engineering education, as it becomes more and more scientific in its content, must, I think, become more and more an integral part of total university education. The professional, yes, even the social and economic barriers between engineering and the arts and sciences — the academic and administrative adjustments to be made and the spirit of cooperation and mutual respect to be fostered constitute a wall, artificial to be sure, but a wall sometimes difficult to penetrate. But penetration is not the only way to get to the other side of the wall. The wall can be climbed. The wall can be stormed. But one can also reach the other side by having the double locked door unlocked on each side and entrance made through the mutually opened portal.

The members of our departments of mathematics, geology, physics, chemistry, history, philosophy, geophysics and indeed the whole of University College opened the door to the engineers, and the engineers welcomed their new colleagues with enthusiasm, with trust and with understanding of their joint responsibilities to education.

The Correct Approach

An effective programme of engineering cannot be accomplished simply by cursory decisions; neither can changes. The traditional approaches must be respected as proven. New approaches should be made only after a dispassionate, critical study of aims, objectives, course content and method of presentation. The locale of the institution may be a factor in the decision. The present and future place of the university should never be forgotten.

It is my firm conviction that as a professional faculty or school, engineering, or applied science, belongs in a university; on the other hand technical training does not belong there and should not, under any circumstances be a part of university activity. This matter is fundamental. "Training is aimed at a fixed objective while education is directed toward a moving one." (Dr. Allen Gregg, I believe.) Engineering teaching consequently must be directed toward education rather than training, toward principles rather than practices, towards the acquisition of knowledge rather than skills. The days of proprietary schools of medicine and schools of engineering in Canada have long since been relegated to history.

And on the basis of this philosophy and recognizing the fundamentals of any form of higher education, a course was introduced at this University in 1954, after two years of planning, and with the help of many engineers and engineering societies. The course in Engineering at Western is not the traditional type with major specialization in one field of engineering. It is primarily a four-year common programme with some electives in the two final years. (And here it should be pointed out that it is a four year course from grade XIII.)

Some 20 per cent of the time each of the four years is devoted to the humanities and social sciences—regular courses as offered in University College and not in any way directed towards engineering. Four years of mathematics, four years of physics, three years of chemistry etc. set a pattern for the basic science content of some 25 per cent of the total programme. Emphasis is placed on theory — fluid mechanics, thermodynamics, electronics, atomic energy, etc. — engineering science rather than engineering skills. And naturally engineering design, analysis etc. have not been neglected.

Many factors led us to adopt this type of engineering science course. We believe that it is a realistic approach to the education of engineers in today's and tomorrow's economy in Canada and the United States. We believe that it is both educationally and philosophically sound. Economically it is, additionally, extremely attractive. The cooperation of industry in permitting us to use, in a really educational and serious manner, many of their facilities and staff, for major laboratory work, will be most helpful.

Dr. G. E. Hall, president, University of Western Ontario, speaking at the recent meeting of the National Conference of Canadian Universities, of which he is also president.

Adopting a New Approach

Not having had previously an Engineering School, there were no obstacles to the adoption of this new approach to engineering education. Having no traditions in this field, no major compromises in curricula were necessary. And it is interesting to note that the main recommendations contained in the report of the ASEE, published in 1955, were in effect in our programme planned in 1952-53. Please don't misunderstand me. This simply indicates that a great deal of thinking, by many people and in many places, relative to engineering education had been shifting to a more basic and less specialized approach. We were in a position, as it were, to inaugurate an idea of our own which was later found to be the idea of many, many others.

Our first graduates will receive their Bachelor of Science (Eng.) degree in June 1958. Subsequent classes will add to the increasing flow of engineers into our Canadian society. Time alone will be the judge of the success of this experiment in engineering education.

It is as impossible as it is unwise to discuss engineering education without giving consideration to technical training. This of course is a subject for discussion at this conference. I do not wish to anticipate the outcome of those deliberations nor to detract from any recommendations which may arise. But I do wish to clarify my own position once again.

On many occasions over the past six years, and more frequently during the past two years, I have pointed out publicly and at conferences, the urgent necessity of developing many more technical institutes at post-high-school level. Thhe work of the Ryerson Institute of Technology is recognized; its contributions to industry and business, through its graduates, commend it; its overcrowding indicates its acceptance by students, by parents and by employers. But there are not enough of them. Ontario alone needs not one, not two, not three, but conceivably eight or ten or more of them, strategically located in areas of major urban populations.

The future of this country is to be guaranteed, not alone by more university graduates, but as well by more and more skilled technicians, by more and more craftsmen.

The graduates from such institutes of technology — the technicians and the craftsmen, gaining experience within industry and business, will be found, as they are now, working as a team with the engineers and with the pure scientists.

These technical institutes have an important place in industry, in business, and indeed in our whole society; so too have the universities. The universities are not, never have been and never should be, in competition with the technical institutes. Their purposes are distinct and different. The craftsman and the technician should be respected by the engineer and the scientist, the engineer and the scientist respected by the technician and craftsman. There should be no conflict relative to the values and virtues of each. There should be no conflict relative to the educational approach for the engineer, the craftsman or the pure scientist. They are all of great importance. But there is a difference between training for a job, vital as that job may be, and education. A university is, and should remain, an institution of higher education.

Engineering education must prepare students for about forty years of self-development and self-education.

Someone has said that education is a journey and not a destination.

Long Range Planning in an Atomic Age

A Management Panel Discussion

Held at the 70th Annual General and Professional Meeting of the Engineering Institute of Canada, Montreal, May 1956

ONE OF THE features of the 1956 Annual Meeting of the Institute that aroused very wide interest was the management panel discussion, which had as its theme "long range planning in an atomic age".

A distingushed panel was assembled under the able charmanship of Lt.-Col. L. F. Urwick, joint chairman, Urwick Currie Limited. The panel members were: S. M. Finlayson, M.E.I.C., president, Canadian Marconi Company; L. A. Forsyth, president, Dominion Steel and Coal Corporation Limited; J. G. Notman, M.E.I.C., president, Canadair Limited; and R. B. Smith, vice-president, The M. W. Kellogg Company, New York.

After introducing the panel, the chairman presented some of the problems that were facing industrial management today. He then called on individual members to express their views on the subject, after which there was a short session for members of the audience to submit questions, which were answered by the panel. The account that follows is a summary of the recorded proceedings.

The Chairman

Thirty years ago the late Edward A. Filene wrote "Successful Living in this Machine Age". His theme was that the great unsolved problem of business was distribution. This afternoon, thirty years later, we are considering what is really a fresh phase of that same problem. As far as North America is concerned, the thought which preoccupied Filene is now realized. Mass distribution is redeemed as a reality, but the process of technological development has accelerated and expanded and it will continue to do so at a continually more progressive rate.

Among the possibilities seriously advanced as probable within the next twenty years are, electronic light, producing startling substitutes for present types of illumination; atomic batteries, providing power for years from small units, without re-charging; purification of sea water on a scale that will make deserts blossom; better ways of releasing nuclear energy than by fission; automation may be used for industrial process control, legalized industrial economic planning, and for many other purposes; probable human intervention in atmospheric and climatic matters within a few decades.

Lt. Col. Lyndall F. Urwick

The more useful technological advances are, the more unstabilizing their effects can be. It is in the time lag in our individual and social power to assimilate what technology has to offer, that the real danger lies. Much of our thinking is still encumbered by the uncleared ruins of ideas only appropriate to a handicraft age.

Half a century ago the American engineer, Frederick Winslow Taylor, urged that a business management suited to a scientific age must be scientific. He recognized clearly that to achieve this condition would involve a mental revolution. What are we, as business management, doing about that mental revolution?

Peter Fraser's latest book, "The Practice of Management" emphasizes the longer time which is beginning to elapse between basic research and actual sale. The manager is dealing with constantly protracting futures.

The entrepreneur used to be somebody who perceived the demand and then followed the market, but today the ordinary principles of using mechanized equipment quite rules out following the market. You have to create and lead the market. That leads to the problem how are we to do this longer-range planning which modern management methods require and the economic and technological situation make mandatory? The problem is whether the same minds can do the long-range planning and lead tomorrow's battle.

Ought we to re-vamp our business organization so that by segregation of planning for the future, an active command for tomorrow is achieved? At least we can try to develop a next generation, competent to handle these innermost problems.

How are we to turn technical engineers into first class general managers, and, if we continue, to persuade highly skilled technical engineers to submit cheerfully to the leadership of boys with Arts degrees who don't know one end of a spanner from another, and so on? These are some of the problems that face industrial management in the heat of the development of our time.

L. A. Forsyth

If I had the time I would take issue with some of the things our chairman said. In the first place, we are not yet living in an atomic age, but I believe that most people look forward to the advent of the atomic age with equanimity. People adapted themselves eventually, from the stone age to the iron age, and thence to the machine age. In these successive developments the tempo was stepped up, but there is no revolution in thought or in the method of approaching new problems.

One of the things I try not to do is to plan too far ahead, because I think it dangerous to tie the hands of somebody who is going to succeed me by committing them to a long-range plan that may have to be altered or abandoned.

I am not prepared to say that nuclear fission will not create many interesting situations, but I have above all other things the responsibility for the employment of thirty thousand people, and in planning I think that I must maintain a vigilant outlook; I must impress upon those working with me the necessity for observing what is going on around them and to take every new idea coming forward and apply it, so that we will keep abreast of the times.

That brings me to the long distance planning that I find us wholly unable to cope with — the education of the rank and file of those employed in the industry, and those who are going to be employed in the years to come.

Obviously we are going to require more skilled people. And there I think is perhaps the weakness of all planning with respect to the forthcoming atomic age. If I could know that the next generation are provided with adequate facilities for education and guidance during the course of their education, I would feel a very great deal better about the whole thing.

So far as the use of nuclear energy is concerned, I don't believe that its practical use is quite as close as some of us would like it to be. I think we are still living in the machine age, and it is a different machine age from what is was when it started. It has brought us airplanes, television, radios, the automobile and a host of things that have improved and speeded up our production.

Personally, I believe that the time is not yet for us to forget what we have learned, and proceed to learn something else. I don't believe that we have to forsake the old philosophies or the old methods. I still believe a clear head and hard work, backed by education, will solve most of these new problems.

J. G. Notman, M.E.I.C.

L. A. Forsyth

In my long distance planning I must see that there is some advantage in what is exploited today to the utmost; that I continually improve the calibre of my organization. I feel that if we hold to that policy we will meet the challenge of the atomic age when it comes.

Ronald B. Smith

I think we all recognize that there is too much of the element of Buck Rogers in our approach to the problem of the atomic age. At the same time we must recognize that we are in a gigantic stage of transition. I submit we cannot look only at the problem of atomic power when we think of this atomic age. We have many other problems which can be very revolutionary to our business and our outlooks as a result of the application of nuclear effects to the concept we now have.

Our whole concept of petroleum refining and of the chemical industry may be altered in a major way by the submission of these materials to control radiation. This can change the whole pattern of our life, and the whole pattern of industry. For instance, it may change the whole pattern of our clothing industry, and of our food industry and its related refrigeration.

If we are ever going to approach this problem capably and effectively we have to adopt a very flexible long range plans policy, one that is concerned with the development of adequate managerial talent to cope with the problems of the future. This needs a long range plan; it involves more than the strike-by-lighting that probably characterized too much of the long past.

I think two of the things that have created difficulty in the management problem in the past are going to be

S. A. Finlayson, M.E.I.C.

R. B. Smith

extended to the future. Certainly one of these is going to be the increased complexity of the problem and probably its increased tempo, but I think also that a period of transition is likely to take place, where most of us in a management position are not equipped to understand the problem's complete technicalities.

Now, there is liable to be, for a period, a rather sudden change from the way we have operated in the past. We may find the need to bring more and more highly skilled technical people into the realm of management, and we must gear ourselves to take and develop them into strong sound management material.

In our long range plan approach, it seems to me that the one region we can be sure of, is to keep ourselves in a flexible position until perhaps our course is a little clearer.

S. M. Finlayson

It seems to me that in addition to the problems being created by the harnessing and control of nuclear fission there are many others of a technical character pressing upon our community, which may perhaps be of even greater importance in the near future.

Therefore, it would seem wise to cast our thinking on very broad terms if we are to hammer out a pattern of procedure that will be useful, not only in the next few years, but for a couple of generations.

Frequently we fail to recognize that the real challenge ahead of us all, whether we be engineers or managers or professional people, is to find some means of making our problem clear and apparent to the rest of the community.

We all know that nearly everything is reducible, with a little bit of thought, to a fairly commonplace, simple, plain explanation, either directly or by way of analogy. We know one of the main purposes of engineers is to fraternize, to interchange their ideas and discuss their problems. It seems to me we have got to carry that procedure the whole way so that as we advance into this new, complicated and much faster moving era, we will be able to help others to look upon the forthcoming age, not as a prologue to some form of disaster but much more, as a challenge and an opportunity.

Our problem is to find some way in which we can take the whole of the public into our confidence, explain to them the values, and thus gain their support in an orderly, peaceful, and useful development, instead of letting the thing run haywire, as it is almost certain to, unless those of us who have knowledge are willing to share that knowledge with others and give them a chance to become associated with us in the solution.

J. G. Notman

In the first place, nuclear physicists have given us a tool to work with, which has a potential source of heat with unlimited bounds. But the harnessing of this heat for the use of mankind presents manifold problems, not heretofore coped with on the scope that is now envisaged.

Safe practice with radio-activity is based on over fifty years of experience on the effects of radiation and radio-activity on human beings; safe practice that may be engineered into every phase of a nuclear project, in varying degrees.

I think too few people realize the fact that when you start your fission you necessarily produce radio-activity, and that means having to design every piece of equipment used in a nuclear plant to safeguard human beings.

It would seem, in developing nuclear energy, that the most logical way to use it first of all will be to produce electricity in a nuclear power plant. This has been done, and in some cases where it is now difficult to procure the ordinary type of full supervising engineers, the situation is becoming critical.

I believe that we must, as far as possible, be active in the nucleus of a group of people who are knowledgeable on this subject and that, with the cooperation of the Government we should be doing what we can in producing those who will be able to help us make the best possible use of this equipment.

Question

"Do you think we might persuade the universities to undertake to train technological interpreters who might be capable of explaining one technology to another, and all of them to the general public?"

Mr. Finlayson

I don't know whether it will be practicable to train a special race of interpreters. My own view would be we should do what we can to encourage the universities, and we have a great duty and responsibility toward the universities; we are going to develop some of their problems, but I think our university education could be made less specialized than it seems to have become, so that they would develop people who have more broad basic education than seems to be the case at the moment.

I do feel it would be better even to eliminate some of the more highly specialized technological studies, and add to the broad and sociological and economic general knowlege of the graduate, than it would be to try to develop a race of interpreters. My fear is they would go only half way towards solving the problem.

Question

"Should not part of industry's long range planning be to get the Government out of the atomic energy business?"

Mr. Forsyth

I have no conception of any private industry in Canada that could tackle the job and provide the capital for it, knowing the original investment, so far as any particular industry is concerned, to be entirely unprofitable.

Mr. Rose

"At what level can we interest the young engineer to obtain greater education in applied sciences? Can we not emphasize and encourage more development and education in the field of mineralogy for instance, that has been last from the money standpoint?"

Mr. Notman

I think it is an admirable idea. I do think that is one of the things we are faced with — the problem of developing technical thinking among boys to be more technically minded in school than the stage where they can go to college.

I am rather surprised to read in the McGill Annual Report that, of the boys entering engineering the last two or three years, only 54 per cent have actually graduated. I think it is a good idea that people should give a lot of thought to development in the primary schools, particularly that of more technical knowledge.

Mr. Forsyth

At a luncheon the other day I met people, all connected with the study of mathematics in our universities, who had the same experience in the last two years. They put to me the rather astounding proposition that the boy or girl who graduates from some of our high schools could go

(Continued on page 1696)

DISCUSSION

of Technical Papers and Other Articles

LONG RANGE PLANNING IN AN ATOMIC AGE

A Management Panel Discussion

The Engineering Journal, 1956, December, 1688.

J. Thoburn Rose[1]

In this discussion the problem arises, how our people could best be educated for an atomic age. It is evident that the need for revision of our educational methods is important. The writer ventures to ask: "How soon can our young people be expected to prepare for a definite career? How much can they be guided to develop hobbies which will provide a background for future preparatory school and university work?"

Some years ago a prominent wild life authority said he despaired of finding sufficient candidates for mammalogical sections of the wild life division in the Civil Service of Canada. His own collection of wild life specimens had been started early. He declared that unless such studies were started early as hobbies, few young people could have the best of academic training without the background of long years of collecting and study from which there might be developed a keen interest that no monetary incentive, in later years, could replace. It is generally said that scientists are born to their calling, or at least have an enthusiasm early developed by earnest teachers of high calibre, well informed and dedicated to their profession.

It is widely recognized that university training of four years, with five months or more taken off each year to earn enough to get through successive years, is not enough to qualify a youth for the offices of the atomic age in many of the demanding positions so rapidly developing. Will it not become increasingly evident that more planning for employment of undergraduates of universities, and even of our high schools, be general? High school teachers advise that too many are lured into industry, neglect to go on to finish or even matriculate. It seems that industry, and possibly the civil service, to be assured of the highly trained young people necessary to carry on in an atomic age, must screen and offer them chosen employment with the possibility of continuous training even to half their time. Similarly, taken as far as the graduate stage, training must come to be recognized as a duty to our developed requirements and both employers and employees must realize their joint obligation to society to train intensively to the high degree necessary.

The idea of including the liberal arts must be kept in mind in order not to become a regimented state. Recent enlistment from the British has brought out the fact that their young scientifically trained men have a much better grounding in basic subjects which here are often minimized or not thoroughly developed. Too often the high school teachers do not engender enthusiasm, or pupils are distracted by extra-curricular activities, so that, combined with too little strictness in large classes, good material dissipates its time and a career is shattered in early high school.

Though the tendency is to plan and attract graduates for the many new professional positions it seems this must be started with counselling and career training at a much earlier age than has been our practice. Possibly a much more extensive scholarship structure must be started to ensure that none of the available supply are lost to our urgent requirements. This may require an early reorientation of our educational system and employment.

[1]Department of Northern Affairs and National Resources, Ottawa.

A PILE LOAD TEST

D. F. Coates, M.E.I.C., *Department of Civil Engineering, McGill University.*

The Engineering Journal, 1956, March, 228

Floyd K. Beach, M.E.I.C.[2]

Professor Coates has an interesting study of a pile load test. As an encouragement to engineers who may have a problem on their hands where piles cannot be driven to refusal, may we recall a pile trestle that successfully carried rail traffic for years over Kootenay Lake with no sign of settlement, yet the only apparent support for the piles was skin friction.

The bridge was built before I arrived on the scene in 1908, so I have only hearsay evidence to submit. The story was that on driving the first pile it went so far with each stroke of the hammer that it looked as if a bridge would be out of the question. The pile was left overnight and on resuming work the next day several blows were needed to start it down. A decision was made on the spot to drive pile bents with a suitable length of pile in the mud, frame them and lay the bridge on top.

As I recall, each pile went some 20 or 30 feet into the mud and, some years later, I could see no sign of irregularity in the rail line on top of the bridge.

The shore rocks are, I think, pre-Cambrian and are most competent, but the bed of Kootenay Lake is a loose, unconsolidated mud, some of which may date back into Tertiary time or earlier, but is mostly the accumulation of Pleistocene to Recent sedimentation. It is quite safe to

[2]Consultant, Calgary, Alberta.

believe from all evidence to be seen that there is a much deeper mud deposit than there is any hope of penetrating with piles.

I regret that I cannot give the weight of hammer nor its length of fall and I cannot say how far each pile was driven.

I can suggest that no two situations are likely to be exactly the same and that it would be most difficult to find values for the variables suggested in the formulas that Prof. Coates quotes, particularly when a pile driver is on the job with a crew of men waiting for direction. However, this bridge appeared to stand very largely because of adhesion to the pile shaft (skin friction), and that adhesion did not develop until the pile had been static for some hours. The best indication that could be had was the fact that several hammer blows were needed to start it after standing over night. Doubtless the framing of several piles into a bent gave a combined bearing in excess of what would be obtained as the product of the bearing of a single pile by the number of piles in the bent.

The Author

Mr. Beach has mentioned an interesting case where piles were driven into a sensitive clay, allowed to sit until the clay had regained its strength (i.e., similar to the thixotropic regain mentioned in the paper), and then used assuming the adhesion of the soil to the pile to be sufficient for the design loads.

This may be a reasonable procedure when the nearest bearing stratum is at excessive depth. It is done today — in some cases without analysis, in other cases where analysis should indicate two things: (1) that the safety factor against failure of the adhesion is commensurate with those incorporated in the superstructure; and (2) that the immediate and consolidation settlement of the structure is not likely to be excessive.

Regarding Mr. Beach's last sentence, I would point out that the *maximum* allowable bearing capacity of a group of piles would be equal to that of a single pile multiplied by the number of piles — in most cases for piles not on bedrock the allowable bearing capacity of the group should be less than this product.

I agree with Mr. Beach's observation that it is difficult on many jobs to determine the appropriate values for the variables required in the different analyses of pile capacity. This is rather a counsel of despair for it means that, even with a reasonable amount of soil testing and, as a check, with conservative and measured constants in a dynamic formula, in many soils (particularly those of a semi-granular and semi-cohesive nature) you still cannot be confident of the static reaction and settlement of each pile. This seems to indicate that in such conditions for jobs involving the use of several hundreds of piles an extensive program of load testing together with a probability analysis of the results would be the rational and economic procedure.

In case I give the wrong impression, it should be realized that in many cases of piles supported by soils a reasonable amount of soil testing and/or the use of a dynamic formula allows one to predict pile capacities quite accurately.

DEVELOPMENT OF INTERNATIONAL RIVERS

General A. G. L. McNaughton, M.E.I.C., *Chairman, Canadian Section, I.J.C.*

The Engineering Journal, 1956, November, 1493.

General McNaughton has added the following information as a further commentary on his paper.

The Author

I would mention specifically, in relation to power, the help we have offered as an interim measure to reduce the prospective heavy energy deficiencies in the Pacific Northwest by the use of Mica storage downstream in the Columbia in the U.S.A. in the period of from fifteen to twenty-five years before load growth in the Vancouver area requires flows diverted from the Columbia for the further progressive regulation of the Fraser; the added heads at Grand Coulee and Libby made possible by permissions to flood 42 feet and 37 feet into Canada, respectively, at the boundary; and the use of Murphy Creek storage for release in years of exceptionally low flow — all this of course on the basis of a fair bargain in respect to the recompense to Canada for the benefits conferred.

In addition, I would mention the very great benefit to flood protection downstream which would result from the withdrawal, primarily from the crest of the flood flows, of a total of some 26.3 million acre-feet in major projects only which might be possible through Canadian co-operation. (The details are in the table.)

As matters stand, the United States has about 9½ million acre-feet of storage on the main stem of the Columbia, of which, even with the extensive changes now being made at Grand Coulee, perhaps no more than 5 million could be effectively operated for flood prevention. The requirement has been put at 27 million acre-feet to reduce possible peak flows to tolerable proportions.

To illustrate the acuteness of the flood menace on the Columbia in the U.S.A., in the 1894 flood the river had a maximum flow of 1,240,000 cubic feet per second at the Dalles; this is more than three times the maximum measured flow of the St. Lawrence at Lachine.

The Columbia flood of 1894 did 5 million dollars' damage. If this same flood occurred today the damage is estimated to exceed 350 million dollars, that is, a factor of increase of 70.

The 1894 flood on the Columbia is by no means to be regarded as an isolated incident, because there is historical record of some nine other floods where the flow exceeded 800,000 c.f.s.

	Reservoir	Storage (million acre-feet)
Canada		
Columbia River	Bull River-Luxor	3.4
	Mica	11.8
	Murphy Creek	4.0[1]
Kootenay River	Duncan	1.0
	Kootenay Lake	1.1[2]
		21.3
U.S.A.		
Columbia River	Grand Coulee	3.3[3]
Kootenai River	Libby	1.7[4]
		5.0
	Grand Total:	26.3

[1]Might be operated so as to be available for flood control, though this is not at present planned.
[2]Of which 0.4 m.a.f. might be added to existing storage.
[3]Extra storage due to 42 feet flooding being permitted at the boundary.
[4]With 37 feet flooding at the boundary; without this privilege conferred by Canada the project would be uneconomic.

Canadian Section, I.J.C.

In our editorial comment on the above paper, mention was made of the tasks facing the Canadian Section of the International Joint Commission. Supporting the chairman, General McNaughton, the other members of the Canadian Section are Hon. George Spence, AFFIL.E.I.C., and J. L. Dansereau, M.E.I.C.

ABSTRACTS

BASED ON CURRENT LITERATURE AND EVENTS

EXTENSIVE LOANS BY THE WORLD BANK

The International Bank for Reconstruction and Development, widely known as the World Bank, has recently made extensive loans to various countries, including Austria, Italy, Thailand, and Uruguay.

Two loans, totalling $31 million, were for expansion of electric power in Austria. One project is the Ybbs-Persenbeug hydro-electric plant on the Danube, some 80 miles up-river from Vienna, which will have a capacity of 192,000 kw. from six units installed in two powerhouses; half the units should be operating early in 1958. The second loan was for two thermal power plants, using domestic brown coal for fuel, in south-western Austria. Additions will be 65,000 kw. at Voitsberg (now 60,000 kw.) and 100,000 kw. at St. Andrae (now 67,500 kw.). Total capacity of the newly-financed projects will be 357,000 kw.

A loan equivalent to $74,628,000 has been made to the Cassa per il Mezzogiorno for the agricultural and industrial development of southern Italy. This raises the total of loans for similar Italian programs to nearly $165 million. The Cassa per il Mezzogiorno is the governmental agency established in 1950 to administer a 12-year program for the development of southern Italy (and Sicily and Sardinia). The $2 billion program has reached the halfway mark.

Agriculture will be aided by the Flumendosa irrigation scheme to divert waters now flowing into the sea to some 123,500 acres of arid plain in south-western Sardinia. Bank funds will also be re-lent to the principals of ten industrial projects: two cement factories, two glass factories, a vegetable cannery, an automobile assembly plant, a plant for the construction of bus and truck bodies, a fertilizer factory, and plants for the production of hardboard and polyethylene.

The Cassa will also re-lend funds to power companies for expansion of facilities, including three hydro-electric plants on the mainland and a thermal plant at Augusta, Sicily. The projects will increase installed capacity of the Cassa area by 217,000 kw., or 14 per cent, and the annual generation of power by 17 per cent. All plants will be operating in 1959.

The loan to Thailand is for $3.4 million to the country's Port Authority for the purchase of three dredges and auxiliary equipment to be operated in the channel leading to the port of Bangkok and in the harbour. A previous loan was used to deepen and widen a channel, which can now accommodate vessels of up to 10,000 dw. tons; the dredging equipment is needed to maintain sufficient depth in the channel and harbour.

Uruguay has received a loan of $25.5 million for electric power development, to help construction of a hydro-electric plant at Rincon de Baygorria, on the Rio Negro, and additional transmission and distribution facilities. The project will increase generating capacity in Uruguay by about one-quarter, and will consist of three generating units with a combined capacity of 103,000 kw. Also included in the project is a plan for the improvement of the primary distribution system in Montevideo.

DIESEL-HYDRAULIC LOCOMOTIVE ROAD-TESTED IN CANADA

A Diesel - hydraulic locomotive, built and owned by Maschinenbau Kiel Atkiengesellschaft of the Western zone of Germany, is being road-tested this year by both Canadian railways, to determine its usefulness for switching and branch line service.

Known as the "MaK Diesel", it is powered by an 8-cylinder, in-line, supercharged Diesel engine of 9 1/16 in. bore and 11 13/16 in. stroke, rated at 800 h.p. at 750 r.p.m.

Power is transmitted to the wheels by a Voith hydraulic tranmission gear operating in conjunction with a MaK reduction and reversing gear, a lay-shaft, and side-rods coupling the four pairs of driving wheels. The hydraulic transmission gear is similar in some respects to the automatic transmissions in late model automobiles. There are two speed ranges, from 0-30 m.p.h. in low gear and from 0-50 m.p.h. in high. The locomotive must be stationary to change from one speed range to the other or to change from forward to reverse movement. Maximum tractive effort in low gear is approximately 40,000 pounds.

The smooth application of torque and the fact that all driving wheels are coupled with side rods, improve the co-efficient of adhesion. This co-efficient is related to starting friction and is defined as the ratio of the tractive effort at the point of slipping of the wheels to the weight on the driving wheels. According to information received from the office of the chief of motive power and rolling stock of the Canadian Pacific Railway, these features allow a co-efficient of adhesion of 33 per cent when starting a train on a good rail. Under similar track conditions, steam locomotives average 16 per cent and diesel-electric units have a co-efficient of 25 per cent.

Because of the wheel arrangement, described as 0-8-0, the track curvature which can be negotiated by the MaK locomotive is somewhat less than that which can be negotiated by locomotives having two trucks. Maximum track curvature is 24 degrees.

Of interest to railway men is the possibility of easier maintenance due to the absence of complicated electrical circuits. In the Diesel-electric locomotives currently in service, certain parts of the electrical system have been found vulnerable to vibration and dust.

RUGBY — ONE OF WORLD'S MOST MODERN RADIO STATIONS

United Kingdom Information Service (from an article by John Godwin).

The Rugby radio station first went into operation in January 1926 as a radio-telegraph transmission station, and was the first high-power unit to use thermionic valves. Since then it has expanded steadily, the most recent extension having been completed in 1955 ,at a cost of £ 1,000,000.

A year after its opening, Rugby operated the first radio-telephonic service between Britain and the United States. The recent expansion was largely due to the rapid growth of this service; radio-telephone calls via Britain to the U.S.A. rose from 31,322 in 1937 to 81,669 in 1954, and the rate is increasing.

The station site, originally 900 acres, has grown to 1620 acres and now houses an additional twenty-eight high-power transmitters, each capable of handling several messages simultaneously and automatically controlled from a central control position. Though the station has nearly doubled in size and power, staff has increased only from 128 to 167, thanks to extensive use of automatic control, which frees most of the staff for necessary maintenance work.

Power is supplied via three underground cables, each capable of carrying full load; three standby diesel generators are installed at the station. There are some 240 miles of wiring at the station, and 750 miles of cable conductor link the equipment of the new extension. Supply tanks holding 10,000 gallons of distilled water are provided where water-cooled valves are still in operation.

Twelve 820-feet high steel masts dominate the scene, but the number of aerials is kept low by the use of multi-wire rhombics, which are non-resonant and operate over a wide range of frequencies.

A technician at Rugby radio station, England, making a radio-telephone call to New Zealand. The recently-extended station has 53 transmitters.

Apart from the uses already mentioned, Rugby broadcasts Greenwich mean time, accurate to 1/100th second, news reports, and meteorological reports for shipping; radio-telephone service is maintained with several ocean liners. For the Department of Scientific and Industrial Research (comparable with Canada's N.R.C.), the station transmits standard frequencies, accurate to one minute in 100 years.

All is not strictly utilitarian, however. The water supply for fire-fighting is held in an ornamental lake, complete with aquatic plants and goldfish; furthermore, Rugby once sent a message of goodwill to the planet Mars on behalf of a member of the British public — unfortunately no reply has been received.

GET EDUCATED BEFORE YOU SPECIALIZE TOO MUCH

S.A.E. Journal, 1956, August, 63.

There were 180 specialized engineering degree courses in mechanical engineering alone in the United States just a few years ago. The majority of these still exist. The desire for specialization in many colleges in Canada and United States is actually handicapping the student and costing employers money. Statistics show that less than 20 per cent of engineers are practising in the field of engineering for which they prepared themselves in college.

What do we in industry want to find in a newly graduated engineer? What should we do, and what should he do to further his training after he graduates?

An "educated man" regardless of his profession or business, should have some knowledge of history and human development; he should have capacity to enjoy our cultural heritage in arts, letters, music, literature, and so on. He should have an understanding of contemporary society and of himself as a human being; an understanding of one's emotional nature and the capacity to subject oneself to self-discipline. And he should have acquired certain skills and information which he can turn to practical use to make a living.

Industry as a whole requires young engineers:

(a) Capable of applying basic principles to the creative solution of new problems

(b) Capable of contributing to the solution of man's social problems.

(c) With an educational program sufficiently flexible to meet the changing desires which come with maturity.

Industry in its turn must provide the training in specific applications not available in college. There is no substitute for industrial experience, no way to develop mature judgment or an up to date knowledge of current practice, other than by growing up in the proper industrial atmosphere.

For complete paper write SAE Special Publications (price 35c to members) address, Business Press, Inc., 10 McGovern Ave., Lancaster Pennsylvania.

AUTOMATIC OPERATION OF WATERWORKS PLANT

The Journal of the Institution of Waterworks Engineers, 1956, August.

This is a series of three papers prepared independently, then coordinated. A tabulation sets out some of the factors most commonly used to effect control in waterworks, some processes of control and some means of actuation and transmission, in the case of suction pressure, rate of flow, speed or power, suction and delivery levels, pressure time, availability of grid power and tariff for grid power.

Various safety measures, giving the process of safeguarding and means of actuation or transmission, for each of a number of risks involved, are presented in a further table. Examples covering much of the range of these tables are found in the following three papers.

The first paper deals solely with the subject of pumps driven by electric motors and discusses the following divisions: (1) Necessity of boosting. (2) Conditions governing the selection of plant. (3) Types of booster pumping plant. (4) Detailed descriptions of typical plants.

The second paper points out the advantages to be gained by automatic control for water pumping and treatment plants. It deals in turn with main pumping stations, standby arrangements, booster plant, maintenance control gears, pumps, motors, valves, and the pump house. In conclusion a brief summary is given.

The third paper describes automatic control at Castle Hill booster station of Cambridge University and Town Waterworks Company. Outlining the conditions to be met, a brief description of the new plant is given and the basic and actual control systems in use.

A fourth paper gives further examples of automatic control, as used by the Metropolitan Water Board's Sunnyside, Chingford, and Ashford Common pumping stations and by the Bristol Waterworks Co. at its Chew Stoke pumping station. Several pages of verbal discussion and written communications end the series.

HOW FAR DO WE GO WITH INSTRUMENTATION?

Industrial and Engineering Chemistry, 1956, August.

The true solution of how far we go with instrumentation is a balance of cost of controls versus advantages gained by them. How far we go depends on optimum product quality desired, final product cost, and hazards involved in the process. Once the advantage under consideration is established, the final question is: "Can we afford to spend that amount of money to achieve the expected advantage?"

Remote operation and automatic control are achieved by instrumentation. The two together provide many advantages to the modern chemical plant: greater safety of operation; better quality of product; greater operating economy. Instrumentation will accomplish things which it may be impossible to do manually. Processes can operate faster and more continuously when mechanized.

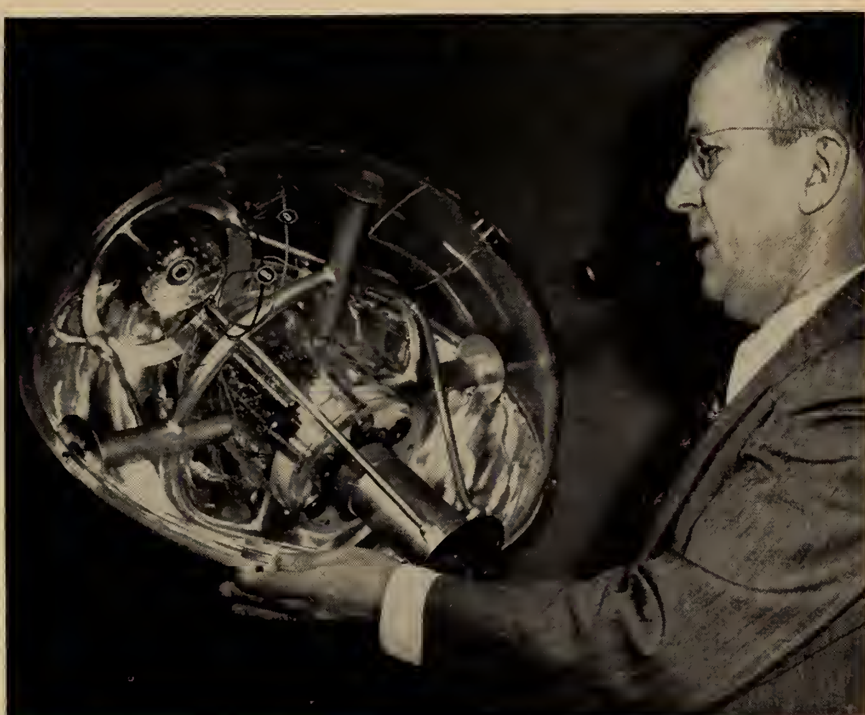
But Professor Thomas Walsh of Case Institute of Technology warns that "further automation of currently used large scale chemical processes is unlikely because it would only add 1 or 2 per cent to the efficiency of such processess." The author, who is not entirely in agreement with this conclusion, believes how far we can go depends on several important factors such as: optimum product quality required; final product cost; and hazards involved in the process of manufacture.

If control systems can be devised to produce a better product quality than can be produced by others, we may be able to compete in new markets, he believes. How well we achieve and maintain an attractive position in the chemical field may depend on how far we go with instrumentation.

THE PROJECT VANGUARD EARTH SATELLITE

The November issue of *The Engineering Journal* (p. 1531) contained a fully descriptive technical paper, by Adml. F. R. Furth, on the earth satellite, known as Project Vanguard, to be launched during the International Geophysical Year. The photograph below shows Dr. John P. Hagen, director of Project Vanguard at the Naval Research Laboratory, holding a model of the 20-inch diameter, 21.5-pound spherical satellite. Through the transparent plastic half of the model can be seen the internal arrangement of the delicate recording and transmitting instruments that will be incorporated in the satellite.

(Official U.S. Navy photograph released by the Department of Defense)



CANADIAN AIRCRAFT ON INTER-CITY TAXI SERVICE

Two Canadian-designed aircraft have been operating, from April to November, on a rapid transportation service between downtown Detroit and downtown Cleveland, carrying passengers and freight.

The aircraft, an 11-passenger DHC3 Otter and a 6-passenger Beaver, both float-equipped, were operated between the port facilities of the two cities by Taxi Air Group, Inc. (known as TAG Airline). Some 3600 passengers were carried during the season.

Despite unfavourable weather, 98 per cent of planned schedule was attained, at an average load factor of 49 per cent.

The service has stopped for the winter, since float operation is not practical, but will be resumed in May 1957. In the meantime the company has bought a second Otter and is converting the original one to land use for an air-taxi service out of Miami to the Florida Keys and other resorts.

A Canadian-designed Otter aircraft taking on passengers at the Detroit seaplane base for a flight to downtown Cleveland, which can be reached in less than an hour.

Progress in the Development of the Energy Resources of Canada *(Continued from page 1684)*

it is probable that new industries based upon cheap gas will develop, but in the more distant areas gas will probably be too highly priced for industrial use except possibly on an intermittent dumping basis.

Finally, as evidenced by the projected increase in the energy required for transformation processes, ective in the type of energy required. The demand for electricity cannot be supplied by any other type of energy, and the internal combustion motor must, at present, be supplied with liquid fuel.

In these two special fields,, it may be estimated that the requirements will be as shown in Table A.

Table A	1965	1975
Electricity for all uses	127,684 x 10^6 kwh.	209,513 x 10^6 kwh.
Petroleum products for internal combustion	24,189,500 kl.	33,066,240 kl.

there will be substantial developments in electric thermal power requirements for fuel. Here again the fuel chosen will be selected on the basis of cost and economy of use.

There are two particular fields of consumption that are inherently sel-

There remains the large field of direct heating, and this may be supplied by any of the fuels. The total energy requirement for this purpose will be approximately 483,005 x 10^9 k. Cal. in 1965. This would be equivalent to approximately — 64,-400,000 m. tons of coal, or
54,274,000 thou. cu. m. natural gas.

The probable course of development will be for oil and gas to secure as large a proportion of the market as the cost will permit, when considering the advantage of ease of use, with coal to supply the reminder.

By 1975, however, the requirements of fuel for direct heating will have increased substantially to 610,-014 x 10^9 k. cal. This, in turn, would be equivalent to approximately
81,400,000 m. tons of coal, or
66,407,000 kl. of petroleum, or
68,545,000 thou. cu. m. natural gas.

A study of quantities of this magnitude, particularly the estimated additional requirement of 33,066,240 kl. of petroleum for use in internal combustion engines, leads to the opinion that coal will be required to carry an increasing proportion of the energy supply.

This development will, in turn, revive interest in the resources of energy available for use in the coal reserves.

Long Range Planning in an Atomic Age

(Continued from page 1690)

through the whole high school course and never study mathematics.

It seems to me that there ought to be some influence at work in our schools that would try to unveil to young people the wonderful field that the study of mathematics offers. The instruction in applied science, I suppose would be almost valueless to a youngster who was not acquiring some knowledge of mathematics.

R. B. Smith

Within our high schools . . . there are not now a group of people who are professionally interested in physics and applied science; and I submit one of the main reasons for that situation is that the number of students graduated from our colleges, and eligible to teach physics and mathematics in our high schools, are tempted by so many offers to enter industry in the atomic age, and receive offers with a much more attractive figure than our school systems can offer, that we are now short at the places where we have to start.

Canadian Developments

NEWS OF MAJOR ENGINEERING DEVELOPMENTS IN CANADA

St. Lawrence Seaway and Power Project

October was marked by a major progress milestone, the diversion of the St. Lawrence flow through the completed first stage Iroquois dam. Overall construction, with the passing of this milestone, approached the halfway mark on schedule and prepared to swing down the home stretch. Concrete placement to end of October exceeded 860,000 cubic yards, excavation for all features exceeded 29½ million cubic yards and employment averaged 4,670 for the month.

Progress by NYSPA

At Long Sault Dam, both gantry cranes were moved from the erection site to the completed stage 1 dam and load testing of both cranes was in progress. Spillway gates were in place and being welded. Removal of the downstream plug of cut F was completed and the upstream plug was narrowed in preparation for diversion of the river through completed stage 1 construction.

Concrete placed in St. Lawrence power dam (Barnhart Island powerhouse) increased the total in place to 388,000 cubic yards. Excavation in the switchyard continued and concrete placement in structures has been started. Embankment placed in the south forebay dike exceeded 660,000 cubic yards at month end.

At Iroquois dam, seventeen stage 2 cofferdam cells had been placed. Stone riprap had been placed along the excavated slope and removal of the downstream cofferdam was started in preparation for total diversion of the St. Lawrence River through the dam.

Stage 1 concrete placement at Massena intake was nearing completion as backfill was being compacted at the west abutment and riprap was being placed. Excavation for the diversion channel was started and stage 2 cofferdam cells were being driven.

Excavation under the five channel improvement contracts was 49 per cent completed at the end of October as work at the Galop south channel neared completion. Topsoiling and seeding of channel improvement spoil areas in the vicinity of Galop Island south channel had been started and was progressing satisfactorily.

Three contracts were awarded for reservoir clearing between Waddington and St. Lawrence power dam, involving clearing of approximately 9,200 acres. (All required reservoir clearing work is now under contract.) A contract was awarded for clearing and chemical treatment of the Barnhart-Plattsburgh transmission line right-of-way.

Relocation of highway route 37 including construction of bridges and relocation of railroad was progressing at a rapid rate and relocation of route 37B was under way. Approximately 97 per cent of the survey work for the Barnhart-Plattsburgh transmission line had been completed.

Progress by Ontario Hydro

Throughout October weather conditions were most favourable for construction progress. Good advances were made in all sections of the development. The work force remained steady with some 4,360 persons employed by Ontario Hydro and the Commission's contractors.

At the end of October, all excavation work on Ontario Hydro's section of the power-house had been completed. A total of 170,000 cubic yards of rock had been removed and some 1,502,000 cubic yards of earth had been taken out of the north channel for the foundation of the main structure.

Concrete placing had been speeded up, and foundation concrete had continued out to unit 16. To the end of the month, a total of 315,000 cubic yards of concrete had been put into the main dam and power-house. Significant progress had been made in the construction of the units for the power-house. The first speedring was put in place for generating unit No. 1. Concrete work is steadily advancing for the next three units. This will enable the acceleration of the work of installing equipment for the generating station.

Favourable weather greatly aided construction of Cornwall dike. More than half the fill material had been placed and compacted on the 3½ mile long dike. Some 1,500,000 cubic yards of compacted till had been put into the dike by month end. During October, construction of the concrete closure structure for Cornwall dike and the diversion canal was essentially completed. A total of 134,000 cubic yards of concrete had been put into this structure, and backfill had been completed at both walls. Good progress was being made on excavation of the mile-long diversion canal both east and west of the closure.

On the relocation of the C.N.R. mainline, the double track had been laid for the entire 40 miles from Cornwall to Iroquois, and two-thirds of the ballasting was finished by month end. Work was being pushed in installing the telegraphic equipment and block signal system. Under the direction of the Ontario Department of Highways, grading was being carried out for the remaining 35 miles of the new road to relocate No. 2 highway between Iroquois and Cornwall.

Good weather aided channel improvement work. The contractor on Galops Island was able to make favourable progress. A total of more than 400,000 cubic yards of rock had been excavated and over 6,700,000 cubic yards of earth removed in this contract to date. A large area of the west end, enclosed by cofferdams, was unwatered at the beginning of the month. On the Chimney Island contract, the Spencer Island pier had reached its full length.

Ontario Hydro's work forces are concentrating on the 1957 phase of the St. Lawrence transformer station installation. This will receive the power from the new Robert H. Saunders generating station during the latter part of 1958.

A total of 90 houses had been moved by month end into new town No. 2. Sidewalk construction at the new townsite was underway and landscaping was in progress. Extension of services and construction of roads for an additional 50 lots had been completed. Some 35 homes were under construction by private contractors.

At new town No. 1, which is being named "Ingleside", installation of water and sewer services was virtually completed. Construction of roads also was nearly finished. Work is advancing on the water pumping station, sewage pumping station, and the sewage treatment plant.

Construction of footings for the new shopping centre at Morrisburg was well advanced. A new sub-division in Morrisburg was taking shape. Construction of sewers and water mains had been virtually completed for this new sub-division. At Iroquois, work had been concentrated on the new shopping centre. Development of the industrial area and the semi-commercial area was underway.

Hydro Model Shows More Power Available

General A. G. L. McNaughton of Ottawa and Leonard Jordan of Washington, joint chairmen of the International Joint Commission, during an inspection trip over the seaway work on October 18, stated they were completely satisfied with the progress to date on construction.

General McNaughton revealed that studies made by Ontario Hydro with the help of a model set up at Islington, Ont., has added about 1¼ per cent to the power potential of the project. These studies, he said, had saved about one foot of 'head' at the power site, which meant the addition of some 27,000 horsepower to the initially planned 2,200,000 horsepower to be divided equally between the two countries.

Progress By SLSA

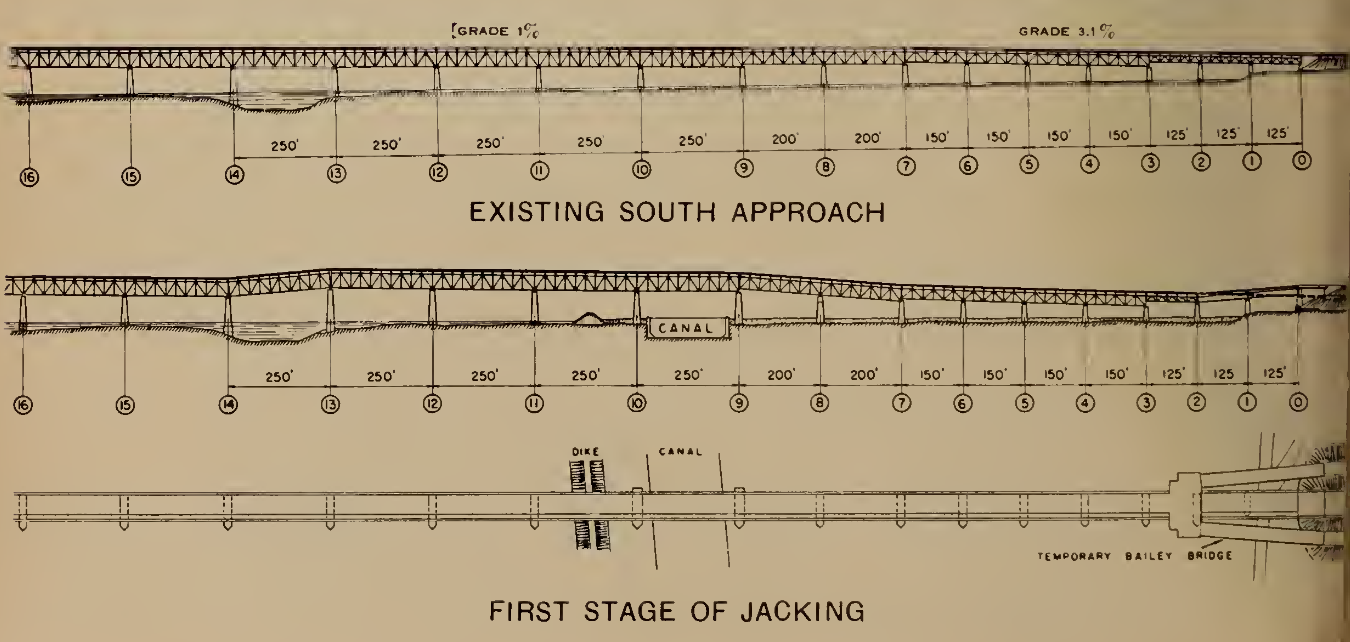
Excellent progress was made on excavation and dredging for navigation channels during the mild and dry weather throughout October, as construction forces strove to make a good showing before winter curtailed earthwork and closed down dredging contracts. Meantime, walls on three of the five Canadian locks were rapidly taking shape. Placing of concrete for some of the lock structures may continue throughout the winter, while at others the mixing plants will be closed down.

At the Iroquois lock, with some 80 per cent of earth excavation already completed by the end of October, 110,000 cubic yards of concrete, or 35 per cent of the total, had been placed to date, most of it in the north side upstream entrance wall, now practically completed. A start had also been made on the placing of concrete for the lock structure itself.

At Beauharnois, rock excavation continued at the upper lock and the New York Central railway had been diverted on to a temporary trestle, though no concrete had been placed. The contractor for the first stage was nearing completion of the rock excavation for the lower lock, while Canit Construction Co. had commenced pouring concrete on the highway approaches to the tunnel underpass under the lower lock.

At the Côte St. Catherine lock the contractors, who were delayed last spring due to flooding, had caught up and were again on schedule. Some 90,000 cubic yards of concrete or 26 per cent of the total for the contract had been placed over the entire length of the north wall of the lock on the river side, and a

Proposed Lifting Stages of the



start had been made on pouring the south wall and a few sections of the lock floor.

At the St. Lambert lock, with excavation substantially completed except for the upper approach channel, some 60,000 yards of concrete or 15 per cent of the total for the contract, had been placed in the shore-side wall of the lock structure west of Victoria bridge, and in the entrance wall on the river side east of the bridge, which was completed to full height for some 2000 feet of its length.

Elsewhere, at the Jacques Cartier bridge, widening and raising of piers 1 to 11 at the south end was proceeding, with some 10,000 cubic yards of concrete placed in the pier bases. The contractor for the raised bridge span over the navigation channel was preparing for diverting traffic to a temporary approach.

At the Honoré Mercier bridge the contractor was at work on the temporary south end highway approach, and had widened and rebuilt the underpass on the Malone highway under the New York Central railway.

Cornwall Dredging

Canada's Seaway Authority has called for tenders on dredging the 27-ft. channel north of Cornwall Island which has been in dispute with the U.S. government. This does not imply agreement has been reached for completion of the channel up to Cornwall, though agreement is still hoped for.

Tenders are also called for dredging from the entrance of Lake St. Francis upstream to a point some 1000 feet from lock 15 on the 14-ft. canal. This is the western end of the channel needed for the 27-ft. access to Cornwall. Both the work and the cost will be divided evenly between the two countries. Each will pay out some $17 million and be repaid about $6 million from the power authorities. Officials emphasize Canada has no present plans for duplicating the U.S. canal and locks in the International Section.

Progress by SLSDC

Bids were opened on October 10 for the superstructure of the international high-level highway bridge across the south Cornwall Island channel of the St. Lawrence, together with the viaduct spans at each end, and for earthfill and pavement on the mainland approach.

The bridge, cost of which will be about $6 million, is a suspension type with a 900-foot main span and 450-foot side spans. There will also be 2145 feet of viaduct spans. The substructure will be built by Canada's Seaway Authority, and must be completed in October of next year. The bridge must be opened for traffic by July, 1958.

The month of December will be an important one for the seaway. It will be the month for diverting the flow from the Long Sault rapids and turning the flow of the St. Lawrence river through a man-made course around the south side of Long Sault Island and over the first half of the Long Sault dam.

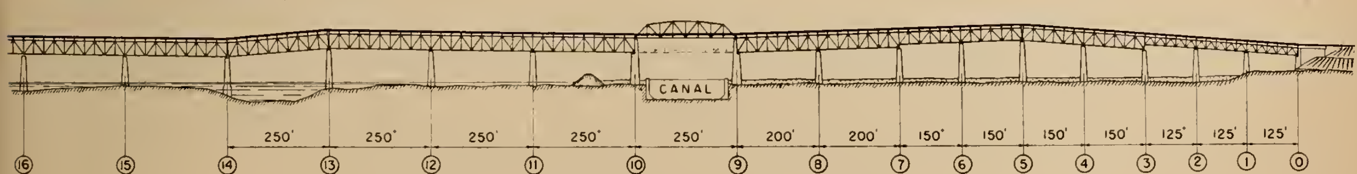
For some weeks past a rock fill had been under construction by aerial cableway across the head of the Long Sault rapids. Last year an earth fill plug had been placed across the channel through Cut "F" south of Long Sault Island. This plug is now being narrowed in preparation for blasting it open to allow water to pass down the south channel and through openings in the partly completed first stage of the Long Sault dam.

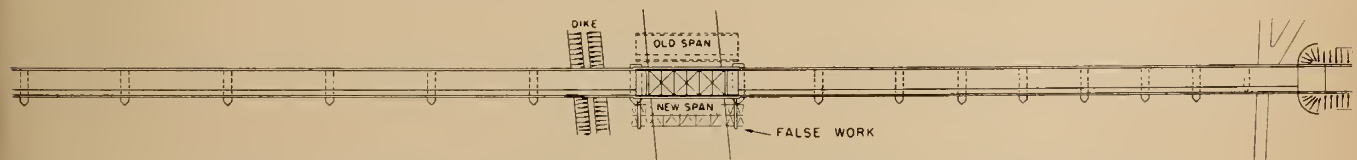
It will take about a month for the plug to be completely washed away. While this erosion of the fill goes on, the rock fill above the rapids will be raised, gradually forcing more and more of the flow through the south channel.

When the rock fill is completed, a downstream cofferdam will be completed for the second stage of the Long Sault dam between Barnhart and Long Sault Islands. This will permit dewatering the rapids, and work can begin on building the remaining half of Long Sault dam.

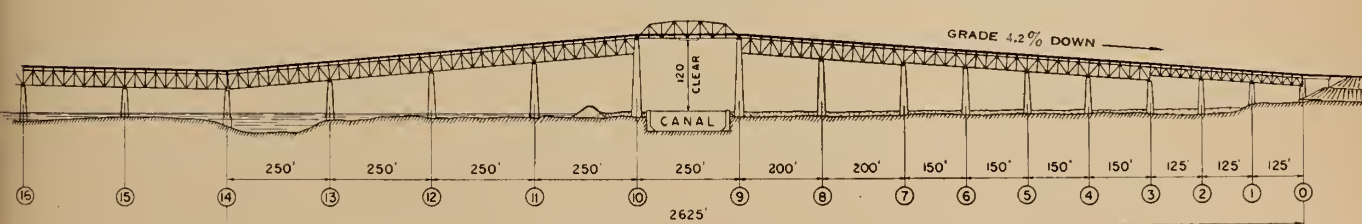
Upon completion of Long Sault dam the rock fill and the downstream cofferdam will both be removed and the water allowed to flow in its old channel. But instead of rapids this stretch will be merely a deep pool backed up by Long

Jacques Cartier Bridge, Montreal.





SECOND STAGE OF JACKING AND REPLACEMENT OF CANAL SPAN



FINAL STAGE

Sault dam and the Barnhart Island power-house downstream.

Planning the Seaway's Future

Dr. R. N. Danielian, president of the Great Lakes St. Lawrence Association, testifying on August 30 before the Great Lakes sub-committee of the Senate Foreign Relations Committee, stated that a medium sized ship must pay between $5000 and $6000 per transit through Suez, and nationalization by Egypt may substantially increase this amount. The seaway must contend with scales of toll charges comparable with these figures.

Thus every user of the seaway had a vital interest in the total investment costs and the tolls they must pay. "Unless we stir up business," he observed, "the revenues will not be there to sustain the investment" . . . If the dream of making the Great Lakes area a new economic frontier is to be realized, he warned, the various interests, federal, state, municipal and industrial will have to learn to work together.

Questions are planned at the next session of Parliament seeking to establish what Canada has done in the way of overall study of means of exploiting the potential commerce that will be opened up with completion of the seaway. Attention to the need of such survey has been called by announcement that the U.S. Corps of Engineers has been assigned to do a survey of the entire U.S. Great Lakes region, in addition to the various local and district surveys.

McGill Study Group

Since its formation about a year ago, as reported in our June, 1955 issue, the McGill Executive Study Group's efforts have been concentrated mainly on the probable effects of the seaway on the Port of Montreal. Movements of bulk commodities in and out (coal, grain and ore) were studied in order to discover trends.

The next step was to determine the nature, significance and timing of expected economies in transport due to the opening of the Seaway. Research also included technical aspects — sizes and capacities of existing channels and locks; numbers, dimensions and capacities of vessels plying the Great Lakes; coal and ore dock facilities, grain elevators, etc.

With these studies substantially completed last March, an interim report was issued to members of the group. This report also contained a summary of informed opinions currently being discussed and tested, though not derived from research activity of the group.

The third step will be an attempt to foresee what effect the conditions found from studies to date would have on the trade pattern and the final influence they would have on Montreal's future as a shipping centre. No date is yet announced for publishing its first report.

Canadian Pipeline Project

Westcoast Transmission

By mid-October good weather and working conditions had speeded construction, and work continued on schedule. More than 350 miles of 30-inch pipe were welded, with 325 miles laid and ready for testing. 1911 employees were at work on pipelaying, river crossings, compressor stations and the absorption plant at Taylor Flats.

Work was also under way on the gathering system in the north eastern British Columbia gas fields. Clearing and grading on the 18-inch Fort St. John gathering trunk had been completed and ditching started. 39 carloads of pipe were in transit for the area. Clearing and grading was also continuing on the main British Columbia trunk from the West Buick Creek field. More than 585 miles of main line right of way had been cleared, 450 miles graded and 475 miles of 30-inch pipe had been delivered.

Until such time as Westcoast gets a pipeline laid across the strait of Juan de Fuca from the U.S. mainland to serve towns and cities on Vancouver Island late in 1957, Vancouver Island Gas Co. plans to supply the city of Nanaimo with butane and propane gas. The requirements will be shipped in from Alberta by tank car.

A second gas pipeline from northeastern British Columbia to the southern part of the province is proposed by Peter A. Schwerdt, a B.C. oil promoter. Within ten years, he claims, at least three pipelines will be needed to transport available natural gas to markets from northern British Columbia gas fields.

Trans Canada Pipelines

By the middle of October the first two spreads working on Trans-Canada's western section to Winnipeg had laid some 160 miles of pipe and expected to complete a further 50 to 60 miles before the end of the month and a further 60 to 75 miles before cold weather called a halt. Pipe had been trickling in at rate of only a few carloads daily throughout the month and the good weather had been largely wasted. The ditch was being cut several miles ahead of pipelaying however, due to lack of danger from caving in the compacted sandy clay terrain on section I, though the ground in section 2 was not so well compacted. Majestic had completed 83½ miles of pipe stringing, and Canadian Bechtel 87 miles.

Little work will be done other than clearing and grading until next spring on sections 3 and 4. Universal Pipeline Corporation, which has 92 miles in section 3, had set up its office in Regina and had started on the 14 road crossings. Dutton Williams Ltd., which had the contract for the 80 miles of section 4, had its office in Grenfell, Sask., and had started clearing by the end of September. Both these spreads hope for an early freeze-up to facilitate haulage of pipe in winter over the large mileage of bog. They will leave pipelaying until next summer, though welding may be continued throughout November.

Two major river crossings over the Assiniboine had been started by Marine Pipeline and Dredging Co. of Vancouver, one at Miniota and the other 10 miles north of Portage La Prairie, with Parkhill Pipe Stringing Ltd., doing the stringing. No action had been taken on contracts for the remaining three sections between Willen, Manitoba, the eastern end of section 4, and the Winnipeg field gate at St. Norbert.

Trans Canada has set up an engineering and planning office at Winnipeg for the survey of the 800 miles of line between Moose Jaw, Sask., and Port Arthur, Ontario. This is a resumption of the work done two years ago by Bechtel, Mannix, Hester, Ltd. The right of way east of Winnipeg is being relocated to miss all lakes. Negotiations are proceeding for contracts on the last 188 miles of 34-inch pipe from Willen to

The natural gas line from Alberta to Eastern Canada moves ahead despite winter working conditions.

Winnipeg, which are all short sections.

A new 20-year gas contract recently concluded between Trans-Canada and Consumers Gas Co. of Toronto is the largest Canadian gas contract signed to date. It involves sales up to 165 million cubic feet of gas daily the fifth year of contract operation. Consumers' decision to greatly expand its requirements above what it requested in earlier stages of negotiation enabled the company to obtain Alberta gas at terms fully competitive with gas now being imported from Texas and Louisiana.

Financing

Trans Canada has thus gained new impetus for financing the $375 million pipeline now under construction. Federal and Ontario governments will finance the $125 million stretch of pipe across Northern Ontario, leaving the $250 million remainder to be financed by Trans Canada. It now appears that with this financing imminent, the company will draw less than $40 million of the $80 million Ottawa agreed to loan the company for the 575 miles of line to Winnipeg.

Trans Canada's financing, completion date for which has been extended to December 1, 1956, will be placed before the Board of Transport Commissioners on October 30. Placing of $144 million of first mortgage bonds is now going on. Marketing of the remainder of $90 million in debentures and stock is dependent on the placement of bonds. Next year Trans Canada will complete the pipeline to Winnipeg and build on as far as the Ontario border, while Trans Canada or the Crown Corporation will handle the second section from the Ontario border to Lakehead.

Deficit Seen in Early Years

Trans-Canada will operate at a deficit for from three to five years, predicts President N. E. Tanner. It was necessary for the company to go back to the producers to alter the contracts and take much less gas at a lower rate in the initial building stages. The company was now engaged in renegotiating contracts with the producers and good progress was being made, he said.

While Canadian sales had been greater than expected, and enough gas had been sold under contract to take all the Alberta gas under permit, there would be an inevitable market buildup lag, he warned. The company still needed the 200 million c.f.d. export to the United States through Emerson for immediate profitable operation, though without it deficits could be taken care of within the three to five years.

L.P.G. Pipeline Gets Permit

Canadian Hydro Carbons Ltd. has received the permit for its subsidiary Hydro Carbons Pipeline Ltd. to build Canada's first 800-mile L.P.G. pipeline from Alberta to Winnipeg and possibly later to Lakehead, at a cost of some $60 million. It will be integrated with Trans Canada and will transport butane, propane and other hydro carbons not handled by the gas pipeline. Dutton Williams Ltd., consulting engineers are now conducting engineering studies, which must be completed before the plans are laid before the Alberta Petroleum and Natural Gas Conservation Board.

Though the exact route is not yet established, it is expected a gathering system will form a grid in central and southern Alberta and will feed the line to Winnipeg, to be located between the Interprovincial and Trans Canada pipelines. Preliminary design calls for 8-inch pipe from Edmonton to Regina and 6 inches from there eastward. Terminal points for delivery of products in bulk stations and refineries will probably be set up at Edmonton, Calgary, Moose Jaw and Winnipeg. Initial capacity will be between 10,000 and 12,000 barrels per day. Some of the gathering facilities and the main line into southern Saskatchewan will be built in 1957 with completion scheduled for late 1958.

University of Alberta Mining and Metallurgy

The Department of Mining and Metallurgy has recently undergone extensive structural alterations and expansion.

To the established degree courses in mining engineering, a new degree course, metallurgical engineering has been introduced. This involves specialization in physical metallurgy in the students' third and fourth years.

Courses leading to the degree of master of science in mining engineering and in metallurgical engineering are also offered.

Two major research projects are being carried out:

1. The sink-float treatment of uranium and other ores by the Driessen Cone, sponsored by the Atomic Energy Control Board and Eldorado Mining and Refining and directed by Professor E. O. Lilge, head of the department.
2. Physical metallurgy of titanium base alloys, sponsored by the Defence Research Board of Canada and directed by Dr. J. Gordon Parr.

The department's building now comprises a mineral dressing pilot plant including a specially designed crushing and grinding room, mineral dressing laboratories, fire assaying and chemical control laboratories, physical metallurgy laboratories classrooms and offices.

Wintertime Construction

The National Joint Committee on Wintertime Construction, having met for the third time in September this year, reported that the campaign to reduce seasonal unemployment in construction activity had been an important factor in the reduction by 20,000 in the number of construction men laid off last winter compared with the year before. It was agreed, however, that the problem was far from being solved.

The Committee recommended that the Government watch closely the effect of credit curbs on the construction program as affecting winter work, and ensure that adequate supplies of mortgage funds be made available for wintertime construction, especially in the housing field.

Members pointed out that peak employment on sizeable projects occurred six months or so after their start. Curbs against new projects during the summertime when materials and labour were in shortest supply would have their main effect during the wintertime when it was desired to increase the volume of construction employment.

In the case of housing, it was reported that many lenders had used up their appropriation for mortgages for the year and could advance no new loans until 1957. This situation would reduce the number of "fall starts" and the volume of winter building.

Members pledged themselves to continue and increase their organizations' efforts to publicize the facts that modern techniques made the traditional wintertime shut-down out of date. The production of films by the National Film Board was advocated as an extra medium of publicity to this end.

Member organizations of the National Joint Committee on Wintertime Construction include the Canadian Construction Association (sponsor), The Canadian and Catholic Confederation of Labour, The Canadian Chamber of Commerce, The Canadian Labour Congress, The Canadian Legion, The Canadian Manufacturers' Association, The Engineering Institute of Canada, The National House Builders' Association, The Royal Architectural Institute of Canada. Associated with the project are the National Research Council and the Federal Department of Labour.

An intensive study of Scandinavian methods brought forth information of mixed value for Canadian operations. The 10 per cent differential between the volume of summertime and wintertime construction was held to be the goal in at least one Scandinavian country. In Canada this ratio had already been obtained with regard to the defence construction program where urgency of completions was of vital concern. During the past four years Defence Construction Ltd. estimated that roughly 45 per cent of its work was carried out each year in the six winter months between November and April. 1600 construction men were employed last winter at the Camp Gagetown project alone.

The N.R.C. Building Research Division has prepared "A Bibliography on Cold Weather Construction", as well as a booklet on "Winter Construction", the sixth in its "Better Building" series. The Division also sells a "Climatological Atlas of Canada" containing data on snow fall, design temperatures, etc. The Canadian Construction Association has recently published the paper "Techniques of Winter Construction", the prize-winning thesis in the 1956 competition.

There is, therefore, being compiled more and more information on the technical aspects of wintertime construction. The Library of the Engineering Institute of Canada is a source of further information on the subject.

Passamaquoddy Board

The International Joint Commission has established the International Passamaquoddy Engineering Board to "carry out all the engineering investigations and studies necessary to enable the Commission to prepare and submit to the governments of the United States and Canada a comprehensive report on the proposed Passamaquoddy Tidal Power Project".

Board members are as follows: Canadian Section, Brigadier J. P. Carrière, M.E.I.C., chairman, and C. K. Hurst, M.E.I.C.; American Section, Lt.-Gen. S. D. Sturgis, Jr., chairman, and Francis L. Adam.

Vancouver-Squamish Railway Line

The Pacific Great Eastern Railway completed in June this year the railway line from North Vancouver to Squamish, which will help to integrate the coast economy with that of the northern interior of British Columbia and the Canadian north country.

The new rail line overcomes the need to ship by ferry to Squamish, to connect with the Squamish to Prince George line which has been in operation for many years. The difficult route of the new line, going along the rugged Howe Sound coast discouraged the project until recent years. Backed by the provincial government, the work was undertaken in 1954. In two years it was completed, providing a system equipped with radio communication between Vancouver and Squamish and all trains.

North of Prince George, some 330 miles are now under construction. The present objective is a railway system with 800 miles of main line.

Research Centre

Dupont of Canada Limited opened the doors of its research centre to representatives of the technical press on September 20.

The research laboratory built in Kingston, Ont., at a cost of $1½ million applies the most modern design to the problems of the research environment.

It was explained by Dr. O. C. W. Allenby, laboratory manager, that in the view of the Company "industrial research is complicated and the equipment used is expensive. Invention today is largely a team effort".

The scientist uses equipment unknown, or unavailable, ten to twenty years ago. It is usually highly complex and specialized.

The experience is that it costs up to $30,000 per year to support the work of one scientist and to supply him with the help of technicians, library facilities, etc.

The long term view in this instance of a company with American affiliations is to base objectives on Canada's future needs, after establishing whether there are reasonable technical prospects for a solution.

Month to Month

News of the Institute and the Profession

COMMENT AND CORRESPONDENCE ELECTIONS AND TRANSFERS

1956 University Registration in Engineering

This issue of the *Journal* continues our practice of listing, once a year, the full university registration in engineering in Canada. The tabulation is on pages 1708 and 1709.

The total enrolment in engineering courses in Canada at recognized institutions, shows a somewhat comforting increase of 12.2% for the new year now started. The actual number of students is 12,723 against 11,341 a year ago. This is the best annual increase for several years, and compares with 10% last year.

The highlight of the survey comes from the figures for the new freshmen classes. Except for a few, these are consistently well up, and in several instances at some of the smaller colleges this year's freshman enrolment has actually doubled last year's intake. Other increases of 62%, 50%, 48% and 42% are reported. Perhaps the most startling development is shown at University of Saskatchewan, where the largest single increase of 146 engineering students jumps their old figure of 305 last year to 451 for 1956-57. This makes it the second largest freshman class in Canada, led only by Toronto with 725. New enrolment throughout the three western provinces is above the norm this year, with B.C. in third place in the Dominion with 404 potential new engineers signed up. Alberta has 386.

Readers will note that Sherbrooke (Quebec) appears on the list for the first time. As reported in the March 1956 *Journal*, a partial engineering course of recognized standing is now available at the University of Sherbrooke, and we are glad to welcome this college to our roster of Canadian engineering educational institutions.

Another item which will be discovered by the careful observer is the slight fall off in total engineering registration at the Services Colleges. The figure shows a decrease of about 7% since last year.

Considering the various branches of engineering, civil remains the most popular with 1,828 students now engaged in this division of study. This is followed by the other two of the "big three", electrical showing 1,359, and mechanical 1,329. Chemical engineering leads the remainder with 960 students enrolled.

One interesting fact uncovered by this year's survey is the high rate of freshman registration in engineering physics. The figure has jumped 40% from 404 to 566. This shows the intensity of interest that must be building up these days in nuclear fission and similar sciences concerned with the use of the atom. This bears watching, as it will have a direct and important effect on Canada's scientific future and our place in the atomic age.

Based on the present size of the senior classes, 1,826 engineering students could obtain their degrees and graduate into the profession in 1957. This represents an increase of 9% over last year, but at the same time it is a large drop from the forecast for 1957 of some 10% which was made in this commentary a year ago. Whether or not this can be accounted for through normal attrition, or perhaps shows that advanced students are falling in the temptation of ready jobs, is hard to say. The persistent demand for help must be having some effect.

UPADI—Fourth Conference

The Union of Pan American Engineers Associations (UPADI) held its fourth regular convention in Mexico City from October 7th to the 12th inclusive. Previous conventions were held at Havana, Cuba, New Orleans, Louisiana, Sao Paulo, Brazil.

This was probably the most successful of all conferences. The attendance, although no official count is given as yet, must have come close to 300, with almost 100 being official delegates. Out of 22 member countries, 13 were represented. It is interesting to discover that of all the South American countries, only Nicaragua is not a member.

The program consisted of a miscellany of formal functions, committee meetings, technical tours, sight seeing tours and distinguished social events.

By far the most important work of UPADI is done by its committees.

Cover Picture

The cover picture was derived from the photographic exhibit which was part of the Institute's annual meeting of 1956. It is one of the six award-winning pictures.

It is a view of the Southern Trans-Provincial Highway on Anarchist Mountain in British Columbia.

B.C. Government Photograph

Formal opening session of UPADI conference. Some of the Canadian delegates and their wives can be seen in the left foreground. In the front row, the president and Mrs. McKillop, I. R. Tait and Mrs. Tait; behind them, the general secretary, Mrs. Anson and Mr. Anson.

The following is a list of the committees and the Institute's representatives on each.

Administration,
V. A. McKillop
Legislation,
C. M. Anson
Technical matters,
Dean Henri Gaudefroy
Relations,
I. R. Tait
UPADI Fund,
J. A. Vance

The Canadian delegation consisted of 13 people, including 7 official delegates. They were as follows:

President of the Institute — V. A. McKillop and Mrs. McKillop
The president elect — C. M. Anson and Mrs. Anson and their daughter
Past President — James A. Vance, Woodstock, and Mrs. Vance and their grandson
Past vice-president — I. R. Tait and Mrs. Tait
Past councillor — Dean Henri Gaudefroy and Mrs. Gaudefroy
General secretary — L. Austin Wright

From the Institute's point of view one of the outstanding events was the reception given by the Institute to all delegates. This took place in the del Prado Hotel, which is the leading hotel in Mexico. There were in the neighbourhood of 200 guests present, all of whom were received at the door by the reception line made up of the entire Canadian delegation.

As part of this reception Mr. Vegh Garzon was presented with a certificate as an honorary vice-president of the Institute, in virtue of the fact that he is the Institute's alternate representative on the Board of Governors, representing Mr. Vance. He has done a splendid job for the Canadians and they were happy to have this opportunity to recognize his services.

All committee meetings and formal meetings were held at a building identified to the delegates as "SCOP". This is a combination of the letters representing in the Spanish language the building which houses the headquarters of the Government's offices controlling all communications. It is a new building and from a North American's point of view is fantastic.

Some of the outside walls are mosaics from the ground line to the roof line, probably a height of a hundred feet. They are done in brilliant colours and with a bold conception. To the North American eye they were at least startling, but it is easy to believe that if one stayed there long enough these things would fit themselves into the background and become very pleasing and perhaps inspirational as well, as they are now to the Mexicans.

The building is ultra modern in

The Canadian party. Seated: Mrs. Gaudefroy, Mrs. Tait, Mrs. Anson, Mrs. Vance, and Mrs. McKillop; standing: Henri Gaudefroy, I. R. Tait, C. M. Anson, J. A. Vance, President V. A. McKillop, Miss Anson, L. Austin Wright, James Stevens, and C. R. Vegh Garzon, Canadian alternate on Board.

Greetings from Canada. President McKillop presents the message from Canada. At table, sixth from right, is president of the Republic, Adolfo Ruiz Cortiniz. Many of the others are members of his cabinet. Third from right is Luis Giannattasio of Uruguay, president of UPADI.

every detail and the auditorium in which most of the sessions were heard was fully equipped for multiple translations, with three completely separate lines of communication from the microphones to the translators and back to the ears of those in the audience. This is all built-in equipment and indeed was a great convenience to the conference.

The conference opened with a real "tour de force". The president of the Republic, Adolfo Ruiz Cortiniz, was there for the entire meeting and representatives from each delegation presented their greetings, at the conclusion of which the president himself made an address in Spanish which, judging from the reactions of the audience, must have contained all the right things.

Foundations

A portion of one day was devoted to visiting the site of a new hospital, where thirteen buildings were being erected. The thing that makes this so unusually interesting is that Mexico City has the most unusual soil conditions. The land is largely made land as the country originally was a series of islands, consequently there is no firm foundation at any reasonable depth. In fact, the engineer in charge of the hospital work told the delegation that his bench mark was 250 feet below the surface. He had to go that far before he could find a bed of sand that would remain reasonably stable.

The buildings are designed as if they were floating in a body of water. No attempt is made to drive the foundations down to a firm level. Instead, piles are pushed down below the foundation framework of the building and are placed in such a way that a beam from one pile to another passing through a column can be used to raise or lower the side of a building in order to keep it level in spite of any settling that takes place. Throughout the entire foundation of the building these beams and jacks are installed, apparently with the intention that the level of the building shall be tested every day so that the necessary adjustments can be made immediately.

Certain of the older buildings around Mexico City show how bad the condition is. It is nothing to find some of the more monumental buildings to have sunk at least six feet. It was reported that the Fine Arts Building had actually gone down eleven feet. The Institute is endeavouring to get a paper for the *Journal* that will tell the members something of the most unusual and disturbing conditions.

A closing function was a "Baile", which as the reader will suspect is a ball. The ball was due to start at 10:00 p.m., but actually in accordance with South American standards it began about 11:30 p.m. Dinner was to have been served at midnight, but it too turned up somewhere around 1:00 o'clock, but nobody seemed to care.

This event was one of the most outstanding that could have been staged any place in the world. It took place in the court yard of a very old building, where the top had been covered over with canvas in order to protect the three or four hundred guests from the elements.

From the gallery around the courtyard it was one of the most beautiful and impressive sights this writer has ever seen. The decorations were all in flowers and the decorative lighting and the spotlighting were extremely well done. It was like a picture out of an old book to look down on the floor and see all the couples dancing, with the ladies mostly in what might well have been old-fashioned hoop skirts.

An unadvertised feature of the meeting was a downpour of rain which ripped right through the canvas coverings of the courtyard and came through onto the dance floor, but again, nobody seemed to care. A few tables were drowned out but the water missed the orchestra and certainly did nothing to reduce the enthusiasm and the fire of everyone who was present, including the Canadians. This will be a long remembered event.

The Canadian delegation was very happy to have with them as guest the Honourable Douglas Cole, the Canadian Ambassador to Mexico. Mr. Cole is an engineering graduate of McGill University and also speaks Spanish. It is not difficult to imagine what a sensation he was before all these South American people.

In the final session a decision was made as to where the 1958 convention would be held. Upon the motion of the delegates from Argentina, seconded by those of the United States, it was agreed that in 1958 UPADI would meet in Montreal, Canada. This date was selected because of the fact that the 1958 meeting of the World Power Conference takes place in Montreal, and it was felt that those attending one conference would like to attend the other.

Meetings for UPADI have now been determined for September 3, 4, 5 and 6; for the World Power Conference the 7, 8, 9, 10 and 11.

A Valuable N.C.C.U. Conference

The announcement by Prime Minister St. Laurent that he would recommend to Parliament that annual federal grants to universities should be doubled greatly pleased the delegates to the recent meeting of the National Conference of Canadian Universities. No less dramatic was the pronouncement of opinion by leaders of the Quebec universities that federal grants (at least for capital expenditure) should be accepted by them, despite the opposition of Premier Duplessis.

The Prime Minister proposed that the federal grants voted by Parliament each year should be handed to the N.C.C.U. for distribution. After consideration by the N.C.C.U. finance committee, the executive committee issued a statement that "The N.C.C.U. . . . accepts the responsibility of receiving federal funds for subsequent distribution to the institutions of higher learning in Canada. Steps have been taken to incorporate the N.C.C.U. and to provide the necessary organization for assuming these new responsibilities should Parliament make the proposed appropriations". Also welcomed was the Prime Minister's further proposal to create the Canada Council (for the arts, humanities, and social sciences) and to recommend the appropriation of $50 million to be distributed by the Council over a period of ten years as capital grants to universities equal to 50 per cent of the cost of specific building or capital equipment projects. If federal grants cannot be immediately accepted by any university, their share will be held in trust until they are able to accept such aid.

The conference was held, 12-15 November, in Ottawa under the general chairmanship of Dr. G. E. Hall, president of the N.C.C.U. and of the University of Western Ontario. Attending delegates represented the Canadian universities, federal and provincial governments, various national organizations, including organized labour, and distinguished educational bodies in the United States. The conference was supported financially by the Carnegie Corporation of New York.

Sessions were held on various aspects of education and papers were presented on technological and scientific education, the use of human resources, problems in securing staff, and finances. Particularly valuable was the animated discussion of these and other subjects.

A list of the papers and their authors is appended; papers and proceedings are to be published later by the University of Toronto Press.

Prime Minister Louis St. Laurent is greeted by Dr. C. T. Bissell at the N.C.C.U. Conference. Looking on are R. D. Mitchener, of the Higher Education Division, Dominion Bureau of Statistics, and Dr. G. E. Hall, N.C.C.U. president (next to the Prime Minister). Dr. Bissell was officially inaugurated as president of Carleton College, Ottawa, at a colourful ceremony on 13 November.

Thirteen Resolutions

At the end of the conference a series of thirteen resolutions, drafted by the resolutions committee, were unanimously adopted. These, in effect, cover the problems discussed at the conference and some of the practicable solutions. The main features are summarized below. Copies of the first nine resolutions are to be sent to the federal and provincial governments.

(1) A statement of the concern of the universities at their current and unforeseen difficulties in maintaining standards, leading to a resolution that the people of Canada be warned of this concern, and that the emergency can be solve only " . . . by the energetic and immediate assistance and cooperation of all governments in Canada, of business and industry, and of private benefactors."

(2) Particular importance is attached to the part of the Prime Minister's statement that federal aid alone was not enough and that provincial government contributions should continue. The resolution states that "without such additional and increasing aid the universities cannot hope to solve the crucial problems now confronting them".

(3) It is hoped that all present and future members of N.C.C.U. will be able to benefit from the implementation of the Prime Minister's proposals.

(4) Income and succession duty taxes, both provincial and federal, should be revised to encourage citizens, business, and industry to make grants to universities.

(5) Central Mortgage and Housing Corporation rules should be amended so that universities could borrow money for residences and housing on most favourable terms, on a self-liquidating basis.

(6) The N.C.C.U. executive should accept immediately the invitation to cooperate with the Industrial Foundation on Education.

(7) The ratio of staff to students should not be allowed to fall still lower in the face of increasing competition; the educational profession should be made more attractive through better salaries, and enrolment encouraged.

(8 Every effort should be made, especially by scholarships and other

financial aid, at high school, college, and post-graduate levels, to identify, encourage, and support young people who have the will and the ability to profit by further education.

(9) The conference commends to the provincial governments the desirability of establishing more institutes of technology comparable to the Ryerson Institute of Technology, in Ontario, and other institutions for vocational and technical training at a non-university level.

The remaining four resolutions expressed the thanks of the conference members to the Prime Minister, the Carnegie Corporation of New York for their grant, the organizers, and the authors of papers.

Co-Ordination of Effort

Perhaps the most valuable result of this conference, which had followed many other recent meetings on the subject of education, will be the ultimate coordination of effort on the part of all those whose hearts are set on a satisfactory solution to "Canada's crisis in higher education", to quote the conference theme.

The federal government has adequately expressed its concern and willingness to help the educators, who themselves had a unique opportunity of discussing all sides of their problems. The voice of industry was heard in discussion of the ways and means of industrial aid to education; between the extremes of an independent body collecting from industry as a whole and distributing the proceeds over the educational field, to specific contributions from one firm to its chosen university, there arose some agreement that industrial support should be encouraged and that industry, generally, was willing to contribute and would often welcome advice on the best way it could help, even though it might reserve the right to direct its support towards certain chosen fields. The conference learnt more of the Industrial Foundation on Education and resolved to cooperate with that body.

Though the advantages of higher education are still far from evident to many Canadians, particularly in some of the large industrial centres, there is a growing awareness of these advantages among the ranks of organized labour. Eugene Forsey, director of research of the Canadian Labour Congress, pointed out that the CLC had recently considered, in detail, many of the very problems that had been discussed at the present meeting. In general, the CLC was in entire agreement with the opinions expressed at the N.C.C.U. conference and, although Canadian trade unions were far from enjoying the affluence of their counterparts in the United States, it was hoped that they might find the means to support higher education in some practical way, particularly by helping talented young people. The Rev. H. J. Somers, president of St. Francis Xavier University, told of the enormous increase in university enrollment from Cape Breton county, where the great majority of the working population is engaged in coal mining or steel-making; from a handful some thirty years ago there are now over 500 students, an increase apparently encouraged by parents who have realized the advantages of higher education.

Engineering Education

Although this conference was called to cover all fields of higher education, the engineer was widely discussed.

Opinion was strongly expressed that the university years should be devoted to giving the engineer, just as the pure scientist, as thorough a grounding as possible in the fundamental principles of his profession. This did not mean cramming a student with facts and figures, but properly training his mind to use the knowledge he can acquire.

The universities could not, and should not, be expected to turn out men trained to fit into a particular industry. Although there is some evidence of industry bringing pressure to bear on universities to produce engineers "to specification", it is generally considered that enlightened industry realizes its own responsibility for training the newly-graduated engineer to give him an adequate knowledge of the industry's operations and his place therein. (This is amply borne out by the replies received from the many Canadian industrial organizations and individuals who have been asked for information on which is based the "Engineering Careers" series published in *The Engineering Journal.)*

Above all, there must be no reduction of the standards of engineering (and other) education in the Universities in order to try to meet the demand for technicians.

The results of this conference (and government action) are that, with approval of Parliament, annual Federal grants to universities will be doubled (to some $16 million) and the money will be distributed by the N.C.C.U.; other funds will be provided through the Canada Council for scholarships and capital grants; it is hoped that provincial governments will extend their financial support; and a long step has been taken towards closer co-operation between the N.C.C.U., industry, and organized labour on the many problems associated with higher education.

The universities clearly do not demand assistance from all these sources as their right; but they do need this revenue for the essential service they provide to the country and all its communities. How unfortunate, therefore, that in accepting the support of the Government of Canada "everyone is out of step" but the premier of the province of Quebec. One can only hope that, in accord with the general tone of this conference, reason will ultimately prevail.

N.C.C.U. Conference Papers

A list of all the papers given at the Conference is published below. The Prime Minister, The Rt. Hon. Louis St. Laurent, also addressed the conference at a dinner on November 12, when he re-affirmed the proposals for increased federal government grants to universities.

General Statistics—C. T. Bissell, president, Carleton College

Educational Structure

English-Canadian Universities: Sidney E. Smith, president, University of Toronto.

French-Canadian Universities: Maximilien Caron, vice-dean, faculty of law, University of Montreal.

Technological and Scientific Education

The Responsibilities of the Universities in the Training of Scientists and Technologists: E. W. R. Steacie, president, National Research Council.

The Role of the Humanities and Social Sciences in the Training of Scientists and Technologists: J. E. Burchard, dean of humanities and social sciences, Massachusetts Institute of Technology.

The Use of Human Resources

Who goes to University? (1) English-Canada: R. W. B. Jackson, assistant director, educational research, Ontario College of Education, Toronto.

(2) French-Canada: Arthur Tremblay, professor of education, Laval University.

(3) Failures and Misfits; Wastage in Human Resources in the Universities: T. H. Matthews, registrar, McGill University.

Problems in Securing Staff

The Humanities: A. S. P. Woodhouse, professor of English, University of Toronto.

The Physical and Natural Sciences: P. Gendron, dean, faculty of pure and applied science, University of Ottawa.

The Social Sciences: B. S. Keirstead, professor of economics, University of Toronto.

University Salaries: V. C. Fowke, professor of economics, University of Saskatchewan.

Finances

Government Support of Canadian Universities: N. A. M. MacKenzie, president, University of British Columbia.

Private and Corporate Support of Canadian Universities: Rev. H. J. Somers, president, St. Francis Xavier University.

A Comparative Study of Methods of Financing Universities in the United Kingdom, Canada, and the United States: F. Cyril James, principal, McGill University.

REGISTRATION IN ENGINEERING AT CANADIAN UNIVERSITIES

UNIVERSITY	Year	General Course	Aeronautical Engineering	Agricultural Engineering	Petroleum Engineering	Chemical Engineering	Civil Engineering	Electrical Engineering	Engineering and Business Administration	Mechanical and Electrical Engineering	Forest Engineering	Geology and Mineralogy Engineering	Mechanical Engineering	Metallurgical Engineering	Mining Engineering	Engineering Physics	Total
Memorial	1st	58															58
	2nd	37															37
	3rd	16															16
Total		111															111
Dalhousie	1st	74														9	83
	2nd	54															54
	3rd	36														2	38
	4th															1	1
Total		164														12	176
St. Mary's	1st	35															35
	2nd	38															38
	3rd	30															30
Total		103															103
St. Francis Xavier	1st	110															110
	2nd	87															87
	3rd	73															73
Total		270															270
N.S. Technical College	4th					17	57	46					48	1	3		172
	5th					4	20	40					20	2	1		87
Total						21	77	86					68	3	4		259
Acadia	1st	79															79
	2nd	48															48
	3rd	46															46
Total		173															173
Mount Allison	1st	86															86
	2nd	75															75
	3rd	36															36
Total		197															197
New Brunswick	1st					16	85	53					23		4		181
	2nd					8	70	42					28		2		150
	3rd					1	50	16					21		1		89
	4th						47	23					16				86
	5th						41	14					16				71
Total						25	293	148					104		7		577
Laval	1st	181															181
	2nd	201															201
	3rd					6	26	24				6	21	4	10	13	110
	4th					13	35	31				5	16	8	8	4	120
	5th					10	41	16				3	9	6	6		91
Total		382				29	102	71				14	46	18	24	17	703
Ecole Polytechnique	1st	230															230
	2nd	221															221
	3rd	133															133
	4th					10	42			57		7		6	6		128
	5th					9	42			53		2		9	2		117
Total		584				19	84			110		9		15	8		829
McGill	1st	333															333
	2nd	339															339
	3rd					45	55	54					69	8	6	24	261
	4th					39	66	90					75	10	10	14	304
	5th					39	71	68					64	10	12	13	277
Total		672				123	192	212					208	28	28	51	1514
Sherbrooke	1st	54															54
	2nd	33															33
	3rd	35															35
Total		122															122
Ottawa	1st					17	31	10					7	1	6		72
	2nd					21	21	14					6	1	3		66
	3rd					7	7	9					3				26
	4th					4											4
	5th					3											3
Total						52	59	33					16	2	9		171

REGISTRATION IN ENGINEERING AT CANADIAN UNIVERSITIES

UNIVERSITY	Year	General Course	Aeronautical Engineering	Agricultural Engineering	Petroleum Engineering	Chemical Engineering	Civil Engineering	Electrical Engineering	Engineering and Business Administration	Mechanical and Electrical Engineering	Forest Engineering	Geology and Mineralogy Engineering	Mechanical Engineering	Metallurgical Engineering	Mining Engineering	Engineering Physics	Total
Carleton College	1st	45															45
	2nd	24															24
Total......		69															69
Queen's	1st	292															292
	2nd					44	39	40				14	62	7	19	17	242
	3rd					40	54	37				10	53	7	13	16	230
	4th					41	53	34				5	39	5	15	19	211
Total......		292				125	146	111				29	154	19	47	52	975
Toronto	1st					88	133	114	54			39	104	16	30	147	725
	2nd					73	80	76	49			18	80	8	23	90	497
	3rd		11			75	71	69	65			9	84	10	16	49	459
	4th		12			64	73	68	41			18	90	11	6	31	414
Total......			23			300	357	327	209			84	358	45	75	317	2095
Ontario Agricultural College*	3rd						8						15				23
	4th												4				4
Total......							8						19				27
Western Ontario	1st	53															53
	2nd	17															17
	3rd					3	4	3					2				12
Total......		70				3	4	3					2				82
Manitoba	1st	266															266
	2nd	158										9				5	172
	3rd						42	35				3	68			3	151
	4th						42	28					48			3	121
Total......		424					84	63				12	116			11	710
Saskatchewan	1st	451															451
	2nd	165				14										23	202
	3rd			1		28	52	25				18	50			14	188
	4th			2	4	15	34	17				6	45			11	134
Total......		616		3	4	57	86	42				24	95			48	975
Alberta	1st	386															386
	2nd				17	67	98	44					3	3	9		241
	3rd				11	51	57	35						2	12	9	177
	4th				9	30	57	22							10		128
Total......		386			37	148	212	101					3	5	31	9	932
British Columbia	1st	404									8						412
	2nd	241									2						243
	3rd					22	28	54			5	12	51	10	1	26	209
	4th			1		17	31	50			2	10	39	7	4	11	172
Total......		645		1		39	59	104			17	22	90	17	5	37	1036
Canadian Services Colleges Royal Military College (Kingston)	1st	57															57
	2nd	70															70
	3rd					14	32	37					27			9	119
	4th					5	33	21					23			3	85
Total......		127				19	65	58					50			12	331
Royal Roads	1st	91															91
	2nd	55															55
Total......		146															146
Collège Militaire Royal de St.-Jean	1st	86															86
	2nd	54															54
Total		140															140
Grand Total		5,693	23	4	41	960	1,828	1,359	209	110	17	194	1,329	152	238	566	12,723
Prospective 1957 Graduates	...		12	3	13	232	505	357	41	53	2	44	370	50	56	88	1,826

*Students in Agricultural Engineering who will proceed to their final year in Mechanical or Civil Engineering at the University of Toronto on completion of their studies at Guelph.

The Continuing Education of the Graduate Engineer

This was the topic of the joint ASME-E.I.C. conference which was held at the University of Western Ontario on October 18 and 19, 1956. Nearly one hundred delegates took part, representing educational and industrial institutions from the United States and Canada.

It was a lively conference. The topic was subdivided into five subtopics, each handled by a panel composed of a moderator and four panel members. The conference program was published on page 1390 of the October *Journal.* Conference material will be published in *The Engineering Journal* in this and succeeding issues. The address by Dr. G. E. Hall, president of the University of Western Ontario will be found elsewhere in this issue, under the title, "The Fundamental Concept of Education". This will be followed in January by the address delivered by Dr. J. W. Barker, president of the ASME, under the title, "Meeting the Shortage of Engineers and Scientists". The panel presentations will be published in succeeding months, one presentation in each issue.

It is unfortunate that the discussion which took place at the panel sessions cannot be published. Experience has shown that the vitality of spontaneous exchange of ideas is lost when discussion periods are reported, either verbatim or in digest. Yet the discussion periods were almost as interesting as the panels. Discussion was vigorous, reflecting at times wide differences of opinion. Several of the delegates began their remarks by saying: "I know I may be sticking out my neck but . . ."

The session on "The Product of the Engineering Baccalaureate Curriculum" was possibly the one concerning which opinion differed most widely, particularly during the first part of the discussion period. The question of the specialized course versus the general course received another going over and actually overflowed into all the other discussion periods. When the smoke of battle cleared, it appeared that the courses now taught by the universities were not too bad after all, and that the baccalaureate curriculum, based on two years of common fundamental principles followed by two years of limited specialization, was turning out graduates which were acceptable to the majority of prospective employers. However, large industrial organizations which developed and manufactured the complex machines of today would still have to provide their own programs of supplementary on-the-job instruction. The graduate engineer has become a long-term investment with an increasing rate of return. This rate and its increments are determined, not only by the capital investment of engineering education but also by the development of guided experience.

Dr. Joseph Barker, president of ASME, was the speaker at a dinner during the conference. Shown at the head table, left to right, Mrs. McKillop, Dr. Barker, President McKillop of the E.I.C., chairman of the dinner meeting, Dr. G. E. Hall, Mrs. Gordon Henderson. Others at the head table were Newman A. Hall of Yale University, Gordon Henderson past vice-president of E.I.C., Mrs. Austin Wright, and C. E. Davies, secretary of ASME.

The audience for one of the panel sessions.

The proposed course of Engineering Science now being developed at the University of Western Ontario received considerable attention, particularly by the university representatives from the United States. This course will be even more general than those taught at other Canadian universities and is expected to produce the general practitioner of engineering.

Considerable concern was expressed regarding the growing tendency of engineers to leave engineering, a few years after graduation, to become supervisors, managers or sales engineers. More significant, however, was the realization that many engineers were doing work which could be done by trained technicians or engineering aides. The first panel session on "The Engineering Technician" explored this aspect of the problem. The need for more and better technical institutes, proper recognition of the trained technician and his role in amplifying the work of the graduate engineer, were discussed.

Notwithstanding that this was definitely a working conference, with day and evening sessions, there was unanimous approval of a resolution, read at the closing dinner, that there should be another conference, possibly in two years' time. This would ensure continued study and interest in the education of the engineer. It would also keep this important subject of engineering education in true and dynamic perspective, at a time when the shortage of graduates might lead to the cutting of corners.

E. V. Buchanan,
Julian C. Smith Medal

Edward V. Buchanan, M.E.I.C., of London, Ont., consulting engineer, and former general manager, Public Utilities Commission and London Railway Commission, will receive the Julian C. Smith Medal of the Institute for "Achievement in the development of Canada". The Council reached this decision at the meeting of November 10, the award to be presented at the annual meeting in Banff, June, 1957.

Mr. Buchanan was born and educated in Scotland, graduating from Royal Technical College, Glasgow.

He has contributed greatly to professional affairs, serving the Institute as branch chairman and councillor and as a representative on the Engineers Council for Professional Development. In 1948 he was awarded the Fuller Memorial Award of the Canadian Section of the American Waterworks Association.

E. V. Buchanan, M.E.I.C.

ECPD Meets in Detroit

The twenty-fourth annual meeting of the Engineers Council for Professional Development was held in the beautiful building of the Engineering Society of Detroit on October 25 and 26. From every point of view it appears to have been the most successful meeting ever held.

The Engineering Institute is the Canadian member of this Council. Most of the Institute's working members of the Council and of its many committees were present and the president was there as well.

Speakers

There were three speakers in addition to the chairmen of committees, and the president. At luncheon on the 25th the speaker was Dr. Kenneth McFarland, educational consultant for General Motors Corporation. It is doubtful if any other man could wrap up so serious a message in so much side-splitting wit and humour. To hear him was an experience long to be remembered.

The annual dinner Thursday night was presided over by the president, Thorndike Saville, dean of engineering, New York University. He gave an interesting and inspirational "boil down" of his annual report. It was clear that ECPD had a big year, but it was even clearer that a bigger one was ahead. The speaker was J. H. Foote, president of Commonwealth Associates of Jackson, Michigan.

Friday's luncheon had as its speaker N. W. Dougherty, dean emeritus, College of Engineering, University of Tennessee. His message was that in spite of all the counselling, guidance and other forms of assistance that were offered the young man, he would become a professional person and recognized as such only when his own behaviour showed he merited it.

Committees

The Council works through a group of well established committees. These committees demand much of their members because there is much to be done and none of it comes easily. It can be said that this Council has no existence outside of its committees. Every action taken throughout the year is taken by or on behalf of a committee. The reports of the several committees were presented at Detroit and this *Journal* account makes available to Canadian engineers an abridgement of each one.

ECPD is the first successful cooperative organization in North America to survive over a reasonable period of time. It has done a great work for the profession and every year sees it growing in size, accomplishment and recognition. As each field is opened and developed, new fields are attacked, so that the ECPD program takes on the character of a healthy tree whose branches grow longer and stronger, whose stature increases steadily and whose roots go deeper and deeper.

The Institute is proud to be associated with the great United States societies, in the outstanding work that is the purpose of ECPD.

Guidance Committee

Chairman,
K. F. Treschow, Secretary,
Engineers Society of Western Pennsylvania, Pittsburgh.
E.I.C. Representative,
R. F. Shaw, Vice-President,
Foundation Company of Canada, Montreal, Que.

The Guidance Committee, with a well developed organization in the United States, Canada, and Hawaii, built up by former chairmen of this committee, has with the fine cooperation of regional, state, and local chairmen and their committees continued to bring student guidance to an increasing number of secondary schools, especially in the outlying districts.

Following recommendations made in last year's report, the revised fourth edition of the folder, "After High School—What?" will be mailed the latter part of this year to superintendents and principals of all secondary public, private, and parochial schools. With the mailing of this folder, the usual offer is being made for counselling by committee members at the schools if application is made to the state chairman. The state chairman refers such requests to his local committee in or near the locality from which the request is received.

Local Activities

Forty-three state chairmen have submitted annual reports giving number of schools visited, number of students contacted, and brief outlines of the various types of programs. Sixteen - hundred - and - fifty schools were visited and 118,260 students were contacted. However, the number of schools given is no indication of the students reached as practically all of the large cities sponsored Career Days to which students in all of the local schools are invited. The number of these schools is not included.

In general, local programs consist of Career Days, speakers at the schools, inspection trips to industry, speakers at PTA meetings, and meetings with school counsellors. A number of committees have arranged radio and TV programs. We regret that space does not permit our giving a more detailed report on the many programs sponsored by local committees.

Education and Accreditation Committee

Chairman,
Harold L. Hazen,
Dean of Graduate School,
Massachusetts Institute of Technology,
Cambridge, Mass.

E.I.C. Representative,
Professor C. H. R. Campling,
Queen's University,
Kingston, Ontario.

This year's work of the Education and Accreditation Committee has taken on substantial elements of new thinking arising from new problems in what appears superficially to be a semi-routine and standard program of visitation, appraisal, and recommendations to Council on engineering curricula.

The impact of accelerating technical sophistication in industry and defense is being felt in our engineering schools, through several channels. One of the most important channels is the Evaluation Committee report of the American Society for Engineering Education, accepted in June, 1955. Related to and in some sense growing out of this report are the "Additional Criteria for Engineering Curricula," appearing as part of last year's report of this committee. These have had the general effect of raising the sights both of engineering education and of ECPD standards for engineering curricula. There is a widespread recognition that the art of technology and engineering practice must take a role secondary to sound grounding in science, and the development of these methods of thought by which science can be applied with understanding and judgment to the solution of new problems. The degree of acceptance of these ideas and of the essential place of general education in an undergraduate engineering curriculum has been indeed notable across the country.

Simultaneously with these raised levels of performance that engineering educators have set for themselves, inflationary effects have appeared that work against achievement of these levels. Employers of engineering graduates strive mightily to increase the attractiveness of industrial employment at the same time that general economic inflation is decreasing the attractiveness of an academic career in comparison with an industrial career. The effects of these trends on faculties pose problems in appraisal and judgment to ECPD visiting committees that are at once challenging and difficult. Engineering faculties, especially in smaller departments, tend now to be much less stable than in less dynamic times, and the committee finds necessary a correspondingly large number of short-term recommendations.

Technical Institutes

Considerable attention was focused on technical institute education during the past year through three unprecedented actions. Early in the year, Engineers Joint Council held a general assembly in New York City at which the topic of the engineering technician received considerable attention for the first time. In addition, during the summer the President's National Committee for the Development of Scientists and Engineers created a working group to design an action program for the development of more and better qualified engineering technicians. Also, during the year, it was announced that in an effort to establish and compile a body of factual information on the subject of the engineering technician, the Technical Institute Division of The American Society for Engineering Education requested and received from the Carnegie Corporation a grant for the purpose of studying technical institute education in the United States. With this growing interest shown by government, industry, and education in the extended use of technicians in the "engineering team", the function and responsibility of the technical institute becomes a matter of concern to a growing group of persons.

Financing Accrediting Activities

The accrediting activity is no more immune to rising costs than any other activity. An increase in the charges appears inevitable for the coming year. This charge will be designed in accord with the following principle approved by the Executive Committee. The profession, through ECPD, will supply the overhead of the central office administrative expense, while the institutions inviting visitation with a view to accrediting will bear the expenses associated with arranging, carrying through, and evaluating the results of the examination of their curricula.

Chairman's Conclusion

At the conclusion of his last report as chairman of this committee, the chairman bears testimony to the satisfactions of working in this activity. Even when curricula and operations of an institution have been criticized vigorously, the character of its considered response has reflected deep dedication to cause rather than the personal reactions which would be only human under the circumstances.

Even more intimate have been the satisfactions of working with the members of this committee and its headquarters staff. In their sense of personal dedication and generous contributions of professional and personal service to a common cause for the profession, the spirit of this group is outstanding. Individually and in groups they not infrequently face problems quite as delicate, difficult, and demanding of the highest skills and judgment as those for which the professional executive or counsel is paid an impressive salary or fee. Yet the members of this committee contribute their services (and members of inspection teams as well) out of extremely busy schedules and frequently from time otherwise available for consulting or other personally or professionally profitable activity. It is a privilege and pleasure of the highest order to share the activities of such a group.

Student Development Committee

Chairman,
N. W. Dougherty,
Dean of Engineering,
University of Tennessee

E.I.C. Representative,
H. Brian White,
Montreal, Que.

A brief review of some materials on professionalism may be helpful to those who are doing instruction

(Continued on Page 1715)

Elections and Transfers

At the meeting of council held at Victoria B.C., November 10, 1956, a number of applications were presented for consideration and on the recommendation of the Admissions Committee, the following elections and transfers were effected.

MEMBERS

H. R. Baines, Hamilton
J. S. Bright, Toronto
E. S. Buhayar, Montreal
L. B. Crossing, London, Eng.
R. J. A. Fricker, Montreal
R. A. H. Galbraith, Ottawa
R. D. Gilbert, Windsor
G. C. Gregory, Toronto
W. R. Haynes, St. John's
T. L. Hennessy, Sudbury
C. N. Hopkins, Shawinigan Falls
J. V. Laurient, Calgary
D. H. Lee, London, Eng.
J. R. Lindsay, Montreal
C. L. Moon, Brampton
W. E. Morden, Brockville
R. W. McCurdy, Shawinigan S.
R. D. Perry, Trail
E. N. Reed, Ottawa
L. S. Roullier, London, Eng.
V. F. H. Samson, Montreal
D. Segal, St. John's
J. R. Simpson, Toronto
J. R. Traves, Montreal
P. Tuck, Peterborough
W. H. Wisely, New York, N.Y.
J. E. A. Yeats, Montreal

JUNIORS

Y. J. Fokkinga, Montreal
G. J. Jakobson, Montreal
P. L. Mullen, Montreal
A. P. Ruffo, Montreal
W. L. Sutherland, Brockville
M. A. Wilson, Hamilton

TRANSFERRED FROM THE CLASS OF JUNIOR TO THAT OF MEMBER

S. M. Breuning, Cambridge, Mass.
V. B. Cook, Fort William
J. G. Feltcher, Montreal
F. G. Lynch, Toronto
T. R. Marien, Montreal
M. J. Roche, Toronto
R. G. Serneels, Windsor

TRANSFERRED FROM THE CLASS OF STUDENT TO THAT OF JUNIOR

G. A. D. Reed, Montreal

THE FOLLOWING STUDENTS WERE ADMITTED

LAVAL UNIVERSITY

J. C. G. Allard
J. H. R. Angers
L. Arsenault
R. Asselin
M. Aubry
A. Beaudin
J. P. Beaudry
R. Beaulieu
J. V. Begin
J. M. Belanger
M. L. Belcourt
R. Bigaouette
V. Bissonnette
G. Blouin
N. Blouin
G. Boivin
G. Bourassa
G. Bourgault
C. Boutet
L. Brochu
P. Caron
R. Chabot
D. C. Charest
J. L. J. Charland
G. H. Cloutier
L. Cloutier
J. G. G. A. Cote
R. Cote
J. R. C. Crepin
G. Jacob
T. Jiona
L. R. Jobidon
M. Jobin
J. G. Joseph
F. Labrecque
J. W. R. Lafrance
R. Lamontagne
E. Langlois
J. H. D. Larrivee
J. G. J. La Roche
J. R. Larouche
A. Lavoie
G. D. Lemieux
R. E. Lemieux
A. Marcoux
R. Marcoux
J. G. Marsan
J. Mercier
I. Methot
L. Montambault
J. A. J. G. Morin
M. Normand
C. E. Pageau
G. A. Paquet
A. Pare
J. C. C. Pelletier
M. A. Potvin
S. G. Pouliot
G. Delisle
J. M. Desgagne
J. P. R. Deslauriers
P. Dionne
J. P. Dorion
J. T. Doyon
G. Dufour
J. J. Dumas
P. H. Durand
A. East
J. Fournier
J. G. Frechette
A. R. Gagnon
G. C. T. Gauthier
L. Gauthier
R. Gilbert
R. Godin
L. Goulet
M. Guay
G. Rheault
R. Richard
A. Royer
B. St. Laurent
G. Saint Pierre
J. L. Simard
Y. J. Simard
A. C. Simoneau
J. A. P. Tellier
J. G. R. Tessier
M. Tessier
G. Thibault
J. Thiverge
P. Tremblay
J. M. Trepanier
G. Turcotte
R. Turcotte
J. A. J. A. Vezina
L. J. L. Vignula

UNIVERSITY OF MANITOBA

W. J. Aspinall
G. B. Babiy
S. P. Baker
L. D. Barber
R. P. Barschel
I. H. Bassin
R. A. Baynton
R. W. Besant
E. G. A. Bowkett
J. D. A. Borthwick-Leslie
W. P. Brown
B. R. B. Buckland
G. E. Burns
N. D. Cameron
J. D. Campbell
T. F. Cartar
W. D. D. Christie
G. W. Crabtree
I. S. Diakunchak
E. Enns
G. C. Fabro
J. B. Finstad
K. C. Foster
D. M. Fry
H. S. Garrioch
A. G. Gesell
A. Harms
M. J. Harper
E. Hawrylyshen
J. D. Hill
D. C. D. Johnstone
F. R. Kaito
W. S. Kolodinsky
V. W. H. Leung
W. R. E. Lozanski
L. Mak
G. E. Maunder
D. W. Miller
G. L. Monro
D. R. Motyka
J. McIntyre
R. J. McRae
J. E. Nykoluk
W. K. O'Neill
D. M. Onysko
D. J. Paterson
J. H. Paterson
F. L. Peterson
A. L. Ross
D. H. Ross
V. G. Rowe
R. H. Schilling
B. I. Shulakewych
B. Semchuk
D. B. Sinclair
R. R. Smedley
L. Solar
A. C. Soudack
H. M. Sutherland
P. Szeto
M. Z. Tarnawecky
H. E. Thexton
C. G. Troyer
E. Van Doorn
H. G. Volume
M. A. Ward
K. I. Weisz
W. R. Yee
R. E. Zelmer

UNIVERSITY OF OTTAWA

W. Beaudoin
M. F. Beaupre
P. J. Bennett
J. Bissonnette
P. Bourgie
R. V. Brady
J. F. Castonguay
R. Charbonneau
T. S. Cheng
J. T. Chychrun
J. K. Clarke
J. M. Denis
H. L. De Vries
G. A. Duffield
J. G. Entwistle
H. K. Fang
E. Fontaine
F. Fortier
N. Fraser
C. Gagne
J. J. G. Gelineau
P. D. Holt
N. Houle
Y. Hurtubise
B. K. Jeun
S. K. Jeun
N. S. Jew
R. Lalonde
W. J. Lamb
B. Landry
M. Landry
G. Lascelles
J. L. R. Legault
P. G. Leroux
J. Lescuk
S. K. Leung
E. Lord
B. P. McCloskey
A. Marcil
R. Marcil
B. Marois
I. Masse
E. J. Mattiuz
K. Menard
H. Michaud
L. G. Miliette
D. J. Murphy
P. Oleskevich
G. E. Otis
R. J. Payne
H. M. Pedroso
L. Pharand
R. Pophie
J. M. Ranger
D. J. C. Rouleau
M. Roy
A. St. Amant
C. Simard
R. E. G. Sommerville
O. Symko
M. Tessier
W. F. Tremblay
M. Vinette

UNIVERSITY OF BRITISH COLUMBIA

C. W. Alexander
J. W. Bailey
A. E. Beauregard
J. Lunder
T. F. McKimm
W. R. McNeilly
R. L. Begg
R. W. Blackburn
W. C. Boomer
L. H. Bradshaw
C. G. Brewster
G. W. Brown
P. M. Brown
R. H. Cawley
J. F. Davey
L. Demosky
C. J. Friedrich
E. A. J. Hahn
P. Haley
C. K. Harman
P. D. Hibbert
C. E. L. Hunt
J. H. Isberg
J. Kalmins
H. M. Langtry
R. F. Lim
A. D. Morrison
D. Y. Morrison
W. W. Nassichuk
R. Y. Nishi
B. J. G. Patsch
F. W. J. Peitzche
L. H. Rohloff
J. C. Selby
P. A. Shields
G. J. Sofko
G. K. Stewart
H. J. Stolz
T. Suzuki
W. H. C. Thompson
C. R. Webb
H. G. Wiber
J. J. Witt
A. L. Zarbock
J. Ziegler

UNIVERSITY OF TORONTO

L. Atteraas
E. A. Bambers
A. Bergs
V. R. P. Bersenas
H. E. Braun
W. C. Cameron
B. E. Cherrington
R. E. Day
W. Dolega-Kowalewski
R. W. J. Ellwood
S. Fromovitz
G. P. Germann
R. M. Gies
H. Gross
H. D. Hallamore
P. J. Harris
W. H. Johnston
B. A. N. Khojajian
J. Kjollesdal
H. K. Knapp
N. G. Kozody
J. E. Kryzanowski
A. B. MacArthur
K. L. McIntyre
B. Maksymec
R. G. Matthews
J. C. L. Phillips
E. A. Rae
D. G. Robertson
W. H. Scholich
H. P. Shelegy
C. A. Stevenson

UNIVERSITY OF NEW BRUNSWICK

J. A. Baxter
G. Bourassa
L. O. Boyd
H. W. Burman
D. C. Campbell
B. G. Christie
J. D. Cook
G. S. DeLong
F. W. Diamond
D. G. Dow
B. A. Eshekwu
J. H. Evans
E. M. Fanjoy
K. G. Farmer
R. F. Fitzmaurice
R. J. Hebert
J. P. Jolly
A. W. MacPhail
J. W. R. McCarthy
J. H. McMackin
J. P. Power
W. G. D. Redstone
W. J. Ross
R. J. Rowe
F. A. Ryder
W. L. Sears
R. J. Sperrano
D. M. Todd
B. A. Tomilson
H. W. Walford
W. H. Wishart

NOVA SCOTIA TECHNICAL COLLEGE

D. L. Allen
J. P. R. Bertrand
J. D. Brown
W. G. Brown
J. I. Clark
L. E. H. Day
E. W. Diab
M. A. Godin
G. B. Hill
S. H. James
F. R. Jefferson
J. J. Lamie
D. W. Latimer
M. E. Lloyd
E. H. A. MacKinnon
J. A. MacLean
J. J. MacLellan
M. J. McGrath
G. W. McPhee
M. W. Moloughney
I. E. J. Morrison
J. B. Pelletier
G. V. Penny
L. D. Sears
Q. H. Shemdin
L. B. Stevens

MEMORIAL UNIVERSITY

A. D. Burden
P. J. Duggan
J. E. Dunne
D. D. Fry
D. W. Greenland
A. C. J. Langdon
A. W. Moore
T. G. Moore
D. O. Noble
R. G. Pafford
G. W. Peddle
D. J. Pretty
H. G. Walsh
R. T. Williams

UNIVERSITY OF ALBERTA

N. T. Anderson
T. A. Bethune
T. E. Bourne
N. M. Boyd
C. F. Carter
K. E. Howery
C. A. Ing
E. F. Kaszas
H. Kupczynski
J. P. Parkinson
D. Ropchan
R. Solodzuk
J. M. Warne

McGILL UNIVERSITY

J. W. Barnes	A. Duranleau
R. H. Barrigar	N. Long
J. L. Chun	J. G. Schmidt
J. R. Dubord	T. C. Sequera

ROYAL MILITARY COLLEGE

L. J. A. P. Chaumette	O. M. Hodgkins
R. G. A. Clare	P. A. Kirk
W. G. Doupe	P. G. Kirkham
T. G. Drummond	S. G. Morin

DALHOUSIE UNIVERSITY

R. D. Crooks G. D. Hiseler

CARLTON COLLEGE

A. G. Bellinger

SYDNEY SUSSEX COLLEGE

J. M. Preston

MOUNT ALLISON UNIVERSITY

R. D. MacIntosh

UNIVERSITY OF SHERBROOKE

Y. Beauregard

GRADUATES

N. P. O'Briain, Univ. Coll. Dublin, B.E. (Mech. & Elec.), 1956

V. J. O'Doherty, Univ. Coll. B.E., 1956

R. W. Healey, Queen's Univ., B.Sc., (Civil), 1956

G. R. Mason, Univ. of B.C., B.A.Sc. (Engrg. Physics), 1956

C. M. Williams, N.S.T.C., B.E. (Elec.), 1956

B. W. Little, McGill Univ., B. Eng. (Mech.) 1956

Applications through Associations

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections and transfers have become effective:

ALBERTA

Members

K. R. Brown	J. A. McDonald
L. E. Colburn	R. E. Mitchell
F. W. Hewes	E. Puchalski
L. O. Hostland	

SASKATCHEWAN

Members

M. L. Bailey	B. R. Richards
D. N. Cass-Beggs	G. L. Spackman
T. B. G. Hicks	D. M. Wylie
R. D. Knowles	

Juniors

G. E. Baldwin

Students

A. M. Campbell	R. S. Lang
N. H. Erichsen	O. H. Smail
J. A. Hanlon	

Junior to Member

R. M. Burton	M. Gov
E. P. Garrison	J. R. Sutherland
D. R. Gilley	

MANITOBA

Junior

G. E. Bates

NOVA SCOTIA

Members

D. R. Barteaux	F. Holden
F. F. Burchell	

Junior to Member

C. L. Dodge A. R. MacKenzie

NEW BRUNSWICK

Member

C. E. Spear

Confederation

Word has just been received from Charlottetown, P.E.I., that the first joint meeting between the branch of the Institute and the Association of Professional Engineers was held there on Thursday, October 25.

The business of the Association was to appoint officers for the ensuing year. This was done very simply, by electing to the various posts the persons who occupied similar posts on the executive of the Institute branch. Herewith are the officers so elected.

Chairman, Norman F. Stewart
Vice-Chairman, C. W. Currie
Secretary-Treasurer, C. F. Buckingham
Members of the Executive Committee, R. D. Donnelly, John MacDonald, Laurie Coles, Gordon Milligan
Councillor, Stuart Veale

This same procedure is followed precisely in the province of Saskatchewan and almost precisely the same in the province of Manitoba. Those provinces seem to like this procedure and it is interesting to see that P.E.I. has followed their good example.

This is indeed Confederation. It is a policy quite similar to that adopted by these provinces that many members of the Institute have in mind when they speak of Confederation. It is simple, it is economical and it is effective.

Ball and Rod Mills. An award-winner in the E.I.C. Photographic Exhibit, 1956, this picture was exhibited by Dominion Engineering Works, Limited.

H. J. Lawson, Photographer.

ECPD Meets in Detroit

(Continued from Page 1712)

in this area. The chairman was a member of the EJC Committee on Employment Relations which studied employment practices for some two years and came up with recommendations which were published as an EJC report on "raising professional standards and improving employment conditions for engineers." The report gives a brief discussion of employment conditions, including the impact of collective bargaining on the employment of engineers. It further defines professionalism and makes suggestions regarding solutions of the employment problem. One short paragraph will give a glimpse of its contents: "Prestige, however, is something which must be won. It cannot be bought or automatically accorded through affiliation with an organization. It is something that one can *command* but never *demand*. In the final analysis an engineer achieves professional standing only to the extent that he accepts his responsibility to himself, to his client or employer and to society."

Guidance for Student Engineers

A major activity begun by the committee during the present year is guidance of students while they are in college. Average losses are more than 50 percent of the entering students. Studies which have been made indicate a number of causes as, for example, discouragement due to low grades, developing a new interest, financial problems, entering the armed services, etc. A University of Missouri follow-up of engineering drop-outs summarizes the problems as follows:

1. Lack of guidance in high school.
2. Lack of good preparation for engineering.
3. Need for better orientation, advisement, and student-staff understanding.
4. Knowledge of the requirements in engineering causes the student to change to some other activity.
5. Many of the dropouts thought the engineering program was not practical enough, though very few of them thought there should be a reduction in mathematics.

There is a lack of understanding on the part of some students, and parents as well, that certain scholastic standards must be maintained to remain in college. Many feel that once they are in college the college is obligated to give them an education regardless of the time it may take to do it.

Failures are due to:

1. Lack of motivation.
2. Lack of aptitude.
3. Counsellors advising an engineering college when a technical institute is in order.

1. There seems to be no way of psychologically measuring or otherwise determining motivation. Boys showing high aptitude for engineering sometimes just do not have the motivation to exert the effort, and it is doubtful that it can be cultivated to last for more than just a short-time spurt. It is something innate to the boy's makeup. This deficiency may occur in boys from wealthy families who never had to struggle for their existence. There is not much that can be done after they arrive in college, although parents think that colleges should imbue them with the enthusiasm that they themselves failed to develop in the growing-up period.

2. There are boys who lack aptitude but have intense interest. Many of these boys succeed eventually simply by persistent effort usually over an extended period of time. Often interest is mistaken for aptitude, particularly on the part of parents and the boy is forced into a program too heavy for his abilities. It is particularly difficult for counsellors to get the parents to understand this.

3. This is related to 2 above. Parents often force a boy into engineering college because of a demonstrated aptitude to build a radio receiver or to service the family car, even though he shows up poorly in mathematics in high school. Such a boy should be guided to a technical institute or to some other field of activity, but once he is in college and his deficiencies begin to show up he feels that he is being degraded to be advised to transfer elsewhere. He therefore persists in college, until the tragedy of failure catches up with him.

Actually, counsellors in the engineering colleges need some good information on technical institutes and their programs so as appropriately to advise boys and parents of the dignity and useful aspects of such types of training. This could save some misfits in college and at the same time help relieve the engineer shortage by providing more technically trained assistants.

Professionalism

Many engineers have the strong feeling that the professional attitude is something that "can't be taught but must be caught". It is a mien, a mannerism, a personal characteristic that the student gets by association with professional people; he gets it from his teachers, his preacher, his banker. That puts a real responsibility on his teachers in particular, and it is here that engineering teachers are somewhat lax. Careless dressing, sloppy handling of pipe or cigarettes, public drinking, swearing, and poor English are all contributors to the public's lack of respect for the engineer. One often sees much more dignity in the medical, law, and divinity schools than he does in the engineering schools.

The Cult of Mediocrity

We oldsters "view with alarm" some of the trends of present-day engineering education. Our schooling was in a period of small numbers and individual contacts with faculty members. Just ahead, the schools will increase their enrollments and at the same time they will have more difficulty in finding qualified faculty members. There will be a temptation to mold students into a pattern, to make them as uniform as group education can devise and, as a result, we may border on the cult of mediocrity.

Training Committee

Chairman,
Edwin L. Yates,
Director, University & College Relations,
General Motors Corporation—Detroit
E.I.C. Representative,
George L. Schneider,
Hamilton, Ontario

Major attention of the committee during the past year has been focused on activities designed to implement "The First Five Years of Professional Development" program in specific communities.

The project was introduced to the Detroit industrial community last fall in a meeting sponsored by the local committee at the Engineering Society of Detroit. Representatives of some 200 companies attending the meeting heard Mr. George Porter, chairman of the local sponsoring group; Mr. J. C. McKeon, director of training, Westinghouse Electric Corporation; Professor Cornelius Wandmacher, University of Cincinnati; and members of the local committee tell of objectives of the Five Year Program and plans for its application in Detroit.

In Cincinnati the local committee has continued active in promoting the objectives of the program first started in this community in 1952.

Part-time graduate study for practising engineers, directly supported during the past three years by the local industry committee, is now well established as a regular part of University services to the community. The first advanced degrees awarded primarily on the basis of part-time work may be expected to be granted in June, 1957. A new program in nuclear engineering has attracted wide attention from practising engineers both within and beyond the First Five Years Program.

Professional Development Programs, as operated in Canada, are built on the six points promoted by the Training Committee. Many of these programs are now in their seventh year in Canada. Currently, projects are in full swing in such centers as Quebec, Hamilton, Halifax, Winnipeg, Ottawa, Belleville, Cornwall, Kingston, Saguenay, Saskatoon, and Toronto.

With respect to "Continued Education of Graduate Engineers," The Engineering Institute of Canada branches presently are sponsoring some fifteen courses. These not only deal with technical subjects, but are primarily lectures and courses in the nontechnical field designed to promote a broadened outlook to enable young engineers better to express themselves, and in general to foster their over-all development. During the past year approximately 450 young engineers enrolled in such courses, and it is estimated that since their inception, over 2000 engineers have benefited from these programs.

Recognition Committee

Chairman,
George H. O'Sullivan,
Electrical Engineer,
T. G. White Engineering Company,
New York, N.Y.
E.I.C. Representative,
Guy Savard,
Montreal, Quebec

A number of studies have been started or continued during the past year, each of which is treated in some detail herein:

Definition of Engineering

The subcommittee has continued its study. Since the publication of a suggested definition in the 1955 report, well over fifty letters have been received from individuals and groups, all of whom obviously have given a great deal of consideration to the subject, and many of whom have contributed helpful suggestions and criticisms. Most of the reactions have been favorable, with suggestions for improvements, although some have found considerable fault with the definition.

As a result of a study of all criticisms and suggestions received, the following definition is suggested. Several points on which a number of comments have been received are discussed.

Engineering is the Profession in which a knowledge of the mathematical and physical sciences gained by study, experience and practice is applied with judgment to develop ways to utilize, economically, the materials and forces of nature for the progressive well-being of mankind."

It has been suggested that the profession provide itself with a new designation to replace "Professional Engineer". A subcommittee under Mr. Goodkind is now studying this problem.

A committee of EUSEC is now studying foreign experience and practice on this matter, and the findings of that committee will be included in our study.

Meanwhile several suggestions have been received from individuals, and these, too, will be considered.

Prestige for Young Engineers

An important phase of the problem of developing and maintaining the interest of young men in our profession is that of increasing the use of their creative abilities and minimizing the amount of routine work. To many, this takes precedance over salary but we must provide recognition of their attainments.

Since professional service is basically a service of individuals who have individual responsibilities, it behooves those of us having engineers under our direction to guide each one in his professional development. Our Training Committee has established guideposts to assist in orientation of the young engineer, encouraging his self - development through self-analysis and continuing study. We can encourage him to participate actively in his engineering society. A professional man will willingly accept the privilege of serving his profession. He should attend meetings and present papers. He should participate in leadership through committee work and Section activities. He should advance to Associate Member and full Member grade as he becomes eligible. When he is qualified, he should establish his legal standing by registration as a Professional Engineer.

In his day-to-day work as he acquires judgment and is responsible for engineering work, it should be recognized. Why should not drawings and specifications be certified by the young engineers who actually do the engineering work, as well as by the head of the department in charge? This would aid in the prestige of the growing engineer. It would serve to recognize him as an individual professional man rather than as a doer of routine work.

Model Law

It has been suggested that the Model Law be revised to include a clause covering practice by others than individuals. Since the entire subject of such practice is now under study by a committee on which ECPD is represented, the Recognition Committee has not considered this suggestion.

Ethics Committee

Chairman,
C. J. Freund,
Dean of Engineering,
University of Detroit
E.I.C. Representative,
J. E. L. Roy,
Hydro Quebec,
Montreal, Que.

During the past year the Ethics Committee has undertaken a new phase of activity and responsibility.

The original task of the committee was to formulate the Canons of Ethics, to obtain approval of the Canons by ECPD, and to publish them. The formulation of the Canons was a difficult assignment because of much difference of opinion in the engineering profession. These differences of opinion had to do with the structure and phraseology of Canons of Ethics, with their scope, and the detail to which they should be worked out. There has been at no time any lack of agreement concerning essentials of ethics in the profession. Furthermore, a number of constituent societies of ECPD had already published codes of ethics or professional practice of their own, and the Canons of ECPD necessarily had to conform to these various codes and standards.

In spite of difficulty the committee succeeded in time in constructing Canons which were accepted not only by Council, but by the governing bodies of the constituent societies.

Thereupon the committee undertook to prevail upon American and Canadian engineering societies to endorse or accept the Canons. Over a period of years, in excess of 80 engineering societies have endorsed the Canons, and several of them have adopted the Canons as their own codes of practice and ethics.

A New Outlook

During the year it has appeared to the committee that this phase of its work has been largely accomplished, and that the committee should begin new projects. This does not mean that the committee will discontinue its efforts to interest societies in the Canons; it means rather that to interest them should no longer be the committee's principal assignment.

Accordingly, the committee has determined hereafter to concentrate upon the creation of much greater interest in ethics among engineers, particularly as a means for increasing professional understanding and consciousness among them. The committee believes that too many professional engineers look upon ethics as an academic or abstract problem which does not directly concern them. It is apparent that there are engineers who do not appreciate the relation of ethics to professional status, and that there are even some who do not know just what is meant by ethics as applied to the profession.

Both Technical Competence and Integrity

For instance, there seems to be a tendency among engineers to assume that technical competence is the sum total of professional responsibility. Of equal importance to the professional man is his integrity. He commands the confidence of his employer or client not merely by knowing his business but likewise by his reputation for honesty. The ordinary lay employer or client is not competent to appraise the engineer's work. Hence, the employer or client is completely dependent upon him. Since he is completely dependent upon him he must be assured both that the engineer is technically competent and that he is morally responsible.

To be morally responsible means that he subscribes to and complies with an established set of ethical principles which is recognized by the profession. Such an established set of ethical principles are the Canons of ECPD.

Information Committee

Chairman,
Walter E. Jessup,
Editor,
Civil Engineering,
New York, N.Y.
E.I.C. Representative,
L. Austin Wright, Editor,
The Engineering Journal,
Montreal, Quebec

The Publication Fund of ECPD is used, on approval of the Executive Committee of Council, for printing ECPD publications. All but 20 percent of the sales of publications is credited to the Publication Fund, the 20 percent is credited to the general operations account to offset overhead costs of handling, postage, and envelopes. As the stock of publications is depleted the Publication Fund grows.

The Information Committee approved revision or the reprinting of the following several publications, the cost of which will be close to $17,000.

The Second Mile. Since the edition of 1950, 10,000 copies of *The Second Mile*, an address by the late Dr. William E. Wickenden, have been sold.

Canons of Ethics for Engineers. In July 3000 copies of the *Canons of Ethics for Engineers* were reprinted, enough for about one year's sales.

Professional Guide for Junior Engineers. In July, 5200 more copies of the popular *Professional Guide for Junior Engineers*, originally written by the late Dr. William E. Wickenden, were reprinted. Each year the ASME, AIME, and EIC send a copy of this booket to their recent graduates.

Engineering—A Creative Profession. Two years ago 75,000 copies of *Engineering—A Creative Profession* were printed. By November 15 the third edition should be ready for distribution and sale. An edition of 100,000 has been authorized.

Manual for Engineering Career Advisors. The Guidance Committee revised the text of the *Manual for Engineering Career Advisors* and on recommendation of the Information Committee, the Executive Committee authorized a printing of 5000 copies.

Reading List for Engineers. The Training Committee revised the text for the pamphlet, *Reading List for Engineers*, and the Information Committee had 5000 copies printed to replenish depleted stock.

Personal Appraisal for Junior Engineers. Close to 1000 copies of the Personal Appraisal Form for Junior Engineers are requested each year. The stock was replenished in August.

ECPD-EJC Joint Committee on Practice of Engineering

Chairman,
Charles Molyneaux,
New York, N.Y.
E.I.C. Representative,
G. Ross Lord,
Professor of Mechanical Engineering,
University of Toronto,
Toronto, Ontario

This committee was appointed in August, 1954; since that time it has met several times and carried on extensive correspondence. The membership of the committee gives a wide sampling of professional affiliations, geographical location, and points of view. Our studies ranged widely over the "Practice of Engineering" and our interim reports to the appointing boards reflected the general nature of our assignment.

At our January, 1956, meeting the committee decided that it was ready to direct its attention to specific aspects of professional practice and so reported to the board of EJC. The report and appearances of the chairman at the February and March meetings of EJC resulted in the following specific assignment:

1. To consider corporate practice.
2. To consider the responsibilities of partnerships.
3. Reciprocation in licensing.

Recognizing the national scope of EJC and ECPD, as well as their representation of all branches of the profession, the committee has concerned itself with principles rather than specific instances.

Corporate Practice

With reference to corporate practice, the committee recommends that it be the policy of EJC and ECPD that:

> Under certain conditions, corporations should be allowed to provide engineering services.

In an engineering corporation a majority of the officers, as well as those responsible for the engineering work, must be registered professional engineers in the State of incorporation, and that the engineers supervising work must be licensed in the State in which the engineering duties are performed.

Partnerships

The committee is of the opinion that the usual obligations of partnerships are very clear in the law. It also recognizes that questions of ethics, by their nature, go beyond law, and it is the unanimous recommendation of the committee that our boards go no further in questions of partnerships than to recommend that the Codes of Ethics of the constituent societies be made absolutely clear on the point.

ECPD-EJC Joint Task Committee On Survey of the Engineering Profession

Chairman,
Morris D. Hooven
E.I.C. Representative,
K. F. Tupper,
Toronto, Ontario.

At the 1955 ECPD Annual Meeting in Toronto on October 14, Council passed a resolution that it sponsor a survey of the engineering profession, seeking the concurrence of its constituent societies in undertaking such a survey. The Council referred this resolution to its Executive Committee for implementation.

At the December 5, 1955, meeting of ECPD's Executive Committee in New York, it was voted that EJC be requested to act with ECPD in appointing a joint steering committee for implementation of the resolution passed in Toronto.

At the January 25, 1956, meeting of the Board of Directors of EJC, it was voted to authorize the president of EJC to appoint the EJC members of an ECPD-EJC Joint Task Committee on Engineering Profession Survey.

The formation of this committee was completed in April. It met on May 18 in New York and worked throughout the summer in preparing a proposal for presentation by ECPD and EJC to their respective constituent societies for endorsement. Their proposal will appear in the next issue of the *Engineering Journal*.

Dr. Louis S. Pariseau Honoured

Dr. Louis S. Pariseau, M.E.I.C. of Montreal, retired superintendent of Quebec canals for the Federal Government, celebrated his one hundredth birthday on October 22, 1956. This great event received the attention of the engineering profession, and was marked by L'Ecole Polytechnique, Montreal, at an informal reception held on October 30 under the auspices of the Graduates Society. Dr. Pariseau graduated with the first engineering class of Polytechnique, in 1877.

Dr. Pariseau was earlier awarded an honorary doctorate of engineering by L'Ecole Polytechnique on the occasion of its seventy-fifth anniversary celebration in 1948.

Doing honour to the revered centenarian who served the engineering profession for fifty-three years were the officials of L'Ecole, its professors, students and Graduates Association, as well as the Corporation of Professional Engineers of Quebec, and The Engineering Institute of Canada.

An engraved certificate was presented to Dr. Pariseau by Dean Gaudefroy, on behalf of L'Ecole. R. L. Dunsmore, vice-president of the Engineering Institute, offered the gold Engineering Institute membership pin and commented on Dr. Pariseau's long and honourable service to the engineering profession since the time that he became a charter member of the Institute in 1887. He attained Life Membership in 1917. E. D. Gray-Donald, M.E.I.C., chairman of the Montreal Branch of the Institute was also present.

P. A. Dupuis, M.E.I.C., president of the Polytechnique Graduates Association, read a moving address which was responded to by Dr. Pariseau. Mgr. Irenee Lussier, P.D., rector of the University of Montreal, extended his best wishes to Mr. Pariseau.

The Corporation of Professional Engineers was represented by Leo Roy, president.

Some notes on Dr. Pariseau's career make an interesting story: In 1877, he was named a professor at Ecole Polytechnique, at a salary of $50 per month. In 1879 he started his work with the Federal Department of Railroads and Canals as a chainman. He was later associated with work on the Grenville canal, surveys of the Richelieu River, and surveys for the Lachine canal. He was appointed superintendent of canals for Quebec in 1923. He retired in 1930, well known as a pioneer in construction methods for public works.

At reception honouring centenarian engineer L. S. Pariseau are, E. D. Gray Donald, Henri Gaudefroy, Dr. Pariseau, and R. L. Dunsmore.

NEWS OF THE

Associations and Corporation

Information received through co-operation of the provincial organizations.

QUEBEC

Title of "Engineer" for Use by Individuals—Not Corporations

The Act governing the practice of engineering in Quebec stipulates that the title "Engineer" is reserved exclusively to members of the Corporation of Professional Engineers of Quebec. Consequently, a firm not being eligible for membership in the Corporation may not legally use this title.

In the past the Corporation has tolerated the use of the title "Engineer" by firms owned or managed by professional engineers or employing professional engineers. However, this practice has led to serious abuse and the Corporation has reached the conclusion that it would not be properly fulfilling its main duties to the public if this practice was allowed to continue. In addition there is evidence that the prestige of our profession is adversely affected by these abuses.

Consequently, it was decided a few years ago to request all firms using the title "Engineer" in their advertisements to discontinue this practice in the best interest of the profession and of the public which it serves.

Many firms have undertaken to comply with this request on a voluntary basis and in a spirit of cooperation. The Council has recently decided to enforce this request now that every interested party has been given ample opportunity to abide by the law on a voluntary basis.

Wish Annual Meeting

The question of the use of the title "Engineer" in advertisements, letterheads and elsewhere differs from the question of the practice of engineering by the same firms. It will be recalled that a debate was held on this topic at the last annual general meeting of the Corporation and that the Council has agreed to postpone any definite action on this second question until it has been thoroughly debated at committee Council and general meeting levels. Particularly Mr. MacCallum's opinion as expressed at the annual meeting was to be discussed by the committee on directing principles of the engineering profession.

Committee on Advancement of Employee Engineer

A very important committee is at work this year at the Corporation, namely the committee on the advancement of the employee engineer. In order to insure participation of all the membership in the work of the committee, five subcommittees have been set up in various areas of the province. These sub-committees will respond to a co-ordinating committee composed of the chairmen of the subcommittees. It is felt that the creation of this committee will provide the membership with an excellent opportunity to express their views and comments on the status of the employee engineer as well as on the problems which confront him.

Salary Schedule

Our membership was recently advised that during September two copies of the June 1956 issue of the schedule of salaries have been forwarded to the director of personnel of each of the organizations with whom our members are associated. Our mailing list did not include the consulting engineers and those firms whose management was known to us as belonging to the Corporation.

1957 *Annual Meeting*

The next annual meeting of the Corporation will be held on March 23, 1957, at the Mount-Royal Hotel in Montreal. As part of this meeting, there will be an exhibition of films and slides. This is in keeping with a tradition established some years back, which makes it possible for those of our members who engage in art work during their leisure time to receive public recognition of their effort.

(*from the Bulletin of the Professional Engineers of Quebec, October* 1956)

Quebec City may have been a historic site once more on Saturday, September 22, when ten members of the Corporation sat at the conference table in the Cercle Universitaire to consider a proposal for confederation of our profession. This was the first meeting of the newly formed committee on Plan for Unity, appointed by your Council to examine a proposition jointly endorsed by a national committee of the Engineering Institute of Canada and a committee of the Dominion Council of Professional Engineers and presented at the annual meetings of these bodies last spring. Each professional Association and the Corporation have been invited to study carefully the proposal and to submit their reaction to the Dominion Council Committee whose chairman is still J. H. Smith, originator of the Plan some years ago.

The Council has entrusted the following thirteen members with the responsibility of examining the Plan from the standpoint of the Corporation.

Guillaume Piette, chairman, Messrs. Hector Cimon, E. E. Copping, Geo. M. Dick, J. B. Edwards (substituting for W. G. Seline), Henri Gaudefroy, E. D. Gray-Donald, C. C. Louttit, L. Nadeau, R. Painchaud, W. J. Riley, W. G. Seline, and J. St. Jacques.

PRINCE EDWARD ISLAND

ELECTION OF OFFICERS

October 25 was the date set for the election of officers to the Association of Professional Engineers of Prince Edward Island, for the term 1956-57. Choice of the members for the duties of chairman was N. F. Stewart, JR.E.I.C.; vice-chairman, C. W. Currie; and secretary-treasurer, C. F. Buckingham, M.E.I.C.

Executive posts were accorded R. D. Donnelly, M.E.I.C., J. D. M. MacDonald, JR.E.I.C., L. A. Coles, JR.E.I.C., and G. H. Milligan, Affil. E.I.C.

Elected councillor for the Association was W. S. Veale, M.E.I.C.

ONTARIO

Open-Door Policy Stressed

Urging that no undue limitations be placed on engineering student registration, the Association of Professional Engineers of Ontario, in a recommendation passed at the quarterly executive council meeting of the fifteen thousand member Association, called upon the presidents of Ontario universities with engineering faculties, "to see that all possible practical steps are taken to ensure an open-door policy with respect to admittance of engineering students deemed suitable."

The resolution was tabled during a discussion on the possibility that universities might consider limiting registration in the engineering faculties due to current overcrowding, particularly in the freshman year. The Association promised its assistance "in any way possible."

It was pointed out that there were more than seven hundred first-year engineering students enrolled at the University of Toronto, with a total registration in the faculty of applied science of two thousand.

Discuss Enlargement Facilities

During the meeting delegates discussed the possibility of establishing a second university in Toronto or expanding the University of Toronto's present facilities by adding a second campus for engineering students. This would be similar in principle to the former engineering establishment at Ajax, twenty miles east of Toronto, set up by the university after World War II to cope with the increased veteran student enrolment.

Figure Increasing

It was pointed out that 70 per cent of the University of Toronto's present student enrolment is drawn from Metropolitan Toronto and that this figure will increase. Until recently it was only 50 per cent, with the remaining half coming from other parts of Ontario and Canada.

Main problem facing most Canadian universities at present is lack of adequate buildings and teaching staff.

At the meeting, it was announced that during the first nine months of 1956, one thousand three hundred and thirty-six applications for registration in the Association had been received. This compared to a 1955 figure for the same period, of one thousand three hundred and sixty-nine.

Scholarship Program Revision

The Council also announced a revision in the Association's scholarship program which would see both the University of Toronto and Queens' University each being granted $250.00 scholarships for the first, second and third year students. A loan fund has also been opened to engineering students in the first three years at both universities with amounts up to $200.00 per student. Previously the loans were made to high school graduates who were entering university.

Field Representative Appointed

An increase in membership and the expansion of engineering activities has resulted in the appointment of **Blakeley H. Goodings**, as field representative of the Association of Professional Engineers of Ontario. He will work out of the Association's headquarters in Toronto. The A.P.E.O. now has a membership of fifteen thousand registered professional engineers in the province and is the largest professional group in Canada.

In his new position, Mr. Goodings will represent the Association in its liaison with industry and members of the A.P.E.O. throughout the province.

A native of Port Colborne, Ont., Mr. Goodings is a graduate of the University of Toronto in mechanical engineering. Until recently, he served on the staff of the adjutant-general at Canadian Army H.Q., Ottawa, as a captain. He is a graduate from Army Staff College, Kingston, 1955.

Throughout his army career, he served in Ottawa, Kingston, Montreal, and Korea. He spent one year in Korea, and while there, received a citation from the South Korean Government in recognition of his administrative services with Korean troops attached to the Commonwealth forces.

B. H. Goodings

During his Army service he gained considerable experience in the organizing of engineering and administrative work.

Engineers in the News

George Glinski, of Ottawa, has begun the sixth year of lectures on electronic computations and data processing at Carleton College, Ottawa. He has also commenced a new course at McGill College, Montreal, on the application of electronic data processing for business use.

Mr. Glinski, who has long been associated with the electronic computer industry is in charge of the Canadian operations of Electro-Data Division of Burroughs, with headquarters in Ottawa.

D. G. Billings, has resigned from the engineering staff of the Canadian General Electric Co. Ltd., to join the fuel-electric generation department of the Hydro-Electric Power Commission of Ontario in Toronto.

Mr. Billings joined the General Electric organization in 1937 and latterly held the position of manager of an engineering section of the Lansdowne plant in Toronto. He has been active in Association committee work for a number of years and from 1946 to 1949 inclusive, was a member of council of the Association, representing the mechanical branch.

H. L. Hewitt, formerly with Foundation Company of Canada, York Township, and the bridge office of the Ontario Department of Highways, has joined the Department of Public Works, Ottawa, as a supervisor of the bridge section of the development engineering branch. Mr. Hewitt graduated in civil engineering from the University of Toronto in 1927.

James L. Clark, has left the employ of Ontario Hydro in Toronto, where he was with the transmission department, and has moved to San Francisco, Cal., where he has accepted a position with the power division of the Bechtel Corporation of that city.

E. W. Owen, is presently an instructor and part-time graduate student at the Rensselaer Polytechnic Intitute, Troy, N.Y.

Mr. Owen, who graduated in electrical engineering from the University of Manitoba in 1951, was previously assistant distribution engineer with the Ottawa Hydro Electric Commission.

H. W. Whitham, has joined the staff of the Provincial Institute of Mining in Haileybury, Ont.

Ivor Glazer, formerly with Babcock-Wilcox and Goldie-McCulloch Ltd., Galt, Ont., has accepted a position as project engineer in the power engineering department of The Fluor Corporation Ltd., Los Angeles, Cal.

Gordon A. Zinn, Toronto, has recently joined Franklin McArthur Associates Ltd., Downsview, Ont. Mr. Zinn, who graduated in engineering from the University of Toronto, was formerly with C. A. Meadows & Associates Ltd., of Toronto.

The first recipient of the Canadian Industrial Development Award is Col. L. F. Lyle, Toronto. The award, was made at the recent annual conference of the Council at Charlottetown, P.E.I. by the Provincial Governments' Trade and Industry Council.

Col. Lyle served with distinction in R.C.E.M.E. during World War II and in 1945 joined the Ontario Department of Planning and Development as director of the trade and industry branch. Latterly he has acted as consultant to the Hon. W. M. Nickle, Minister of the Ontario Department of Planning and Development.

During his service with the Department he has been instrumental in establishing the Provincial Governments' Trade and Industry Council, the aims and object of which are to provide inter-provincial consultation and co-operation on matters of trade and industrial development; to supply traders and manufacturers from Canada and abroad with a nation-wide provincial service in these fields; to promote greater understanding throughout Canada of the economic conditions affecting the developments of each of the provinces and all of Canada.

In the citation of the award Col. Lyle is described as a person who "has made the most significant contribution to the industrial development of Canada in the public interest".

Harris Popplewell, of Toronto, has been named as sales manager of the new industrial products division in Canada of American Biltrite Rubber Co. (Canada) Ltd. of Sherbrooke, Que. The American Biltrite Rubber Co. recently acquired controlling interest in the Boston Woven Hose and Rubber Co., of Cambridge, Mass., and its line of production is now available in Canada.

Mr. Popplewell, who has had an extensive experience in the industrial rubber goods field, will make his headquarters at 2149 Yonge St., Toronto.

Itienne L. Kenez, has moved from Toronto to Montreal and is a design engineer in the concrete section of the general engineering department of the Aluminum Company of Canada, Ltd.

Colin G. Campbell, has left the Powell River Company, of Powell River, B.C., and has joined the Transport Division of Boeing Aircraft at Renton, Wash.

D. P. Murray, of Hamilton, Ont., has accepted a position as sales engineer with American Air Filter of Canada Ltd., and is at present working in the Niagara peninsula. Mr. Murray was formerly associated with Otis Elevator Co. Ltd., in Hamilton.

W. E. Gladney, has become associated with Pigott Contruction Co. Ltd., 1250 Bay Street, Toronto, in the capacity of project engineer.

G S. Arthur, is now living in Niagara Falls, Ont., and is employed at the Welland Plant of North American Cyanamid Co. Ltd., as an industrial engineer.

Mr. Arthur obtained his engineering degree at the University of Toronto in 1951 and prior to his move was a work standards and methods analyst with Ford Motor Co. of Canada Ltd., in Windsor.

R. B. Sweet, of Canada Paper Co., Windsor Mill, Que., has been appointed mechanical superintendent. His previous position was that of assistant mill superintendent.

Michael O. Jones, has recently been transferred from the Singapore assembly plant of Ford Motor Company of Malaya to the Ford Motor Company of New Zealand and Lower Hutt, New Zealand, where he is assistant to the general manufacturing manager. Mr. Jones graduated in engineering from the University of British Columbia in 1951 and very shortly thereafter joined the Ford Motor organization in Windsor, Ont.

Dr. P. J. Sandiford, has been appointed director of operations research in the management advisory services division of Price Waterhouse and Co., Royal Bank Building, Toronto. Dr. Sandiford was formerly chairman of the operations research group in the Hydro-Electric Power Commission of Ontario in Toronto.

W. S. Allen, of Racey, MacCallum and Associates Ltd., has been transferred from the Toronto office of the company to Vancouver, B.C. where the address of Racey, MacCallum and Associates Ltd., is 742 Denman St.

Arthur C. Simpkins, has been made president of Reg. H. Steen Ltd., heating and ventilating contractors, 1119 Davenport Rd., Toronto. Mr. Simpkins, an engineering graduate of McGill University, formerly held the post of secretary-treasurer of the company.

Michael Lasko, of the Canadian Standards Association Testing Laboratories, is moving from Toronto to Winnipeg, Man., to become Winnipeg district engineer of the Laboratories.

Mr. Lasko is a native of Winnipeg and graduated in electrical engineering from the University of Manitoba in 1933. In 1941 he moved to Toronto to serve as a design engineer with the Inspection Board of the United Kingdom and Canada and later as specification engineer with Research Enterprises Ltd. He will be in charge of the new C.S.A. Testing Station at the University of Manitoba which is being established for use by the manufacturers of electrical equipment in the three prairie provinces. He will also be reponsible for all inspections in these provinces and in certain parts of the United States.

R. L. Cavanagh, who was formerly assistant director of the department of engineering and metallurgy of the Ontario Research Foundation, has accepted the position of president with the Non-Destructive Testing Corporation (Canada) Ltd., 16 Advance Road, Toronto, 18. In addition to his administrative duties, Mr. Cavanagh will act in a consulting capacity to industry on metallurgical problems.

Vincent Lautier, has recently returned to Canada and is employed as a patent examiner in the Canadian Patent Office, Ottawa, Ont.

James S. McBride, of Williams and Williams Ltd., Chester, Eng., who recently was with the company's New York office, is now residing in Neston, Cheshire, England.

He has recently attended a course of the Administrative Staff College, at Henley-on-Thames which he reports as excellent not only as a refresher but for the opportunity it afforded for the exchange of views of sixty young executives who came from all part of the world. Mr. McBride expresses the belief that Canadian companies interested in Anglo-Canadian business, will find it profitable to investigate the possibilities of the course.

H. C. Brown, is now employed by Computing Devices of Canada Ltd., Ottawa.

Alan Wilson, who was employed by The National Industrial Fuel Efficiency Service, London, Eng., has accepted a position on the engineering staff of Unilever Limited, St. Bridget's House, London, E.C. 4. Eng.

David J. Olver, has left the employ of the Canadian Comstock Co. Ltd., St. Catharines, Ont., to take a position as electrical designer with the Bechtel Corporation in the head office of its power division in San Francisco, Cal.

G. E. Bourne, of the Canadian General Electric Company Limited, has moved from the Toronto office to the Peterborough plant of the company, where he is specialist, marketing personnel development in the apparatus department.

M. E. Oattes, of the Bell Telephone Company of Canada Ltd., has been moved from North Bay, Ont., to Brantford, where he is supervising engineer.

E. N. Chorney, has recently accepted a position with American Standard Products Limited, of Windsor, Ont. He was formerly employed by the Ford Motor Company of Canada Ltd., also in Windsor.

J. K. Denver, has been appointed assistant mill superintendent, Kerr-Addison Gold Mines, at the Chesterville Property, Virginiatown, Ont. Mr. Denver, who graduated from Queen's University in 1947, was formerly mill superintendent at Macassa Mines Ltd., Kirkland Lake, Ont.

Barry K. Laramy, has recently joined Johnson & Higgins, (Canada) Ltd., of 44 Victoria Street, Toronto.

M. Z. Cerps, is employed by A. D. Margison and Associates Ltd., 30 Eglinton Avenue East, Toronto, Ont.

Andrew J. Elder, has been appointed to the position of load tap changer engineer with Packard Electric Company of St. Catharines, Ont. He was formerly in the power transformer section of Canadian General Electric Company Limited, at Guelph, Ont.

Bernard L. Kellam, of John Labatt Limited, has been transferred from London, Ont., to Shea's Winnipeg Brewery Ltd., 137 Colony Street, Winnipeg, Man.

Dr. Gordon E. Willey, of Welland, Ont., has been appointed a vice-president of the Electro-Metallurgical Company, a division of Union Carbide Canada Ltd.

Dr. Willey graduated from McMaster University in mathematics and physics in 1936, subsequently obtaining his master's degree in 1938 and a doctorate in physical chemistry and metallurgy in 1940 from the University of Toronto.

Prior to joining the Electromet organization in 1954, Dr. Willey spent five years with the Ontario Research Foundation and ten years in industry, eight of which were spent in positions of increasing responsibility with a Canadian major steel producer. Since joining Electromet he has been responsible for ferro-alloy sales and technical service to Canadian steel producers and has carried out investigations on new and special products in which the company is interested.

Donald J. MacIntyre, of Streetsville, Ont., has been appointed a vice-president of Electro-Metallurgical Company, a division of Union Carbide Ltd. A 1935 graduate, in electrical engineering of the University of Toronto, he joined the Electromet organization at that time.

After being in charge of works engineering, he was appointed general superintendent in 1954, having direct responsibility for all operations at the Welland and Beauharnois plants and the quarries at Killarney, Ont., and Melockeville, Que. His experience includes maintenance, construction, industrial relations and production. He has been actively concerned with the installation and construction program which has taken place almost continuously at the Electromet plants during the past fifteen years.

John H. Bradbury, formerly assistant chief metallurgist with John Inglis Co. Ltd., in Toronto is now metallurgist of the Elliott Company, Jeannette, Pa.

Donald E. G. Schmitt, has been transferred to Noranda Mines Limited, Noranda, Que., where he is assistant manager. Mr. Schmitt was previouly at the Pamour Porcupine Mine.

BRITISH COLUMBIA

Engineers in the News

John Guthrie, of the Alaska Pine and Cellulose Co. has been appointed resident manager of the chemical cellulose mill at Port Alice, B.C. Mr. Guthrie had held a similar position at the Woodfibre Chemical Cellulose Mill.

R. H. Richmond, formerly resident manager of the Chemical Cellulose Mill at Port Alice, will go to the large Rayonier Mill at Port Angeles, Washington, as assistant resident manager.

W. A. Williamson, is now general manager of Riley's Vancouver Ltd. Mr. Williamson had been general manager of Electric Panel Ltd. in Vancouver until recently.

D. W. Thomson, has been elected president of the American Society of Heating and Air Conditioning Engineers, B.C. Chapter, for the 1956-57 season.

R. A. Fisk, has been appointed district engineer for Canadian National Railways at Edmonton. He has been serving as assistant engineer, maintenance of way department, at Winnipeg since 1954. Mr. Fisk, who first joined the C.N.R. in 1941 before enlisting with the R.C.A.F., is a 1950 civil graduate of U.B.C.

W. C. Reuger, formerly with John Laing and Son (Canada) Ltd., is now on the staff of Laminated Structures Ltd.

W. Suboch, a 1955 chemical graduate of U.B.C., recently resigned from the Consolidated Mining and Smelting Company at Trail, B.C. and is now taking part-time graduate courses at the University of Toronto.

W. E. Kenny, of the B.C. Power Commission has been promoted from maintenance engineer to operations control engineer and will move his residence from Nanaimo to Victoria.

D. A. MacIntosh, a 1955 civil graduate of U.B.C. and a lieutenant in the R.C.S.M.E. has been posted from Chilliwack to Germany for a two year period.

H. R. Cameron, of the engineering department, Richmond municipality, was appointed municipal engineer of Richmond on October 1.

G. F. Smith, a 1954 electrical graduate of U.B.C., has left a position with the Canadian Broadcasting Corporation in Montreal and is now a distribution designer for the B.C. Electric in Vancouver.

W. O. Codrington, of the Aluminum Company of Canada, has been transferred from Kemano to Montreal.

D. C. MacVicar, has established the rental equipment utilization service at Merritt, B.C. Until recently Mr. MacVicar has been district engineer with the Department of Highways at Merritt.

D. S. Nielsen, formerly with Phillips, Barratt & Partners, is now employed by Alaska Pine & Cellulose Limited in Vancouver.

B. Davis, is now in Montreal as a designer with the Paper Machinery Division of Dominion Engineering Works Ltd. He has been with the Powell River Co.

O. T. Foss, has left Swanson Wright & Co. and joined Westminster Iron Works as a design engineer.

W. V. Rudd, has accepted a position with B.C. Engineering Company Limited. Mr. Rudd had been with H. A. Simon Limited.

Walter Maslanka, has accepted a position with the Powell River Company at Powell River, B.C. Mr. Maslanka recently resigned from the Finning Tractor Equipment Company in Vancouver.

T. G. Lynch is now with Wescoast Transmission Co. as communications engineer. Mr. Lynch had been with Canadian General Electric and recently, Crossman Machinery Limited in Vancouver.

S. D. Cavers, formerly research engineer with the B.C. Research Council, is now associate professor of chemical engineering at the University of British Columbia.

E. Marzocco, who is superintendent of production, coastal region, with the B.C. Power Commission has been transferred from Victoria to Nanaimo.

J. E. Holdsworth, has accepted a position as project engineer with Canadian Schenley Ltd., at their Valleyfield plant, Quebec. It is expected that this position will lead to that of plant engineer at the company's North Vancouver operations. Mr. Holdsworth had been with Canadian Forest Products at Port Mellon. for the past several years.

D. S. Rae, is with the engineering department of MacMillan and Bloedel (Alberni) Ltd., Pulp and Paper Division, Port Alberni, B.C. He had been with Canadian Forest Products at Port Mellon.

J. C. Cant, previously with Dawson, Wade and Macco at Campbell River, is now with the North-West Telephone Co. in the Manning Park area.

W. A. G. Bell, has been transferred from plant engineer, B.C. Forest Products, Youbou, B.C. to assistant project engineer, B.C. Forest Products, Vancouver.

S. C. Maplethorp, previously with Canadian Western Pipe Mills at Port Moody, B.C., is now with Timber Preservers Ltd., in New Westminster.

J. H. Irvine has retired. Mr. Irvine, a life member of the Association, has been in engineering for over 42 years and is well known throughout British Columbia. His last position was that of project engineer with Defence Construction (1951) Ltd. at Vedder Crossing. Mr. Irvine plans to move to Vancouver shortly.

George Wallbank, is now in Oakland, California with Kaiser Engineering. He had been employed by Letson & Burpee Ltd. in Vancouver.

B. E. Valde, has been appointed chief engineer of the Pacific Great Eastern Railways and is located in Vancouver. He had been at Squamish as engineer of maintenance.

J. H. Parliament, of the Granby Consolidated Mining, Smelting & Power Co. Ltd., has been named manager of Phoenix Copper Company Limited, Grand Forks, B.C.

J. M. Stitt, previously design engineer with Granduc Mines Ltd., is also on the staff of the Phoenix Copper Company.

THIRTY-FIVE YEARS AGO

Comment on the Journal of December 1921

So far, in these mirrorings of the *Journal's* past, only one paper of a truly historical character has been found, but the issue for December, 1921, had two. One was an account of the development of the Montreal water works, by the late A. E. Doucet, M.E.I.C., who was then the chairman of the Montreal Water Board, and the other was "Engineering Theory and Practice at the End of the Seventeenth Century", by the late D. S. Ellis, M.E.I.C., of Queen's University.

Prior to 1800, Montreal got its water supply from private wells, from the numerous small streams which drained into the St. Lawrence river and from the river itself. Peddlers also sold water by the "bucket" from puncheons on carts hauled through the streets. Montrealers were paving from about four dollars to as much as sixteen dollars per thousand gallons for their water, prices which seem appallingly high today.

At about this time, the city, with a population of approximately 9,000, provided a limited number of public wells and pumps. The "Companv of Proprietors of the Montreal Water Works" was incorporated in 1800 and received a fifty-year exclusive franchise. It got its supply from a spring on the western flank of Mount Royal and brought it to a reservoir in the town, along the river front, through an unreliable line of wood pipe. The company, in financial difficulties, sold out to another in 1819.

This second company got its supply from the St. Lawrence through new cast iron pipe, some of which was still in service the last this writer knew. By 1843 it had fourteen miles of pipe and was pumping 90,000 gallons a day. The service was poor and the quantity inadequate, which led to the purchase of the system by the city in 1846.

Following the great fire of 1852, the city engaged T. C. Keefer, to design a new system. Mr. Keefer recommended a four and a half mile "aqueduct" from the St. Lawrence above the Lachine Rapids to the Little St. Pierre river to develop about three hundred horse power for pumping. This canal also served as an intake.

This project was carried out and its subsequent history is a record of successive enlargements and modifications. Finally, hydraulic power was abandoned in favour of electricity and since then the growth of Montreal's water works has followed the usual pattern — a new intake, additional pumps, enlargements of the filtration plant and reservoirs, more feeder lines and the like.

Engineering in 1739

Dean Ellis had picked up an old book *"La Science des Ingénieurs dans la Conduite des Travaux de Fortifications et d'Architecture Civil* written by Belidor, a professor at the Royal Artillery School in Paris and published there in 1739. It appears to have been the civil engineer's handbook of the time, for the contents included sections on the mechanics of materials, engineering design, the materials of engineering, earth pressure and retaining walls, foundations, cost keeping, contracts and other subjects.

On reading Dean Ellis' abstracts from and comments on this book one will readily agree with him: ". . . One can conclude that except for mechanical improvements in the way of tools and transportation, there has not been much change in engineering since the time of this old book. And if we were to compare the modern engineer with the engineer of 1700, we would find them very similar in their ideas and methods."

Belidor's theory of beams was much like ours, but he had no conception of the neutral plane and therefore thought that all the fibres of the cross section were in tension, but he realized that the stress in these fibres varied, those at the bottom being the most highly stressed. His experiments on beams taught him that a beam with fixed ends would carry more than one with ends free; by a process partly guesswork and partly induction he concluded that the ratio of the strength of such beams was as two to one. Columns he didn't investigate; they were always of masonry then.

His theory of earth pressure was really our sliding prism theorv. It gave the point of application of the resultant earth pressure as 38.5 per cent of the height of a wall just within the middle third of the base.

Regarding foundations, Dean Ellis had this to say: " . . . Our more advanced methods of calculation and the results of our (analyses) of materials give us an . . . advantage in regard to superstructures, yet when we . . . consider foundations we are not much better off than (the old engineers) were." This was true in 1921, but the case is not so hopeless today.

Those who have the idea that cost keeping is a modern frill should read Belidor's precise instructions on how to keep records of costs which would not only apply to work in progress, but would be good enough to use in estimating.

Most large work was done by contract. Belidor quotes de Vauban, the great French engineer on the subject of contractors: "When we can find contractors solvent and who have the capacity to handle a general contract, it is best to deal with them. But it is rare indeed to find heads steady enough to carry a burden so heavv as a general contract . . . It should be noted that . . . it is well to go through all the forms, but not always to award (the contract) to the lowest bidder. For it is necessary to see if the (bidder has) the intelligence to carry out the contract."

Professional Matters

The formation of two new branches was announced in this *Journal*, one in London and the other in Lethbridge, bringing the total number of branches to twenty-two, not a bad record for only four years. The rest of the branches were holding meetings and listening to papers, but seem to have been in thoroughly peaceful frames of mind. The Calgary Branch, however, was scolded by a member of the press because of the "absolute inabilitv" of most engineers to write anything except "in technical jargon quite incomprehensible to the public." Everv engineer should be able to write clear and concise English, but to condemn all engineers was too drastic.

Nothing had been heard of unemployment among engineers since September, so perhaps it is fair to assume that the depression which had affected them was disappearing. At any rate, the *Journal* closed its fourth volume with this number in a state of apparent content, though, of course, still convinced that engineers' salaries should be raised and that somehow their professional status ought to be improved, two matters which still engage a lot of attention.

R. DeL. F.

OBITUARIES

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Dr. Lionel Clare Charlesworth, M.E.I.C., former deputy minister of public works, railways and telephones and early member of the Alberta civil service, died in Edmonton on September 11, 1956.

Born in Windsor, Ont., on November 17, 1873, he attended Wellesley Public School, the Jarvis Street Collegiate Institute, Toronto, and graduated in 1893 from the School of Practical Science, the engineering branch of the University of Toronto.

Engaged for a time in engineering work at Welland, Collingwood and Rat Portage, Dr. Charlesworth later became an Ontario Land Surveyor in 1898, and a Dominion Land Surveyor in 1903. From 1899 to 1903 he served as Mining Lands Agent of the Ontario government at Kenora.

In 1903 he was appointed district surveyor at Medicine Hat for the government of the North West Territories, and, on the formation of the provinces of Saskatchewan and Alberta, became director of surveys for the government of Alberta.

Appointed deputy minister of public works in 1915, Dr. Charlesworth held this position and also that of deputy minister of railways and telephones, until 1921. From that time until his retirement from active work in 1945, his life was devoted to the highly important work of irrigation. A very live issue in southern Alberta during the series of dry years that commenced in 1917, Dr. Charlesworth played an active part in the preparation of the Irrigation District Act, passed by the legislature, to provide for development of that kind.

Later, when the provincial government became pressed for financial assistance for the construction of irrigation projects and proceeded to guarantee the bonds of certain districts, an irrigation council was appointed. This was a government body exercising certain jurisdiction over all irrigation districts. Dr. Charlesworth became chairman of the Irrigation Council. He also assumed the duties of official trustee of the Lethbridge Northern Irrigation District, which organization had been advanced large amounts of money by the government. During the following years a number of other projects got underway.

countered by settlers on irrigated lands, in meeting the whole cost of construction of the irrigation works, a commission was

In 1929, as a result of difficulties en-

set up to study the situation. Certain recommendations of that commission, in which Dr. Charlesworth was a member, were later put into effect.

In 1930 he accepted an appointment as director of Water Resources, retaining at the same time the post of chairman of the Irrigation Council and official

trustee of the Lethbridge Northern Irrigation District.

Following the proposal of settlers in the eastern block of the C.P.R. Irrigation District to take over the project from the railway company, in 1933, Dr. Charlesworth was requested to report on the matter to the government and was involved in the ensuing negotiations. The result of this was the passing of an act in 1935 establishing the Eastern Irrigation District.

He continued to serve as chairman of the Irrigation Council and director of Water Resources until his superannuation in 1939. From that time until his retirement in 1945 he devoted himself to the duties of general manager of the Eastern Irrigation District, with headquarters in Brooks.

Awarded an honorary degree of doctor of laws by the University of Alberta in 1950 he also received a senior citizen's certificate from the Province of Alberta, on the occasion of the province's golden jubilee in 1955.

In earlier years Dr. Charlesworth was one of those who took a strong interest in the formation and development of the Iron Ring ritual in Canada.

A past president and Life member of the Alberta Land Surveyors Association, he was also a past president of the Professional Engineers Association of Alberta.

Dr. Charlesworth joined the Institute in 1918 as a Member and gained Life Membership in 1946.

Colonel H. M. Bailey, M.E.I.C., city engineer at Yorkton, Sask., for more than twenty years, and veteran of two world wars, died September 8, 1956 at Yorkton.

A native of Eastern Canada, he was born at St. Mary's, Ont., on January 20, 1889, and educated there. His early engineering experience was gained with the Kirkton Telephone Company, St. Mary's, Ont., Stromberg-Carlson Telephone Company, Huron County, and the Tuckersmith Telephone Company, at Seaforth, Ont.

Col. Bailey moved to Saskatchewan in 1911, six years after its formation as a province. His first project was the building of the Davis Telephone System. With Sask. Government Telephone the following year he was responsible for the construction of long distance lines in the north of the province. In 1913 and until the outbreak of World War I, he was superintendent of the electrical department for the town of Melfort, Sask.

Overseas from 1914 to 1919, on command to the Canadian Corps Signals, he did a great deal of work in construcing underground cable systems, in connection with the 172 Tunnelling Company which was in charge of the construction of Vimy fortifications and with the Fourth Army Troop Company engaged in constructing a hydraulic water supply in North Flanders.

Once back in Canada he returned to Melfort to resume his duties as superintendent of the electrical department for the town of Melfort. He became superintendent of public works and utilities in 1921 and in 1922 he relinquished these duties to accept the appointment of town engineer at Melville, Sask. Seven years later, in 1936 he began his long career as city engineer at Yorkton, which was in 1939 interrupted by the onslaught of World War II. Colonel Bailey again offered his services to the Allied cause and left for overseas duty early in 1940. He served with the Seventh Corps which included the First Canadian Division. In 1946 he returned to carry on the work of city engineer at Yorkton.

Colonel Bailey held memberships in the American Public Works Association, the American Waterworks Association and the Canadian Institute of Sewage and Sanitation, as well as the Association of Professional Engineers of Saskatchewan.

Colonel Bailey joined the Institute as an Associate Member in 1922 and was transferred to Member in 1940.

Henry Cormack Grant Ligertwood, M.E.I.C., for many years associated with the Winnipeg Electric Company, died on September 19, 1956, at Winnipeg.

A native of Aberdeen, Scotland, where he was born on September 23, 1896, he had his high school education at Kelvin Technical High School, Winnipeg, and studied engineering at the University of Manitoba from which he graduated in 1924 with the degree B.Sc. in civil engineering. After considerable student engineering experience with the Canadian National Railway and the Manitoba Power Company during the summer months, he accepted a position with the C.N.R. on graduation, as instrumentman and inspector in the bridge engineer's office. Two years later in 1926 he transferred his services to the Manitoba Power Company and Northwestern Power Company also in Winnipeg and worked as an office engineer for a period of five years. In the early thirties he found employment at Regina, Sask., as a sales engineer for Canada Ingot Iron Company. His affiliations with the Winnipeg Electric Company at Winnipeg began in 1937. At that time he was engineer in charge of the construction of transmission lines. In 1939 he assumed the duties of resident engineer in charge of concrete repair work and became construction engineer with the company in 1946. He was named assistant to the manager of the surveys and construction division of the firm in 1953.

Mr. Ligertwood was a member of the Association of Professional Engineers of Manitoba. He joined the Institute as a Member in 1947.

Personals

News of the Personal Activities of Members of the Institute.

Air Commodore Sir Frank Whittle, Hon. M.E.I.C., has been awarded the coveted Franklin Medal, highest honor of the Franklin Institute of the State of Pennsylvania, presented annually to a worker in physical science or technology without regard to country, at the Institute's annual Medal Day ceremonies, held October 17, 1956 at Philadelphia.

Sir Frank Whittle has been mechanical engineering specialist for the Royal Dutch Shell Group since 1953. He is being recognized for his vision in realizing the limitations of the conventional propellor type of power plant for high speed aircraft, his conception of the combination of the principles of the gas turbine and rocket, and his pioneering development of the turbo-jet aircraft engine which has revolutionized high speed flight.

Born in Coventry, Eng., in 1907, Frank Whittle entered the R.A.F. as an aircraft apprentice in 1923. Later, while qualifying as flying instructor he conceived the idea of the turbo-jet engine and in 1930 filed application for a patent. In 1936 Power Jets Limited was formed for the manufacture of an experimental jet propulsion gas turbine to be built according to his design. Later he was appointed to the Special Duty List to proceed with jet engine design, during which period of his career British Thomson-Houston Company used his design to build an experimental engine. Whittle subsequently was put in charge of the design of Power Jets' engines.

In 1944, holding the rank of Temporary Air Commodore, he was awarded the C.B.E. (Commander of the Order of the British Empire). Also at that time the government company, called Power Jets (Research and Development) Limited, was formed to purchase the assets of Power Jets Limited. Whittle remained with the company meanwhile but in 1946 resigned and became technical advisor on engine design and production, to the Controller of Supplies (Air) of the Ministry of Supply. In 1947 he was awarded the C.B. (Companion of the Order of the Bath). Forced to retire from the R.A.F. in 1948, due to ill health, he was also knighted that year. He held the appointment of Honorary Technical Adviser to the British Overseas Airways Corporation, 1948 to 1952.

He has received many honorary degrees as well as a number of awards internationally recognized.

Frederick Krug, M.E.I.C., president of the International Power Company, Limited, Montreal was among those who received a citation at the recent convocation of the Cooper Union for the Advancement of Science and Art.

The convocation, held in New York, October 6, 8, 9, 1956, inaugurates its Centennial Program. Panels of outstanding educationalists, engineers, scientists, and businessmen discussed the topic, "Tapping Hidden Resources for America's Future Engineers and Leaders."

The program included the presentation of citations to twenty-five distinguished alumni who were selected by their peers as the recipients of the first alumni citations the Cooper Union has awarded.

D. B. Armstrong, M.E.I.C., was appointed during this year an Engineering Institute representative on the executive committee of the Column Research Council. Mr. Armstrong is chief engineer of the eastern division of Dominion Bridge Company Limited, Montreal.

The Column Research Council is a project of the American Society of Civil Engineers, founded to sponsor and carry on research in civil engineering and particularly in the theories of columns and other compression members. It is a technical board with about fifty members representing technical societies, universities, trade groups and industry.

Engineering Institute representatives are P. L. Pratley, M.E.I.C., consulting engineer, of Montreal, and John N. Finlayson, M.E.I.C., of Vancouver, former dean of the faculty of Applied Science of the University of British Columbia.

W. A. Dawson, M.E.I.C., was re-elected national president and chairman of the board of directors of the alumni association of Queen's University for a second term, at the recent annual meeting.

Today Queen's University boasts some 16,000 graduates and forty-two active alumni branches established across Canada and the United States.

Mr. Dawson is associated with The A. R. Williams Machinery Company Limited as their representative sales engineer in Hamilton and the Niagara Peninsula.

He is a past chairman of the Hamilton Branch of the Institute.

F. W. Bradshaw, M.E.I.C., has been appointed executive assistant to the president of the Consolidated Paper Corporation Limited.

Associated with the pulp and paper industry since 1921 Mr. Bradshaw joined the Corporation in 1934 and has served as chief engineer, manager of the Laurentide Division and manager of manufacturing.

He is a past-chairman of the St. Maurice Valley Branch of the Institute.

William A. Bentley, M.E.I.C., former contract engineer with Dominion Bridge Company Limited has been named sales manager of the Ontario division of the firm.

Born in Toronto and educated at Central Technical School and University of Toronto, he joined the staff of McGregor and McIntyre Works Limited at Toronto in 1927. After this company was acquired by Dominion Bridge Company Limited in 1928, he served in the drawing office, short order department and the design office.

In World War II he was resident engineer at the Sorauren Avenue munitions plant. Since 1946 he has been sales engineer in charge of mining sales. From 1951 to 1952, he was on loan to the Department of Defence Production. In 1955 Mr. Bentley was appointed contract engineer.

F. Gordon Murphy, M.E.I.C., general manager of the electric products department of Linde Air Products Company, division of Union Carbide Canada Limited in Toronto has recently been named general sales manager of industrial products with the firm.

A 1940 graduate of the University of Toronto in mechanical engineering Mr. Murphy has been on the staff of Linde Air Products and its predecessor for the past ten year, holding various positions in the Ontario and Quebec areas.

F. M. Pratt, M.E.I.C., formerly of the Anglo Newfoundland Development Company Limited, Grand Falls, Newfoundland, retired from his position as chief engineer in May 1956, after twenty-three years service with the firm. Now, resident in his native Ottawa, Mr. Pratt intends to engage in work as an engineering consultant in that city.

Mr. Pratt spent a number of years with the E. B. Eddy Company Limited in Ontario, as chief engineer, prior to 1933 when he joined the Newfoundland firm. A graduate of the University of Toronto, he spent three years overseas with the Canadian Engineers, early in his career, during World War I.

• PERSONALS

E. de Haas, M.E.I.C., **W. E. Cooper**, M.E.I.C., of the Hydro Electric Power Commission of Ontario are lecturers in a program comprising a course in nuclear energy, which began in Toronto this fall.

The two-hundred and fifty participants, mostly professional engineers, are members of the Ontario Hydro Unit of the Canadian Federation of Engineers and Scientists.

Responsible for the first five lectures, Mr. de Haas addressed the group on nuclear physics. In the five remaining talks, Mr. Cooper will deal with reactor technology.

Walter G. Seline, M.E.I.C., of Trois-Rivieres, Que., has been appointed manager of the Quebec manufacturing division of the Packard Electric Company Limited of St. Catharines, Ont., at Trois-Rivieres.

Born in Finland and educated in Winnipeg, Mr. Seline graduated from the University of Manitoba in electrical engineering in 1945. On staff at the University the following year, Mr. Seline joined the Shawinigan Water and Power Company at Shawinigan Falls, Que., in

W. G. Seline, M.E.I.C.

1947. From 1948 to the present time he was design engineer in the electrical repair department of the company at Trois-Rivieres.

Mr. Seline is a member of the Corporation of Professional Engineers of the Province of Quebec, and the American Institute of Electrical Engineers.

COURTAULDS (CANADA) LIMITED

Drummond Giles, M.E.I.C., president and general manager of Courtaulds (Canada) Limited, held office in the Institute in 1950 as a vice-president representing the province of Ontario. In 1947 and 1948 he represented the Cornwall Branch on the Council of the Institute.

Mr. Giles was appointed president and general manager of Courtaulds in 1949, having served the company since 1944. He resigned from the position of special assistant to the co-ordinator of production in the Department of Munitions and Supply, Ottawa, at that time.

Jack Morris, M.E.I.C., manager of the plant in Cornwall, is at present active in the affairs of the Institute, serving as chairman of the Branch in that city. He also held office in 1955.

Originally from England, Mr. Morris came to Canada in 1933, and joined Courtaulds in 1945 after periods of duty with the Princess Louise Fusiliers (MG) as a general staff officer and with N.D.H.Q. as assistant to the director of chemical warfare.

George van Beek, M.E.I.C., has been appointed chief plant engineer with Courtaulds (Canada) Limited at Cornwall, Ont.

Mr. van Beek joined Courtaulds in 1955 as chief services engineer, following a six-year appointment with the Howard Smith Paper Mills Limited at Cornwall as assistant chief power engineer.

A native of Holland, Mr. van Beek came to Canada in 1924 and received his education in the public and high schools of Chatham, Ont. In 1940 he enlisted in the Royal Canadian Navy, engine room branch, and served for five years. On his discharge he entered Dalhousie University and obtained a B.Sc. degree in 1948. The following year he was awarded a B.Eng. degree at Nova Scotia Technical College.

P. H. Nasmyth, M.E.I.C., of Courtaulds (Canada) Limited, Cornwall, Ont., has resigned from his position as chief plant engineer in order to return to his former home in Western Canada. Associated with the textile organization for seven years, he served as plant engineer for four years.

Mr. Nasmyth graduated from the University of British Columbia in 1942 with a B.A.Sc. degree in mechanical engineering. During the next three years he saw extensive service overseas with the R.C.E.M.E. At war's end, returning to Canada, he accepted employment with Robert A. Rankin and Company Limited, consulting industrial engineers, as a project engineer in charge of Courtaulds plant extension in Cornwall.

The Courtaulds engineering staff at Cornwall consists very largely of members of the Institute. Some of these members are as follows:

L. H. Snelgrove, M.E.I.C., planning engineer for the organization, joined the staff in 1946, following graduation from McGill University with a B.Eng. in electrical engineering in 1946.

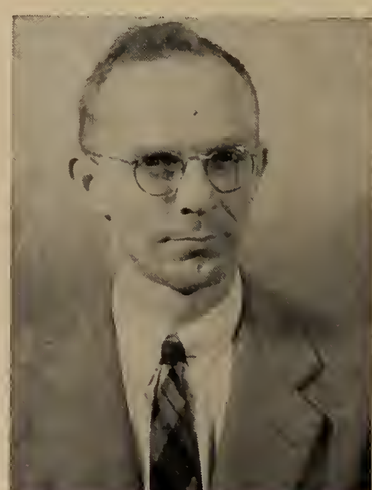
M. H. D. Broadbent, M.E.I.C., a native of England, who was awarded an A.M.I. Mech. Eng. in 1952, joined Courtaulds in 1955. He serves as an assistant plant engineer.

J. Haworth, JR.E.I.C., design engineeer on the engineering headquarters staff of Courtaulds for the past three years, is a Queen's University graduate, class of 1947, in mechanical engineering.

Donald C. McEwan, JR.E.I.C., assistant plant engineer, originally became associated with the organization in England in 1952. He came to Canada as a member of the plant engineering staff in 1953. A 1949 graduate of Edinburgh University in mechanical engineering he has previously had four years experience as a design development engineer in England.

Graham B. Wray, M.E.I.C., a design engineer on the engineering headquarters staff of Courtaulds (Canada) Limited, joined the company in 1955. A native of England, Mr. Wray received his G.M.I. mech. eng. from the Royal Technical College at Glasgow, in 1952.

James D. Buchanan, M.E.I.C., assistant plant engineer with Courtaulds for the last year is a graduate of Glasgow University, class of 1947. He has held supervisory positions in several well-known engineering firms in England.



P. H. Nasmyth, M.E.I.C.

G. van Beek, M.E.I.C.

• PERSONALS

John H. Fox, M.E.I.C., has been appointed vice-president in charge of sales with Honeywell Controls Limited, formerly known as Minneapolis-Honeywell Regulator Company Limited, Toronto.

Mr. Fox was named general sales manager, responsible for the sales activities of all divisions of the company's twelve Canadian offices in 1953.

He has been associated with the organization since 1935, working in various sales engineering and sales management capacities.

C. V. F. Weir, M.E.I.C., of Ottawa, has recently accepted an appointment with the Department of Justice as senior assistant to the chief engineer, Penitentiaries Branch.

A graduate from the University of Alberta and the University of Toronto, he worked for a number of years before the war, with the City Power plant, Edmonton, on design work and as field engineer. Returning to Western Canada in 1945, after lengthy military service, he rejoined the power plant as an electrical engineer. He was transferred to the position of assistant superintendent of the Edmonton Transportation System that year and in 1946 became superintendent of the Calgary Transit System.

Taking up residence in Ottawa in 1949, he has since then held engineering positions guiding development in the National Parks and Historic Sites of Canada and many federal projects in the Yukon and Northwest Territories. In carrying these out he has been chief of the engineering and construction service of the lands and development services branch of the old Department of Resources and Development, which later became the engineering and architectural division of the new Department of Northern Affairs and National Resources.

Lenox T. Lane, M.E.I.C., president of Lane and Lane Associates Limited, consulting engineers in Sudbury, Ont., is the 1956-57 chairman of the Sudbury Branch of the Institute.

L. T. Lane, M.E.I.C.

J. A. Drain, M.E.I.C.

A native of that city, Mr. Lane has been engaged in the consulting engineering field with his father, F. C. Lane, O.L.S., since 1945. Prior to that he served for two and a half years with the Royal Canadian Engineers following graduation in 1943 from Queen's University. Mr. Lane was awarded a civil engineering degree.

He is a member of the Association of Professional Engineers of the Province of Ontario and of the Association of Ontario Land Surveyors.

James A. Drain, M.E.I.C., has been named to the newly created post of vice-president and general manager of the mining and construction division of Joy Manufacturing Company. He will be responsible for research, engineering, manufacturing and sales of mining and construction division products.

Mr. Drain first joined the Sullivan Machinery Company, which was a predecessor of the Joy Manufacturing Company, in 1941, as assistant to the president. He served as vice-president in charge of engineering for Joy until 1948 when he became vice-president of the Canadian subsidiary, at Galt, Ont.

He is a graduate of the Massachusetts Institute of Technology and holds membership in the American Institute of Mining and Metallurgical Engineers and the Canadian Institute of Mining and Metallurgy.

H. L. Smith, M.E.I.C.

P. Laporta, M.E.I.C.

Philip Laporta, M.E.I.C., has been appointed vice-president of the J. Serrentino Construction Company Limited, Montreal.

Before joining his present firm Mr. Laporta acquired experience in management, design and supervisory functions related to the construction industry while in the employ of the City of Montreal for a period of six years, and at Canadian Vickers Limited for three years.

He graduated from McGill University in 1946.

H. Leslie Smith, M.E.I.C., has accepted a partnership in the firm of H. H. Minshall and Associates Limited, consulting engineers, at Vancouver.

Mr. Smith recently returned from San Francisco where he was employed with the power division of Bechtel Corporation as assistant project engineer on the design of the Pittsburgh and Morro Bay steam plants for Pacific Gas and Electric and the Fort Lauderdale plant extension for Florida Power and Light. While there he was also engaged on water-power development studies including those on Snake River. Prior to moving to San Francisco, Mr. Smith was employed as senior engineer with Canadian Bechtel on the Trans Mountain Oil Pipeline, as hydraulic design engineer with the B.C. Electric Company Limited on the Ruskin and Wahleach developments, and as design engineer with Western Bridge and Steel Fabricators Limited.

He graduated from the University of British Columbia in civil engineering and took post-graduate studies in soil mechanics, theory of thin shells, and vibrations of structures at the University of California.

Dan Scouler, Jr., M.E.I.C., is assistant chief engineer of the Dominion Steel and Coal Corporation, Limited, with headquarters in Montreal.

A native of Halifax, and graduate of the Nova Scotia Technical College, class

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• PERSONALS

of 1948, Mr. Scouler was first employed with Dominion Bridge as a student and also served with the R.C.N.V.R.

He joined Halifax Shipyards Limited on graduation as a maintenance supervisor, and in 1952 was appointed plant engineer for both the Halifax and Dartmouth plants & Halifax Shipyards Ltd.

Karl Bulins, M.E.I.C., has received the appointment of senior design engineer with Bowater's Newfoundland Pulp and Paper Mills at Corner Brook, Nfld.

Previously concerned with the mechanical design of most of the major development in the firm during his first eight years at Corner Brook, Mr. Bulins came originally from Latvia, where he graduated as an engineering technologist from the University of Latvia in 1931. From then until 1944 he held various posts in Latvian industry, ending as area manager for the Latvian Electric Corporation. At this point in his career, ordered by the Germans, he was obliged to go to Germany to work for the Prussian Electricity Company in Hanover. Released in 1945 he accepted appointments with A.M.G.O.T. and U.N.N.R.A. prior to taking up his present work.

Henry B. Carter, M.E.I.C., of Corner Brook, Nfld., has been named senior electrical engineer with Bowater's Newfoundland Pulp and Paper Mills, following service with the company dating to 1946. He will also serve as consultant to the Bowater Power Company Limited.

At that time a recent graduate of McGill University, with a B.Eng. degree in electrical engineering, he worked as an electrical draughtsman. In 1954 he was promoted to the duties of electrical engineer.

He is president-elect of the Association of Professional Engineers of Newfoundland.

F. H. Clark, M.E.I.C., since 1954 construction engineer with Bowater's New foundland Pulp and Paper Mills, has been appointed paper mill engineer, acting as engineering assistant to the mill manager, Corner Brook, Nfld.

A graduate of the Nova Scotia Technical College, class of 1943, he holds a B.Eng. degree in mechanical engineering. Joining the R.C.A.F on receiving these qualifications, he has also been associated with Construction Equipment Limited in Toronto, and Canadair Limited, Montreal. In 1948 he returned to his native Newfoundland, to take up work with Bowater's.

Goerge P. Hobbs, M.E.I.C., chief engineer with Bowater's Newfoundland Pulp and Paper Mills Limited, Corner Brook, Newfoundland, has received the appointment of mill manager

A native of Newfoundland, Mr. Hobbs has been with his present firm since 1946, joining as assistant chief engineer, and remaining in the position until two years ago. Concerned with electrical problems, speed-up and expansion of parts of the mill, and the complete renovation of the electrical and power systems at Corner Brook and Deer Lake, he will now have the duty of operating the equipment and process for the design of which he was as chief engineer, responsible.

A McGill University graduate, class of 1940, Mr. Hobbs had varied engineering experience before taking up his work with Bowater's. In the electrical design field for the explosives factories of Defence Industries Limited, during the war, he also served as electrical superintendent of one of the plants at Nobel, Ont. At war's end, transferring his interest to the Pulp and Paper industry, he joined the Marathon Corporation. After designing the firm's new pulp mill at Marathon, Ont., and getting it into operation, he continued to work for the company as electrical engineer until he moved to Corner Brook.

Norman H. Ursel, M.E.I.C., formerly associate editor of the Engineering Digest, has joined the firm of Francis R. Joubin, consulting geologist, at Toronto. Mr. Ursel's duties within the firm will call for the correlation of the various phases in the exploration and development of mineral resources, with particular emphasis on minerals important to the applications of nuclear energy in industry.

Mr. Ursel graduated from the University of Saskatchewan in ceramic engineering in 1949 and was employed by the Department of Highways of Saskatchewan. Later he worked for the Ontario Department of Highways and the engineering division of Ferro Enamels (Canada) Limited at Oakville.

Mr. Ursel was for a time associated with the editorial staff of the Engineering Journal in 1953 and 1954.

W. Hobson, M.E.I.C., of Montreal, formerly district manager with D. M. Fraser Limited, now heads the firm of W. Hobson and Associates. The organization is one of engineering sales representation for the Esterline-Angus Company Limited, in the province of Quebec and Eastern Ontario.

Mr. Hobson graduated in electrical engineering at McGill University in 1943, and then served with the R.C.N.V.R. He was later associated with the Northern Electric Company Limited, Montreal, in 1948, prior to joining the firm of D. M. Fraser Limited.

Cornelis Boot, M.E.I.C., director of the Spero Engineering and Trading Company Inc., Amsterdam, Holland, a firm of importers and distributors for American and English firms in the metallizing field and packaging industry, is now associated with the establishment of the organization in Toronto, for European representation.

C. Boot, M.E.I.C.

Mr. Boot joined the company in Holland in 1946, after twelve years graduate experience in various engineering fields. These include periods spent with the Acoustical Laboratories of the Dutch Institution of Sound at Delft; with N. V. Philips in commercial technical work for road and airport illumination; eight years with Royal Dutch Airlines in general supervision of the radio and electrical department and training of personnel; and three years with the Provincial Power Supply Company of North Holland in special charge of the electricity rationing during World War II.

Mr. Boot attended the Technological State University in Delft, following a five-year course in electrical engineering. He graduated in 1932.

Last year Mr. Boot was on the instructor staff of the University of Toronto's laboratory of applied physics.

John C. Querido, M.E.I.C. has accepted the position of instrument engineer with C. F. Braun and Company, Alhambra, California.

Mr. Querido was formerly with the Foxboro Company Limited, Montreal. He graduated in mechanical engineering from McGill University in 1951.

Robert Herdman, JR.E.I.C., formerly assistant to the chief engineer at Bowater's Newfoundland Pulp and Paper Mills, Corner Brook, Nfld., has been named to the post of resident engineer.

With Bowater's as a student, Mr. Herdman has been a member of the graduate staff since 1950 when he received a B.Eng. degree in mechanical engineering from McGill University.

E. D. Fedryk, JR.E.I.C., formerly of Montreal, has accepted an appointment with the Canadian Westinghouse Company Limited, Hamilton, Ont., as marketing manager in the distribution ap-

• PERSONALS

paratus department, industrial products division.

Formerly a sales engineer with the Aluminum Company of Canada, both at Montreal and Kingston, Ont., Mr. Fedryk is a 1950 graduate of the University of Toronto in electrical engineering. In 1951 he followed the graduate course in business administration at the University of Western Ontario.

E. L. Littlejohn, Jr.E.I.C., of Union Carbide Canada Limited, has been appointed manager of public relations with the company.

Mr. Littlejohn joined the Union Carbide organization after graduating from the University of Toronto in chemical engineering in 1949. He spent some years in the production department of the Bakelite Company, division of Union Carbide Canada Limited, before transferring to the sales department in 1954. Earlier this year Mr. Littlejohn was appointed sales manager of thermoplastic products.

R. B. Sweet, Jr.E.I.C., formerly assistant mechnical superintendent of the Canada Paper Company at Windsor Mills, Que., has been promoted to the post of mechanical superintendent.

Mr. Sweet who joined the Canada Paper Company early this year, was previously employed by the Algoma Steel Corporation Limited, at Sault St. Marie.

He is a University of Saskatchewan graduate, class of 1949.

Michael O. Jones, Jr.E.I.C., has been transferred from the Singapore assembly plant of the Ford Motor Company of Malaya to the Ford Motor Company of New Zealand, as assistant to the general manufacturing manager.

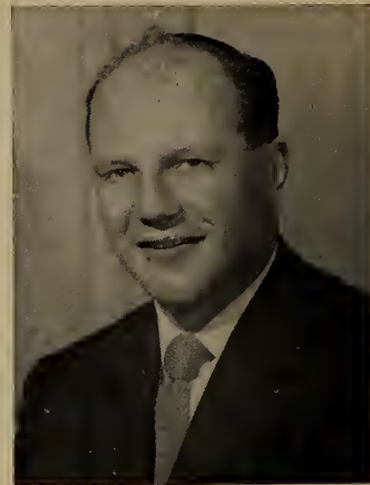
Mr. Jones graduated from the University of British Columbia in 1951 and worked with the Ford Motor Company at Windsor, Ont., shortly after graduation.

Gerard Gaudreau, Jr.E.I.C., has recently joined the firm of J. U. Moreau and Associates, consulting engineers in Trois Rivieres, Que., and is engaged in mechanical and electrical design with related structural work.

Mr. Gaudreau received his B.A. Sc. degree in electrical engineering from Laval University in 1953 and since then has been with Tasse-Sarault and Associates, engineering consultants in Quebec City.

A. F. Joplin, Jr.E.I.C. Chairman of the Central British Columbia Branch of the Institute for the 1956-57 term is A. F. Joplin, division engineer with the Canadian Pacific Railway at Revelstoke.

Born in Victoria, B.C., Mr. Joplin is a graduate in civil engineering with a B.A.Sc. degree from the University of British Columbia. Enrolling at that university in 1938 Mr. Joplin's studies were shortly interrupted by the advent of World War II. After serving with the R.C.A.F. for a period of five years he returned to Vancouver and completed his course in 1948.



A. F. Joplin, Jr.E.I.C.

With the Canadian Pacific Railway before graduation and after, he has since 1951 been employed as a division engineer.

Active in the affairs of the Central B.C. Branch since taking up residence in the Okanagan in 1950, he has since 1951 held a position on the executive. During the year 1955 he acted as vice-chairman and took over the chairmanship of the Branch when W. A. Ker accepted an appointment with the Department of Lands and Forests at Victoria.

Mr. Joplin is also chairman of the Central B.C. Branch of the Professional Engineering Society.

Maurice Paquet, Jr.E.I.C., and **Raymond Bedard**, Jr.E.I.C., have opened the consulting engineering firm of Paquet and Bedard in Quebec, Que., specializing in heating, ventilation, plumbing and electricity.

Both graduates of Laval Univerity, Mr. Paquet studied electrical engineering and obtained his degree in 1950; while Mr. Bedard, who qualified in civil engineering in 1953 was also awarded an Athlone Fellowship and has since then spent two years at the National College for Heating and Ventilating, London, Eng. Last year he was employed with Leblanc, Montpetit and Dorval, of Quebec, Que., as a heating and ventilating engineer.

Mr. Paquet has gained his professional experience with this firm also, and with Tasse, Sarault, and Associates, another group of consulting engineers at Quebec.

W. E. Jubien, Jr.E.I.C., who was last year associated with the department of civil engineering, University of Alberta, has moved to Vancouver where he will work with the firm of Ripley and Associates, engineering consultants in that city. Mr. Jubien who received his engineering training in Eastern Canada, is a graduate of the class of 1954, in civil engineering, at McGill University.

Walter H. Pent, Jr.E.I.C., a 1948 graduate in mechanical engineering of the

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• PERSONALS

Technische Hochschule in Hanover, Germany, has accepted employment with Canadian Mechanical Handling Systems Limited, Windsor, Ont. He holds the position of superintendent of engineering.

In 1952 Mr. Pent joined the staff of the National Breweries Limited, in Montreal, as a draughtsman, production division. Later he was with Dow Brewery Limited in that city as a draughtsman-designer.

Vincent Jolivet, Jr.E.I.C., has accepted an appointment as assistant professor of finance at the University of Washington in Seattle. He will teach corporation finance.

A civil engineering graduate of McGill University, class of 1952, Mr. Jolivet also holds the qualification of Master of Business Administration, received at Harvard Graduate School of Business Administration in 1954. Later he became a research assistant in financial management at the school.

F. M. Corbett, Jr.E.I.C., an Athlone Fellowship winner, has recently returned to Canada from Great Britain where he was associated with the educational department of Metropolitan Vickers Electric Company Limited, at Manchester. He is now employed with the Aluminum Company of Canada in Montreal.

Mr. Corbett formerly served with that organization in 1953, also at Montreeal. Prior to that he was with the Canadian General Electric Company at Peterborough, Ont.

R. E. Chamberlain, Jr.E.I.C., is with the Bailey Meter Company Limited in Montreal, as a production engineer.

With the firm in Cleveland, Ohio, in 1955, he was prior to that time associated with the Shell Oil Company of Canada Limited, as an exploration engineer.

He is a 1953 graduate of the University of British Columbia, with a B.A. Sc. in electrical engineering.

M. T. Rourke, Jr.E.I.C., has accepted an appointment as manager of industrial products with the Sun Oil Company Limited, wholesale and fuel oil departments, for the Montreal district.

After graduating from McGill University in metallurgical engineering, Mr. Rourke was engaged for a year in research work for a large electrical manufacturer. Since joining the Sun Oil Company in 1951 he has been industrial products department representative, for the Montreal district.

J. M. Wigham, Jr.E.I.C., a B.Sc. in civil engineering from the University of Alberta, class of 1955, is employed as an instructor, civil engineering department, at the University.

Mr. Wigham was formerly associated with the Regina, Sask., firm of Ducks Unlimited, as a field engineer.

J. D. Dunn, Jr.E.I.C., formerly with the Canadian Splint and Lumber Corporation Limited, Pembroke, Ont. has joined the staff of Consolidated Paper Corporation, at Trois Rivieres, Que.

Mr. Dunn is a Nova Scotia Technical College graduate in mechanical engineering, class of 1951.

G. E. Cotter, Jr.E.I.C., formerly of the Gartside Supply Company Limited, Granby, Que., has accepted a position with the G.M. Plastic Corporation, also at Granby.

A 1951 graduate in mechanical engineering, he received the degree B.Eng., from McGill University.

E. L. Pearson, Jr.E.I.C., has accepted employment as a division engineer with Canadian Industries Limited, ammunition division, at head office, Montreal.

Recently returned from Great Britain, as an Athlone Fellowship winner, Mr. Pearson was associated with the Fraser-Chalmers Engineering Works, a subsidiary of the General Electric Company, at Erith, Kent, Eng., for the past two years.

He is a 1953 graduate of the University of Manitoba.

R. A. McDougald, Jr.E.I.C., a University of Manitoba graduate of 1954, and Athlone Fellowship winner of that year, has recently returned to Canada, following M.Sc. studies in production engineering at the University of Birmingham.

He is now associated with the manufacturing and engineering department of the Peterborough works of the Canadian General Electric Company.

F. W. Agnew, Jr.E.I.C., formerly of the Dominion Tar and Chemical Company Limited, Toronto, has accepted a position with Commercial Alcohols Limited, at Gatineau, Que., where he is employed as a chemical engineer.

Mr. Agnew graduated with a B.Sc. degree from Queen's University in 1954.

K. M. Milne, S.E.I.C., a 1956 graduate in mechanical engineering from McGill University is working as an engineering trainee with Atlas Steels Limited, Welland, Ont.

NEWS OF THE BRANCHES

Activities of the Forty-Seven Branches of the Institute and abstracts of the papers presented at their meetings

CALGARY

R. G. PRICE, M.E.I.C.,
Branch News Editor

Guest Speakers

The first regular evening meeting of the season was held October 4, at the Palliser Hotel. T. B. Smith, plant superintendent of the Pacific Petroleums Gas Processing and Refining Plant, Taylor, B.C., addressed the gathering on "Some Unique Features of the Peace River Gas Processing Plant."

On October 18, "What Makes Us Laugh", was the topic of John S. Peach, director of Public Relations for the Canadian Petroleum Association.

Monday Luncheon Club

The Monday Luncheon Club of the Calgary Branch held its first meeting September 10, at the Al-San Club. Seventy-five members were present. Phil Meis of Minneapolis-Honeywell Regulator Company gave a short address on automatic temperature control and regulators.

Under the direction of "Nip" Guest and "Bud" Watson, these luncheon meetings will be held every Monday throughout the winter. Visiting members of the E.I.C. are especially welcome.

First social event of the season was a barbecue held September 13, at Colpitts Ranch, southwest of Calgary. More than three hundred people, including E.I.C. members, families and guests enjoyed a successful evening under the joint chairmanship of P. S. Grant and R. S. White.

CORNWALL

L. SNELGROVE, M.E.I.C.,
Secretary-treasurer

The Colonel Magwood Bursary

The Cornwall Branch takes pleasure in announcing the institution and operation of the Colonel Magwood bursary for students in first year engineering. Named after Colonel William Herbert Magwood who served the City of Cornwall for many years as chief engineer, and has a distinguished record as soldier, engineer and citizen, the bursary will assure that the successful candidate will be able to continue to a higher education.

Administered by the Cornwall Branch, the bursary committee consists of Messrs. Drummond Giles, M.E.I.C., W. P. Nesbitt, M.E.I.C., John Hawke, M.E.I.C., and Branch chairman, J. Morris, M.E.I.C. This committee reviews applications and makes the choice of the successful candidate, which receives final approval by the Branch executive.

Funds for the bursary are obtained from local industries. While it is hoped that there will be a number of industries participating in the future, for the present, those concerned in supplying the funds are Courtaulds (Canada) Limited, and Howard Smith Paper Mills, Cornwall.

Applicants must be residents of the United Counties of Stormont, Dundas and Glengarry, must have attended high school in that area, and fulfilled the scholastic entrance requirements for the first year of the engineering school of a recognized Canadian university.

However, while scholastic ability must be sufficient to cope with an engineering course, this will not be the sole basis used in judging the fitness of candidates. The committee will endeavour to select the person who in their opinion will make a good engineer. Such things as character, perseverance, integrity and finances will be given careful consideration.

Further information may be obtained on writing: L. Snelgrove, B.Eng., M.E.I.C., Secretary, Cornwall Branch, Engineering Institute of Canada, c/o Courtaulds' (Canada) Limited, Cornwall, Ont.

Half Century of Service

The bursary honors a man who has devoted a half-century of service to the municipality of Cornwall and whose career exemplifies the highest principles of the engineering profession. Born in Perth County in 1870, he was educated at local schools and in Peterborough. He joined No. "D" School of Infantry at London, Ont., in 1891 and completed partial engineering training. Later he took a military staff course at R.M.C. In 1897 he began his career in Cornwall with the engineering staff of the Ottawa and New York Railway, as an instrumentman, and on completion of this section of railway, remained in Cornwall and was engaged in municipal work. In 1902 he commenced work for himself, doing municipal work for several municipalities. Three years later he began his work as town engineer, and served continuously until his retirement in 1954, apart from a period of active service with the Canadian Expeditionary Force during World War I.

FREDERICTON

G. R. W. BLISS, JR.E.I.C.,
Chairman, Public Relations Committee

O. I. LOGUE, M.E.I.C.,
Secretary-treasurer

Visit Hydro Development

On Sunday, October 14, 1956, Branch members and their wives motored to the site of the New Brunswick Electric Power Commission's $50,000,000 hydro electric power development at Beechwood, New Brunswick's largest. An enjoyable luncheon, served in the contractors' cook house was followed by a talk by J. L. Feeney, M.E.I.C., chief engineer of the New Brunswick Electric Power Commission, introduced by Branch chairman Ira M. Beattie, M.E.I.C. Mr. Feeney gave a very informative talk on the steps leading up to the construction of the Beechwood power dam and the progress to date.

A documentary film, compiled by the public relations department of the Power Commission was also presented. R. E. Tweedale, assistant chief engineer of the Power Commission provided explanations of the film as it was run off.

Later, the group was taken on a conducted tour and various phases of the work were explained by the job site engineers, acting as guides.

Fredericton Branch members returned to their respective homes with a much better understanding of New Brunswick's largest power development.

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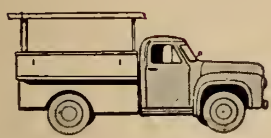
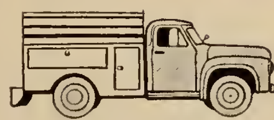
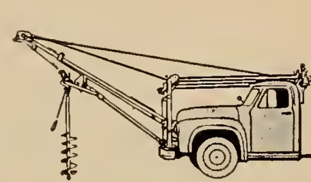

Utility Compartments


KING M96 Utility Body with Superstructure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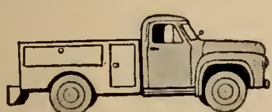
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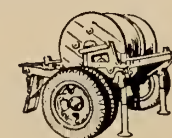
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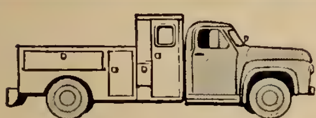
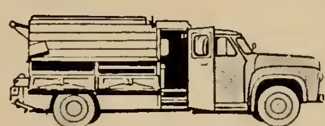

KING M96 Utility Body with Crew Compartment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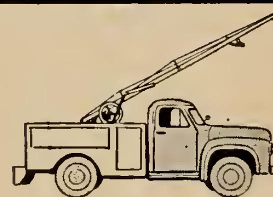
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• BRANCH NEWS

KINGSTON

D. I. OUROM, JR.E.I.C.,
Secretary-treasurer

Brig. C. D. Quilliam — Guest Speaker

The first meeting of the 1956-57 season took place October 23, at the R.C.E.M.E. officers' mess in Barriefield.

The guest speaker for the evening was Brig. C. D. Quilliam of Kingston, a veteran of some thirty years in the British Army and subsequently Middle East correspondent for the London Times. He has in recent years been engaged in book selling and lecturing in Canada.

His topic was "Some Notes on Terrorism" in which he discussed the social and economic conditions which foster unrest and which in the extreme may lead to terror activities by the more radical element of a society. The pattern of terrorist acitivity since the early 1930's, particularly in the Near and Middle East, was traced and the methods employed by various terrorist groups was discussed. In conclusion, Brig. Quilliam posed the question of what Canadian engineers, in particular those who travel and work in international fields, can contribute towards an understanding and solution of the problem.

An especially lively question period followed which dealt with such things as recent terrorist activities in Cyprus and Israel and the significance of the seizure of the Suez Canal by Egypt.

Some fifty members and guests attended the meeting at which Col. C. W. Jones presided.

LETHBRIDGE

R. D. HALL, JR.E.I.C.,
Secretary-treasurer.

R. J. D. GARDINER, JR.E.I.C.,
JOHN FISHER, JR.E.I.C.,
Branch News Editors

October Dinner Meeting

A monthly dinner meeting of the Lethbridge Branch was held on Saturday, October 27, in the El Rancho Banquet Room, Lethbridge. About 30 members were in attendance.

Pleasant dinner music was provided by Mr. and Mrs. George Brown, followed by an enjoyable sing-song led by Mr. G. S. Brown.

Two distinguished guests for the evening were Dr. J. C. Sproule, M.E.I.C., vice-president and Mr. A. E. MacDonald, executive secretary of the Association of Professional Engineers of Alberta. Dr. Sproule gave a short address and presented Mr. R. J. D. Gardiner with his A.P.E.A. membership certificate.

Guest Speaker on Town Planning

Guest speaker of the evening was Mr. Sam Lurie, M.R.I.A.C., A.R.I.B.A., director, Lethbridge and District Planning Commission, who spoke on the subject "Town Planning". Mr. Lurie gave an insight into the requisites of a town planner, but pointed out that while town planning is now emerging as a profession, much of the present town planning is still done by laymen using common sense and an intimate knowledge of the town and its problems.

Before planning can begin, Mr. Lurie explained, a detailed survey of the district must be made; not only of its geographical features, such as location, soil, water supply, drainage, minerals, and climate, but also of its population trends, economics, governments, employment, and the shopping habits of its people.

This survey is followed by a development period in which detailed engineering surveys, including studies of highways, sewage, and architecture are carried out.

Mr. Lurie went on to explain that the third step is to lay out a program. This procedure requires an intimate knowledge of law, government, and administration to ensure that the suggestions pro-

posed by the planner will be acceptable to the community as a whole.

Mr. Lurie concluded with a brief discussion of the Town and Rural Planning Act of Alberta and the chief problems facing the Town Planner in the City of Lethbridge.

Mr. Lurie was introduced by Mr. C. S. Clendining. Mr. W. B. Thomson thanked Mr. Lurie on behalf of the members present for his informative and interesting address.

NIPISSING and UPPER OTTAWA

G. R. KARTZMARK, JR.E.I.C.,
Secretary-treasurer

J. Field Guest Speaker

The Nipissing and Upper Ottawa Branch held the first meeting of the season at Temiskaming, Que., on Sept. 26. J. Field, guest speaker, formerly of C.I.L., delivered an interesting address on "the manufacture of nylon."

The annual fall field trip of the Nipissing and Upper Ottawa Branch was held at Falconbridge, Ont., on Oct. 27, with a visit to the Falconbridge Mines.

After the tour, conducted by various top personnel at Falconbridge and members of the Sudbury Branch, the visitors were entertained by the management at a social hour, held in the directors lodge.

Later, proceeding into Sudbury, a dinner meeting, also arranged by the Sudbury Branch was held at the Granite Club.

KOOTENAY

G. T. HUGHES, M.E.I.C.,
Branch News Editor

Dean A. Macdonald, Guest Speaker

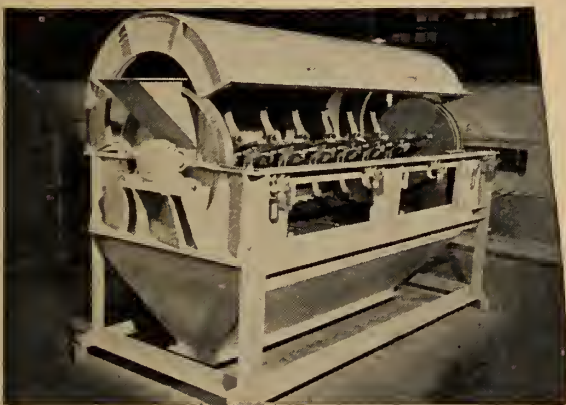
Members of the Kootenay Branch welcomed Dean A. E. Macdonald of The University of Manitoba at a luncheon meeting in Trail on September 27.

Dean Macdonald dealt with the problems confronting the universities arising from the shortage of engineers and he gave a brief account of the National Conference on Engineering. Scientific and Technical Manpower which he attended and emphasized the value of the meeting.

Dean Macdonald commented that as far as the University of Manitoba was concerned, the era of the dedicated teacher was passed. The attraction of high salaries offered by industry was a constant drain upon the resources of academic teaching; though it was also true that certain universities could compete in this sphere.

Bursaries and scholarships partially solved the problem of assistance in the

• Steel box section weighing over 40 tons for a mining company.

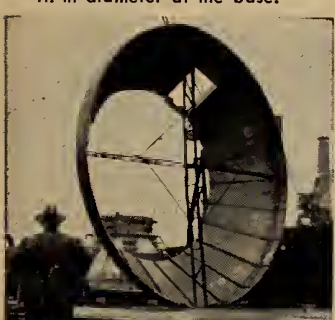


• Ore grading machine built for a mining company.

• Fabricated steel pump and motor base to support a de-watering pump and 6,000 H.P. motor.

• 1¾" tank shell for a high pressure steam drum for an oil refinery.

• Prefabricated sections of tank 80 ft. in diameter at the base.



• Canical section for high pressure reactor.

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training of engineering graduates. Dean Macdonald cited the forward step of Goodrich Rubber in their Waterloo plan proposal of thirteen weeks' employment alternating with thirteen weeks' study for classes of undergraduates, and remarked that this could be a successful undertaking for a city like Detroit. It would be almost inapplicable to a province like Manitoba where long distances would hamper such a scheme.

Dean Macdonald felt that the press could be more cooperative in their reporting of university policy and illustrated his point by reading an excerpt from his local press unfairly criticising the university in its procedure regarding failures.

Dean Macdonald concluded by reading extracts from the Bulletin issued by the National Employment Service published September 1956 concerning the placement of graduates, recognizing the shortage and suggesting that engineers should be usefully employed.

HAMILTON

A. F. BARNARD, Jr.E.I.C.,
Secretary-treasurer

W. A. H. FILER, Jr.E.I.C.,
Branch News Editor

Engineers' Ball

The seventh annual Engineers' Ball was held on October 5, in the Century and Burgundy Rooms of the Fischer Hotel. More than four hundred guests attended this popular event, to enjoy the delightful informal atmosphere which prevailed throughout the evening, and the fast-moving variety of entertainment afforded. Favours were received by the ladies and several lucky winners took home door prizes and special dance prizes. Receiving the guests at this gay social event were J. J. Kelly, chairman of the Hamilton Branch, and Mrs. Kelly, A. F. Barnard, secretary-treasurer of the Hamilton Branch and Mrs. Barnard, and members of the ball committee. Many prominent personalities were presented as invited guests. These were M. V. Hotchkin, president of the Association of Professional Engineers of Ontario and Mrs. Hotchkin, of Kirkland Lake; M. A. Montgomery, vice-president of the Engineering Institute, and Mrs. Montgomery, of Kitchener; Mrs. J. R. B. Carruthers, president of the Women's Auxiliary of the Hamilton Branch, E.I.C., and Mr. Carruthers; H. E. Thomson, president of the Hamilton Construction Association, and Mrs. Thomson.

"Get Acquainted Smoker"

The Hamilton Branch enjoyed a "Get Acquainted Smoker" on October 18, at the Royal Hamilton Light Infantry officers mess. Affording an opportunity for renewal of friendships and the developments of new ones, this informal type of meeting is an important phase of Institute activity which should not be overlooked.

OTTAWA

S. G. FROST, Jr.E.I.C.,
Branch News Editor

H. G. Gerber Speaks on Hilton Mines

The demand for high grade iron ore has made it economical to develop low grade deposits. The mystery of this anomaly was explained by Harry G. Gerber, superintendent of the Hilton mines at a luncheon meeting of the Ottawa Branch, on October 4, 1956.

The Hilton mines, known to old timers in the Ottawa area as the Bristol mines, are located a few miles from the

Mr. and Mrs. M. V. Hotchkin, left, chat with Mr. and Mrs. J. J. Kelly, at the seventh Annual Engineers' Ball, held recently at Hamilton.

capital, and their redevelopment is being followed with much interest locally, due to the methods employed and the re-vitalizing effect on the area.

Concentration of Iron Ore Important Factor

The efficiency of a blast furnace is dependent upon the concentration of iron ore charged to it. The use of high grade foreign ores during the war proved economical and presented a challenge to the old established mines.

Ore from the Mesabi Range assaying 51 per cent had been accepted by the steel mills for forty years. Now ores of 60 per cent iron and more are being demanded and produced. As natural deposits of these high grade ores are rare it has become necessary to concentrate the lower grades in beneficiating plants. It is this concentrating process that has made it economically possible to develop such deposits as were abandoned at the Bristol place.

The Hilton mine will produce a 66 per cent concentrate from a 25 per cent ore. The crude from the pit will be ground to particles the size of tooth powder. By a process of magnetic separation the iron is then taken from the waste rock. This finely ground and concentrated ore must next be prepared for blast furnace use.

The concentrate is rolled in a drum and pellets about one inch in diameter are formed, these pellets are then introduced into an oxidizing atmosphere of about 2400 degrees F. The final product is a dense cluster of pellets looking somewhat like a bunch of grapes. In this form the ore will be shipped to steel mills in Hamilton and the United States.

Mr. Gerber was introduced by W. B. Pennock, chairman, and thanked by councillor R. E. Hayes. Others at the head table were: Alan Brown, vice-president, Gatineau Power Company; B. H. Goodings, Ontario Association of Professional Engineers; R. J. Hawkinson, Pickands Mather & Company; H. I. Marshall, chairman, Ottawa Branch of the Canadian Institute of Mining and Metallurgy; and W. H. Norvish, assistant director of the Mine Branch, Department of Mines and Technical Surveys.

TORONTO

A. C. DAVIDSON, M.E.I.C.
Branch News Editor

Visit to SKF Plant

On September 27, 1956, a visit was made to the Canadian S.K.F. assembly plant on Eglinton Ave., Scarborough. It is always interesting to see how any specific industry operates, adapting fundamental techniques to its own requirements. Since grinding operations predominate in the manufacture of ball and roller bearings it was not surprising to find

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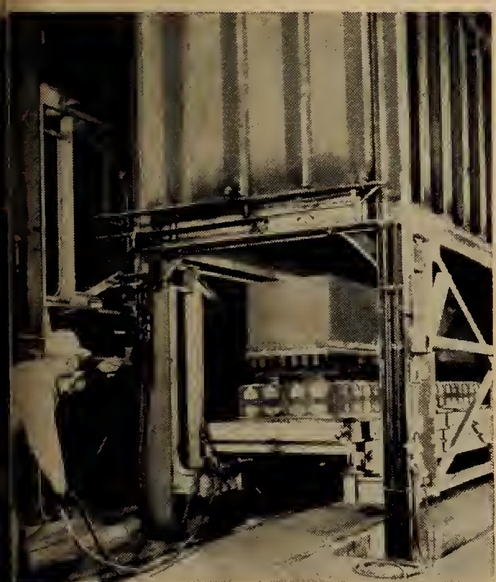

:levator Furnace at Davenport Works of Canadian ral Electric is used for high temperature annealing ınsformer cores. Furnace fits into minimum space.

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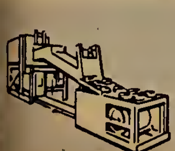
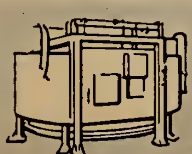
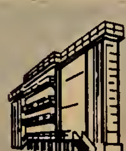


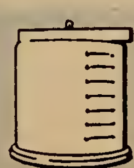
Mesh Belt



Rotary Hearth

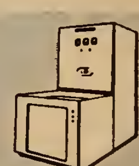


Tower



Cylindrical Bell

Enamelling Furnace



Electronic Induction

these techniques being used in the plant machine shop instead of the basic techniques of planing and milling. Although not entirely displaced, these latter two techniques were employed in a more or less secondary role.

It was a pleasure to see the clean air conditioned area in which designers and draftsmen worked, using modern office equipment and drafting machines. The S.K.F. company are to be complimented on this aspect of personnel relations.

After touring the plant the visitors had a well-prepared light lunch and a bottle of vitamin packed amber fluid to refresh them. A movie of operations in the company's parent Swedish plant rounded out the program. Both the S.K.F. executive and members of the E.I.C. Toronto Branch executive, Messrs. Young and Norgrove, are to be thanked for a pleasant and instructive evening. About one hundred members visited the plant.

Freshmen's "Initiation"

During the Freshmen's "Initiation" on September 25, all embryo engineers were treated to coffee and doughnuts in the great hall of Hart House, through the courtesy of the Engineering Institute, both the Toronto Branch and the Toronto Field Office assisting. Col. L. E. Grant, Hon. M.E.I.C. and Mr. Harvey Self, M.E.I.C., ,were present and explained to the freshmen what the Engineering Institute could do for them. The idea behind sponsoring a part of the Freshmen's reception at the University of Toronto was to make the students aware of the Institute. It was felt that the students are showing considerable interest in the Institute as a Canadian body of professional engineers. About five-hundred and fifty freshmen were entertained.

E.I.C. - I.E.E. Meeting

Mr. Ivan Widdifield reported that the Joint Committee Engineering Institute — Institution of Electrical Engineers group held its first meeting in the Electrical Building on the University of Toronto campus, Tuesday, October 9, in the evening. Mr. W. E. Cooper, liaison engineer for nuclear power, Ontario Hydro, was the speaker.

This photograph, taken at the election dinner of the Eastern Townships Branch in June, shows, left to right: Mrs. Champagne, Mrs. Mawhood, Mrs. Dick, Mrs. Masse, Mrs. Phillips, Mrs. Lemieux, Mrs. Cote; standing, G. Cote, M.E.I.C., B. Lachapelle, M.E.I.C., R. Phillips, M.E.I.C., J. Lemieux, M.E.I.C., G. Masse, M.E.I.C., R. D. Mawhood, M.E.IC., G. M. Dick, M.E.I.C., and J. P. Champagne, JR.E.I.C.

• BRANCH NEWS

Reviewing some of the basic concepts relating to nuclear reactors and the fission process generally, the author lists the basic components of the NPD reactor presently being built by Ontario Hydro, Canadian General Electric and Atomic Energy of Canada Limited, at Des Joachims, Ont.

The reactor core is a cylindrical steel pressure vessel 11½ feet in diameter and 36 feet high, with hemispherical bottom and removable top. Coolant enters the lower header, flows up the tubes and collects in upper header. Around the tubes is the moderator space and inside the tubes the fuel rods are inserted. Lower or fuel ends and upper or plug ends of rods are separable. After irradiation rods are removed and fuel and plug ends are separated. Plug ends are then decontaminated and used with new fuel ends, while spent fuel ends are sent to Chalk River for reprocessing.

The moderator is heavy water, and without it in the core, NPD does not react. The main coolant circuit flows past the fuel rods. The coolant is also heavy water pumped into the lower header, which flows past the fuel rods, picking up heat and gives up the heat to the heat exchanger.

Discussing the unique control system of NPD in detail, and how the moderator level is controlled, the author then describes the plant layout, consisting of—

1. the main section housing reactor, heat exchanger, turbine, generator and auxiliaries
2. the maintenance wing
3. the control wing
4. the office wing.

Reasons for the choice of the site were

1. ample supply of cooling water
2. land was owned by Ontario Hydro
3. accessibility of site by road and rail

The accompanying photograph was taken at the annual E.I.C. - A.P.E.O. dance held at Prudhomme's Garden Centre, Vineland, Ont., on Sept. 28. Shown below, left to right, back row, are: Col. T. M. Medland, I. L. Colquhoun, V. A. McKillop, and T. C. Keefer. Front row, left to right: A. W. F. McQueen, P. L. Climo, J. H. Fox, and D. M. Jenkins, chairman of the Niagara Group of the A.P.E.O.


S&L

4. electric power developed is easily connected to Hydro's southern Ontario system

5. foundation conditions were suitable and

6. proximity of machine shop and stores facilities at Chalk River.

Summarizing, the author points out the joint project is being undertaken for the benefit of Canada. Canada has abundant supplies of natural uranium such as will be used by NPD. Not only will the electrical industry benefit if NPD is a success, but also the mining industry and indeed everyone who uses electricity.

Prof. H. Macklin Guest Speaker

On October 11, Professor Harold Macklin M.E.I.C., of the Department of Civil Engineering, University of Toronto, gave an evening talk on modern mapping methods, in the mechanical building of the university. Professor Macklin was introduced by W. M. Treadgold, M.E.I.C., professor emeritus of surveying and geodesy at the University of Toronto. Professor Treadgold contrasted the days when he worked in the field using heavy instruments and pack horses with the present, where the airplane and machine plotting methods had supplanted the plane table and laborious hand plotting of stadia notes.

Professor Macklin traced briefly the history of surveying up to the present. Today the surveyor is called on to produce cheaply topographic maps which are the best possible in the shortest time,

Maps in the Toronto Metropolitan area will often be at a scale of one inch equals forty feet. In the fringes of the metropolitan area the scale may vary from one inch equals one hundred feet to one inch equals one thousand feet, with contour intervals running from two feet to ten feet. Because of the high accuracy required, the surveyor must use air photography and machine plotting methods.

Professor Macklin described the methods of photography and the costs of obtaining maps by these methods.

Progress in Surveying Instruments

Professor Macklin discussed the progress made in surveying instruments during post war years. The most noteworthy achievement is the Zeiss NI 2 level. This type has no level bubble as such, only a small bull's eye type for preliminary setting of the instrument. A prism suspended in the instrument by wires always gives a level sight to the operator. The instrument is capable of second order accuracy and can be set up in one half to two thirds the time required for the ordinary bubble type of level.

Electronics is being used to an increasing extent for measuring long distances. The Geodectic Survey of Canada is using Shoran to set up geodetic nets. Between 1949 and 1953 about 600,000 square miles of Canada's northland have been covered by a net and some 325 lines of an average length of two hundred miles have been measured with an accuracy of one in sixty thousand. Shoran is a radar type of device whose accuracy depends on the atmospheric conditions prevailing during its use. Better knowledge of the meteorology of the atmosphere will improve accuracy to one in 100,000. Even for the short time of use, the Shoran method is proving a remarkable time saver.

For distances ranging between one and fifty miles, two devices are available for very accurate measurement, one, called a geodimeter, made in Sweden, is capable of first order measurement, but is bulky though portable and quite expensive. The operation is based on the use of modulated light sent out from a fixed station, and reflected to a modulated photo electric call receiver. The successful operation of the equipment depends on intervisibility and clear weather. Another device called a Tellurometer is

being developed in Johannesburg, South Africa, which uses radio waves of 10 cm. wave length. It is expected that this apparatus will be capable of an accuracy in the neighbourhood of one in 200,000 over a 35-70 mile range.

In conclusion Professor Macklin remarked that the chainman was still the most valuable equipment for measuring distances less than two thousand feet.

About seventy members enjoyed the paper and the question period which followed.

Panel on Engineer Shortage

On October 25, a panel discussion was held in the mechanical building of the University of Toronto with the subject "The Engineering Manpower Shortage." Under the expert guidance of the chairman, Dean R. R. McLaughlin of the University's faculty of applied science the panellists developed their themes, beginning with Mr. Ira Needles, president of B. F. Goodrich, Canada, Limited, Kitchener.

Plan for Education

Mr. Needles talked of the plan called Waterloo College Affiliates, telling what is proposed for the Kitchener-Waterloo area. Briefly it is a plan for educating young men so that they will take up engineering or become technicians. The plan alternates a quarter of a year in business or in industry with a quarter of a year completing grade XIII. Two years will be spent this way. A third year may be added to the first two. It is not a terminal course and not an apprenticeship but the key to higher education. Mr. Needles felt that young people growing up in an industrial town have little or no motivation toward higher education because of family environment. The environment is not bad, simply that the youngster sees his father working in a factory and acquiring the material things of life quickly so the youngster wants to do likewise.

Not all will be allowed to enter the course. Selection by counselling and prestudy of the individual it is hoped, will prevent large numbers of disastrous failures.

Foundation to Evaluate Needs

S. H. Deeks, chief of engineering, Orenda Engines, followed. He explained first that he was on leave from Orenda Engines and is presently executive director, Industrial Foundation on Education. His topic was, "The Background of Canada's Science and Engineering Shortage." One of the first moves for the Foundation would be to assess the shortage in the light of the demands of the Canadian economy and then in the light of the demands of world economy as it affects the Canadian economy.

There is now, Mr. Deeks said, a world revolution in scientific discovery and progress. Nations which lead in discovery and progress will control the world.

So that Canada would not be left behind in the advance, the Foundation would evaluate Canada's economic and military needs as far as engineers and technicians were concerned, establish a course of action based on this evaluation, and then increase teaching staffs at the universities and technical schools to produce the necessary graduates.

The shortage of engineers could be alleviated by more technicians who would do the routine work which engineers presently do. The co-operative training scheme such as the one proposed in Kitchener-Waterloo was being viewed very favourably.

As the Foundation presently saw it, there would be a rise in the number of scientists and engineers of about four times, and ten times in the number of technicians over the the next twenty years. Presently Canada can supply one quarter of the demand. We may fall behind in Canada.

• BRANCH NEWS

Definition of Engineer

Colonel J. K. Bradford, the director of the placement service at the University of Toronto spoke briefly on the topic of "Define Your Terms." Colonel Bradford hoped that someone at the meeting would define for him the term "Engineer." After running over some statisics on the probable future needs for engineers in the U.S.A. he remarked that the engineering specialty fields now short of help were the metallurgical, electrical, heat, chemistry, mechanical design and aircraft. There will, said the colonel in conclusion, be an expanded utilization of the engineer who will move into a position in our technological economy where he will displace the lawyer from management.

Wastage — Not Shortage

D. R. Abbey of the Underwriter's Laboratories of Canada, took the view that there was a wastage of manpower rather than a shortage. Engineers should be taken out of the routine jobs of time study, order and pricing departments and other routine technical assignments. There should be proper utilization of present talent and development of future talent.

Small industries should retain consultants rather than attempt to hire engineers, and employers in large industries should train engineers themselves.

Mr. Abbey feels there is a trend toward a general type of engineering course rather than as presently, courses in a number of different specialties.

At the present time there is an artificial shortage created by competitive bidding due to the sudden expansion of the economy in Canada.

Mr. Abbey summed up his arguments by suggesting that engineers should develop themselves; that engineers were not part of the management team, just advisers, and finally that we in Canada should try living within our technical manpower means.

"The Head Hunters"

Mr. McMullen, manager of technical personnel, of Canadian General Electric, discussed the intriguing title, "The Head Hunters." He described the trials of a personnel manager trying to obtain technologists and technicians in Europe. Norway forbids any recruiting on her soil. Germany skims off the good ones for work at home.

Mr. McMullen brought out two very interesting points: There is no distinction between the professional (degree engineer) and the non professional (technical school grdauate) in Europe; and there is not much incentive spread between the salary earned by a man of little experience and a man with a great deal of experience.

Will the European source dry up? It will, because opportunities in Canada are difficult to sell, and the requirement of the degree will increase the use of the technician.

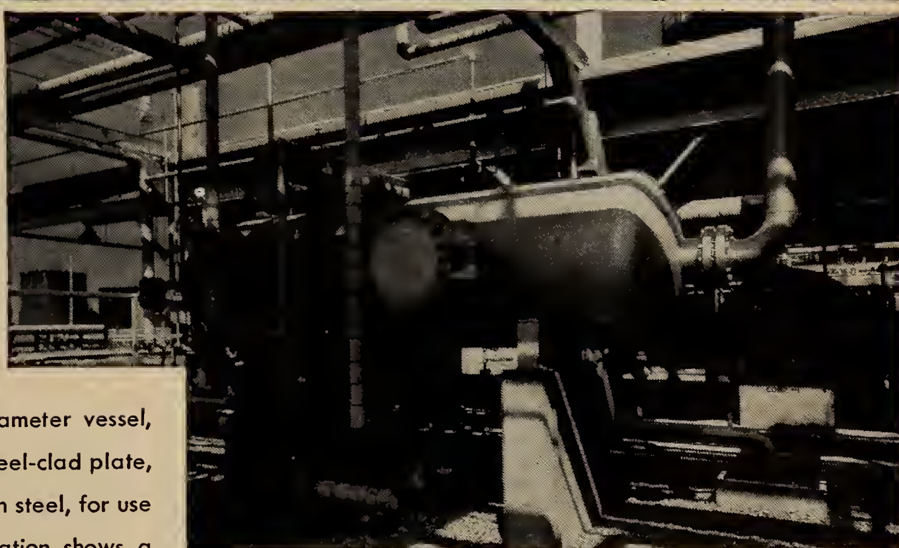
The discussion from the floor was lively. Mr. Needles emphasized that an engineering education was the finest which could be secured, the engineering trained man usually made the best executive material, and finally that young people could be inspired to enter the profession in high school, instead of drifting into industry.

Colonel Bradford felt that he had no stockpile of engineers on hand and considered the flow of engineers to and from the United States a two-way street. Both countries could benefit.

All panellists stood up bravely under fire from the floor and were thanked on behalf of the eighty members present by Lou Bresolin, Toronto Branch secretary.

PRESSURE VESSELS

- CARBON STEEL
- ALLOY LINED
- SOLID ALLOY



Top illustration shows a 10 ft. 6" diameter vessel, 127 ft. long fabricated in stainless steel-clad plate, Monel "Smithlined" plate and carbon steel, for use in an oil refinery. The lower illustration shows a suction drum for 700 p.s.i. pressure at 150° F. It was hydrostatically tested to over 1200 p.s.i. pressure.

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• BRANCH NEWS

VANCOUVER

A. D. CRONK, Jr.E.I.C.,
Secretary
T. F. HADWIN, M.E.I.C.,
Branch News Editor

Stanley Park Pavilion

Social Evening

In its unequalled setting, Stanley Park pavilion, Vancouver, was ideal for a social evening of games and dancing, held on Ladies' Night, October 13.

F. Cazalet, M.E.I.C., and E. S. Hare, Jr.E.I.C., conducted the games and the absence of a house percentage was particularly pleasing to the winners. John Emerson's orchestra played for the dance and was ably assisted with vocal numbers by the hitherto unknown vocalist and chairman, S. S. Lefeaux, M.E.I.C.

The varied program was unusually successful in making members better acquainted with each other and in promoting a feeling of good fellowship.

Field Trip

The 1956-57 executive of the Vancouver Branch have been very successful in promoting activities that tend to weld the Branch into a family unit as well as make the members feel they are getting something available only to members. Recent examples are field trips organized to go through one of the most modern breweries on the continent, September 27 and October 25. Sicks' Capilano brewery was designed with every facility for efficient production and demonstrated what architects and engineers can do to reduce production labor costs, keep equipment maintenance to a minimum and make sanitation easy. With tiled floors and walls, copper and brass vats and the special fermentation tanks, the visitor is impressed with the emphasis on cleanliness. Any day can be visitors' day. D. McRoberts, M.E.I.C., is chief engineer of the company and D. Bloxham, engineer of the inspected plant.

J. T. Madill Paper Presented

While many papers are written on the design features of engineering projects, few are written on construction details and the operating problems that follow completion of a project. The Vancouver Section was very fortunate on October

(*Continued on page 1774*)

News of Other Societies

Commonwealth Mining and Metallurgical Congress

At the invitation of the Canadian Institute of Mining and Metallurgy and with the approval of the Commonwealth Council of Mining and Metallurgical Institutions, the Sixth Commonwealth Mining and Metallurgical Congress will be held in Canada during the period from September 8 to October 9, 1957.

The Program

Arrangements for the Sixth Congress program are well advanced, with major meetings scheduled as follows:

Vancouver, B.C., Sept. 8, 9, 10
Edmonton, Alta., Sept. 16, 17
Winnipeg, Man., Sept. 19, 20
Toronto, Ont., Sept. 27, 28
Ottawa, Ont. Sept. 30, Oct. 1
Montreal, Que. Oct. 2
Quebec, Que., Oct. 3, 4
Halifax, N.S. Oct. 8, 9.

Programs and tours are being designed to include virtually every aspect of Canada's tremendous complex of mineral exploration, development, beneficiation, manufacture and marketing; or government administration, research and scientific investigation.

The Technical Programs Committee has decided that technical information will be most advantageously presented by means of plant visits, subsequent forum and panel discussions, and in specially prepared descriptive literature which will be obtainable during the congress by means of Technical Volumes.

There are special tours of Canada being arranged by Thos. Cook and Son, official travel agent for the Sixth Congress.

The "Second Brochure" of the Congress, now available, contains general information, tour plans and application forms. The Canadian Committee is requesting that completed application forms be delivered by January 31, 1957, to The Executive Secretary, Sixth Commonwealth Mining and Metallurgical Congress, 837 West Hastings Street, Vancouver 1, B.C.

Canada on Display

R. W. Diamond, M.E.I.C., president of the Sixth Congress, in a message to the 3000 interested persons in 70 countries, writes: "Every effort is being made to ensure for all delegates an unequalled opportunity to visit Canada under the best possible auspices. The Government of Canada, the Governments of the Canadian Provinces, The Canadian Institute of Mining and Metallurgy, The Canadian mineral industries and the people of Canada look forward with keen anticipation to the privilege of placing our country and its great mineral industries on display for you next year."

International Welding Institute

The International Institute of Welding, organizing the international annual assembly for 1957 at Essen, Germany, June 29 to July 6, will be supported by a Canadian Committee.

Membership in the I.I.W. for Canada is shared by the Canadian Welding Society, the Canadian Welding Bureau and the Department of Mines and Technical Surveys.

I.I.W. in Canada

In order to expedite and direct the activities of the I.I.W. in Canada the members have elected a provisional executive to act until the formation of a Canadian Council. Rules and regulations have been formulated to govern the operations of the Canadian Council.

R. A. Dunn, general sales manager, Canadian Liquid Air Company Limited, Montreal, (representing the Canadian Welding Society), is the provisional chairman, and R. W. Stickney of the Canadian Welding Bureau, Toronto, is the provisional executive secretary.

Other members of the provisional executive include: E .A. Gill, manager industrial heating, Canadian General Electric Company Limited (representing C.W.S.), H. J. Nichols, chief welding metallurgist, Department of Mines and Technical Surveys, W. P. Campbell, Department of Mines and Technical Surveys, C. H. Elsley, supervisor of automatic welding equipment, Dominion Foundries and Steel Company Limited (representing C.W.S.), and R. M. Gooderham, Canadian Welding Bureau.

The interim executive accepted the duty of informing Canadian industry and individuals of the 1957 assembly in Essen. Details of this meeting were published in the November 1956 issue of the Journal.

Adequate Wiring Program

The Canadian Adequate Wiring Bureau (126 Davenport Road, Toronto) will launch a program in 1957 designed to influence home owners to improve overloaded electrical systems and to demand high standards for systems in new homes.

The estimate is that there are 2.5 million inadequately wired homes in Canada. The results are inconvenience and fire damage, as well as constriction in the market for electrical products.

The Canadian Electrical Manufacturers Association supports the Bureau financially, while other national organizations participate in its work, with electrical utilities, contractor associations and Electric Service Leagues. The executive committee is headed by R. E. Bailey, chairman.

Its objective is to advance the installation of wiring which will be sufficient to increase the use and usefulness of electricity and electrical products in homes and other structures and wherever the better use of electrical equipment depends on the adequacy of the wiring system.

The CAWB acts as a liaison with related U.S. programs, also. Arrangements are being made within the industry to hold the annual Electrical Week in Canada at the same time as it is observed in the United States, the second week in February.

Col. Robert Dickson Harkness, M.E.I.C. of Montreal was elected president of the Canadian Electrical Manufactuers Association at the annual meeting in October. Col. Harkness is president of Northern Electric Co. Ltd.

C.I.S.S. Convention

The 23rd annual convention of the Canadian Institute on Sewage and Sanitation was held in Windsor, October 29 to 31, 1956.

The president of this Institute was C. G. Russell Armstrong, M.E.I.C., past-chairman of the Border Cities Branch of the E.I.C. and a past vice-president of the Institute.

• NEWS OF OTHER SOCIETIES

There were 528 registrations for the convention, which included papers and discussions on the modern science and practice in refuse disposal, public sewerage systems, air pollution, control, oxidation ponds, sewer laying and maintenance, sewage treatment plants for small municipalities, and reviews of specific provincial and local programs, plans and problems.

L. B. Allan, M.E.I.C., commissioner of roads for Metropolitan Toronto, assumed the presidency at this meeting. A. E. Berry, M.E.I.C., is secretary-treasurer of the C.I.S.S. He is general manager of the Ontario Water Resources Commission.

Calendar

Management

The Canadian Management Council will hold the annual general meeting in Montreal, on January 14, 1957.

Concrete Products

The eighth annual convention of the National Concrete Products Association will be held at the Sheraton Mount Royal Hotel in Montreal, January 17-19, 1957.

Metals Engineering

G. MacDonald Young of Montreal has been elected vice-president of the American Society for Metals, the first Canadian to hold an executive office in this society. Mr. Young is technical director of the Aluminum Company of Canada, Limited.

Standards

The Laboratories of the Canadian Standards Association are now known as the CSA Testing Laboratories. The change was made in October.

A new district office of the laboratories was opened in Winnipeg, at that time, with M. Lasko appointed as Winnipeg district engineer.

Heating and Air Conditioning

The 63rd annual meeting of the American Society of Heating and Air Conditioning Engineers (62 Worth Street, New York, 13) will take place in Chicago, Ill., February 25 to 28, 1957.

Steel

The 55th annual meeting of the Steel Founders' Society of America (606 Terminal Tower, Cleveland 13, Ohio) is scheduled for March 18, 19, 1957, at the Drake Hotel, Chicago, Ill.

Plant Maintenance

Advance registration cards for the eighth Plant Maintenance and Engineering Conference, to be held in Cleveland, at the Public Auditorium, January 28-31, can be obtained from Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N.Y.

Tool Engineering

An invitation has been issued to Canadians to submit papers for the 26th annual convention of the American Society of Tool Engineers to be held in April, 1958. Papers submitted for the 1958 convention will be accepted for consideration until May 1, 1957. ASTE membership is not required. Each proposal should include an outline of the paper, the author's name, his title and affiliation. This information should be submitted to L. S. Fletcher, Progress Director, American Society of Tool Engineers, 10700 Puritan Avenue, Detroit 38, Michigan.

The program for the 25th annual convention, the silver anniversary meeting of ASTE, is completed. This meeting will take place in Houston, Texas, in March, 1957.

Road Show

Discussion of the roadbuilding market and new engineering techniques will dominate the 1957 convention and road show of the American Road Builders' Association, taking place in Chicago, January 28 to February 2, 1957.

Canadians may register for this meeting through the Canadian Good Roads Association (270 Maclaren St., Ottawa, Ont.)

Publications of Engineering Societies
1957 Subscription Rates

Exchange arrangements exist between The Engineering Institute of Canada and engineering societies in the British Empire and the United States whereby members of the Institute may secure the publications of these societies at special rates which, in most instances, are the same as charged to their own members. A list of these publications with the amounts charged is given below. Subscriptions should be placed at E.I.C. Library, 2050 Mansfield St., Montreal 2, Que. These prices are subject to change without notice, so no remittance should be sent until an invoice has been received.

	Rate to E.I.C. Members	*Rate to Non-Members*
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS		
Chemical Engineering Progress	$5.75	$6.50
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS		
Electrical Engineering	$7.25	$12.50
Transactions—annual, bound	10.00	12.50
Combined subscription to Electrical Engineering and bound Transactions (1956 Transactions available Spring 1957)	12.00	21.00
Transactions 1957 bi-monthly issues:— Electronics and communications; Applications and industry; Power apparatus and systems ..... per part	3.25	5.25
AMERICAN SOCIETY OF CIVIL ENGINEERS		
Civil Engineering	$5.25	$5.75
Proceedings separates	16.00	25.00
Transactions 1956 ... paper	9.00	16.00
Transactions 1957 (if order received by January 15, 1957) ... paper	7.00	12.00
Transactions 1957 (if order received after January 15, 1957) ... paper	9.00	16.00
AMERICAN SOCIETY OF MECHANICAL ENGINEERS		
Mechanical Engineering	$6.00	$7.00
Transactions and Journal of Applied Mechanics (monthly)	10.50	12.00
Journal of Applied Mechanics (4 issues)	4.50	5.00
Transactions and Journal of Applied Mechanics (Annual, bound) 1956 ready Spring 1957	15.50	18.00
Applied Mechanics Reviews	21.00	25.00
INSTITUTION OF CIVIL ENGINEERS		
Proceedings		
Part I General	$3.50	
Part II Airport, Maritime, Railway and Road Engineering	2.00	
Part III Public Health, Structural Works Construction and Hydraulics	2.00	
All three parts together	6.50	$12.00
INSTITUTION OF ELECTRICAL ENGINEERS		
Journal. General Papers	$2.75	
Part A. Power Engineering	3.50	
Part B. Radio and Electronic Engineering	3.50	
Part C. Collected Monographs	2.00	
Journal and three parts together	11.00	
Science Abstracts		
Section "A" Physics	10.00	
Section "B" Electrical Engineering	8.75	
Both Sections together	16.00	23.00
INSTITUTION OF MECHANICAL ENGINEERS		
Chartered Mechanical Engineer Separates of Proceedings and Automobile Division Proceedings	$20.50	
Automobile Division Proceedings	2.75	$3.25
Chartered Mechanical Engineer	5.50	6.50
INSTITUTION OF ENGINEERS, AUSTRALIA		
Journal	$6.50	$12.00
INSTITUTION OF ENGINEERS, INDIA		
Journal	$8.00	$12.00
NEW ZEALAND INSTITUTION OF ENGINEERS		
New Zealand Engineering	$2.75	$4.00
SOUTH AFRICAN INSTITUTE OF ELECTRICAL ENGINEERS		
Transactions	$5.00	$9.00

Library Notes

Additions to the Institute Library
Reviews, Book Notes
Standards

BOOK REVIEW

Man's role in changing the face of the earth.

W. J. Thomas, ed. Toronto, University Press, 1956. 1193p., illus., $12.50.

In 1955 a symposium was held in Princeton: the topic discussed by the seventy participants was man's role in changing the face of the earth. An attempt was made to evaluate man's capacity to transform his environment, and to assess the cumulative and irreversible alterations man has made on and to the earth.

The symposium was sponsored by the Wenner-Gren Foundation which was created in 1941, two of its objects being the application of techniques developed in other fields to the solution of anthropological problems, and the dissemination of the results of anthropological research in an attempt to win more public support. It was felt that a symposium of this type would further the work of the Foundation, attempting as it did to survey a topic of interest to many different disciplines.

The book is divided into three sections the first of which, Retrospect, provides the background for the study, and traces the changes wrought by man from his first use of fire, through the influences of the food-producing populations in different areas and at different eras, to the present period of urbanization.

The second section, and to the engineer that of the greatest interest, is entitled Process, and describes the ways in which man has made the changes on the earth. Some of the topics considered are the effect man has had on seas and waters; the alteration of climatic elements; erosion and soil changes; pollution; and urban and industrial demands on the land.

The final section, Prospect, considers the effect man's actions have had on the habitability of the earth and on man's own evolution. Also considered are the material and ideological limitations which man may have produced for the future.

This is a very readable book, and is well-documented for those wishing to pursue further any particular topic. The engineer has contributed to so many of the changes which have been made in the past, and will be responsible for so many future developments that we feel this book will be of interest to many of our members. s.c.

Members may borrow the books mentioned in these Notes on application to the librarian. Two books may be borrowed for two weeks.

LIBRARY HOURS

Monday to Friday
9 a.m. — 5 p.m.
Saturday 9 a.m. - 12 noon.

BOOK NOTES

Prepared by the Library The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

***Achitectural graphic standards 5th ed.**

C. G. Ramsey and H. R. Sleeper. New York, Wiley, 1956. 758p., $18.50.

This reference volume for architects, builders, civil engineers, and others interested in building gives the standards and facts needed to deal with a wide range of types and phases of construction. The new edition has been thoroughly revised, and it has been rearranged into twenty-three sections covering such topics as foundations; wood, steel, concrete, and masonry construction; hardware; interior finishes; mechanical equipment; and landscaping. New material on a number of subjects has been added, including furniture; the design of plank and beam framing; curtain walls; pneumatic tubes; elevators; and escalators.

Building code requirements for reinforced concrete.

American concrete institute. Detroit, The Institute, 1956. 73p., $1.00.

The code covers the design and construction of buildings of reinforced concrete and may be incorporated verbatim or adopted by reference in a general building code. Among the subjects covered are: quality of concrete; allowable stresses; mixing, placing, curing and cold weather protection of concrete; forms; reinforcement; pipe and conduits; joints; general design considerations; flexural computations; shear and diagonal tension; bond and anchorage; flat slabs; columns and walls; footings; and precast concrete. The quality and testing of materials used in the construction are covered by reference to the appropriate ASTM standard specifications.

Circuit theory and design.

J. L. Stewart. New York, Wiley, 1956. 480p., diagrs., $9.50.

Intended as a text for either undergraduates or graduates, this book applies modern network theory to the understanding of vacuum tubes and feedback systems. The author uses pole-zero design methods to develop design methods for a variety of circuits, both with and without vacuum tubes, and for systems with and without feedback.

Following a review of steady-state circuit analysis, poles and zeros and their relation to networks are discussed, as are R-L, R-C and L-C networks and their canonical forms. Other topics covered are the approximation problem, network synthesis, image matching, vacuum-tube linear equivalent circuits, low-pass and band-pass amplifiers and feedback devices.

Suggestions for further reading and background material are included in a bibliography which is keyed to the different chapters.

Chemistry of cement and concrete, 2nd ed.

F. M. Lea. London, Arnold, Toronto, Macmillan, 1956. 637p., illus., $14.00.

This second edition has been largely rewritten to incorporate the knowledge of the chemistry of cement and the performance of concrete which has accumulated in the last twenty years. The book deals with the chemical and physical properties of cement and concrete and their relation to problems arising in use.

Some of the topics covered include the raw materials used in the manufacture of portland cements, their properties and the changes they undergo during manufacture; the cementing qualities of cement compounds and their atomic structures; hydration; setting and hardening; pozzolanas and pozzalanic cements; cements made from blastfurnace slag; high alumina cement; concrete aggregates; the resistance of concrete; and the examination of concrete failures.

As the author, the director of building research of the British department of scientific and industrial research, states in his preface, much of the information on the chemistry of cements is also available in other texts. He has therefore devoted more of the book to the problems arising in the use of concrete, as much of the information available in this phase of the subject is not available in printed form.

*Closed-circuit and industrial television.

E. M. Noll. New York, Macmillan, Toronto, McClelland & Stewart, 1956. 230p., illus., paper, $4.95.

The first chapter includes brief descriptions of a number of uses of closed-circuit television as a monitoring device in steel mills, power plants, railroad yards and other locations, and as a means of communication in schools, hospitals, business, etc. Seven chapters deal with the technical aspects of systems, cameras, viewers, circuits, installation, and servicing, and the last chapter presents construction details for a small inexpensive camera.

Currents, fields and particles.

Francis Bitter. New York, Wiley, 1956. 599p., diagrs., $8.50.

The objective of this text for undergraduates is "to give the student an appreciation of one of the great achievements of man—the development of a series of abstract concepts which make it possible to see deeply into the nature of creation." It is also intended to lay a groundwork for the understanding of the laws of nature.

Some of the topics covered include basic electrical quantities, electric and magnetic fields, optics, the experimental basis of atomic physics, wave mechanics, atoms and electrons, and atomic nuclei and nuclear radiations.

Parts of the text are in small type, indicating those sections which are supplementary to the main argument, and which may be used in advanced courses, or by those students wishing to gain a more thorough understanding of the subject. Similarly, certain of the problems are intended for the more advanced student. Many of the problems require several steps in their solution, and serve to review earlier portions of the text.

The author is professor of physics at M.I.T., and has worked in the fields of magnetism, magneto-optics and nuclear properties.

Codetermination in the German steel industry.

W. M. Blumenthal. Princeton University, Industrial relations section, 1956. 115p., $3.00 (U.S.)

The policy of codetermination was introduced into the German steel industry in 1947. It was designed as a solution to the problem of the struggle between management and labour which in the United States and other countries has been solved by collective bargaining. Under the law, labour is given equal representation with management on the board of supervision, and a labour director appointed to the board.

This report, based primarily on the experiences of ten steel companies, considers the operation of the policy, which, as the author points out, resulted in basic changes in management. The findings make interesting reading, but it seems certain that codetermination is not likely to flourish on this side of the Atlantic.

*Electronic components symposium proceedings, 7th session, 1956.

New York, Engineering Publishers, 1956. 240p., illus., $5.00 (U.S.)

These proceedings contain forty-three papers grouped into the following sections: general; progress with materials; theory and operating principles; instruments and measurements; electron tubes and solid state devices; and passive components. Typical subjects covered include ferrites for use in S-band microwave components; glass in high temperature components; effects of nuclear radiation on components; automatic testing; high power silicon transistors; metal film resistors, and manufacturing subminiature tubes. Several of the papers deal with problems of equipment reliability.

*Handbook of chemistry, 9th ed.

N. A. Lange, ed. Sandusky, Ohio, Handbook publishers, 1956. 1969p., $8.50 (U.S.)

In preparing the present edition of this standard handbook for chemists and engineers, the editor has rearranged and rewritten the material of the previous edition in order to make room for new subjects and still keep the volume of convenient size for quick reference. The additions cover such varied topics as composition and properties of non-ferrous alloys, sodium and potassium alloys, and plain carbon and low alloy steels; efficiency of drying agents; physical properties of the earth and its atmosphere; and luminescence. Formula weights of inorganic compounds, and gravimetric and volumetric factors have been recomputed to conform to the values in the 1955 International Atomic Weight Table.

Handbook of chemistry and physics, 38th ed.

C. D. Hodgman, ed. Cleveland, Chemical rubber pub. co., Toronto, Ambassador, 1956. 3206p., $12.00 (U.S.)

In this thirty-eighth edition of the Handbook, the general arrangement remains the same, but many corrections have been made, and new material added. This includes an expansion of the calibration tables for thermocouples; tables listing heats of formation of inorganic oxides, miscellaneous properties of refrigerants, mean specific heat of liquids and salts, and the thermal conductivity of liquids.

The various sections of the Handbook include all the usual mathematical tables, tables of properties and physical constants, brought up-to-date, general chemical tables, data on the specific gravity and properties of matter, heat and hygrometry, sound, electricity and magnetism, light, quantities and units, etc.

The aim of the editors has been to include in a condensed form as much information on all branches of chemistry and physics as would be useful. Many of the tables and much of the information have been compiled especially for the Handbook from different sources, and the whole forms a compact volume, printed as it is on india paper.

*A handbook on belt conveyor design.

Compiled in association with Hewitt-Robins, Inc., New York. Erith, Kent, General Electric Company, 1956. 148p., 30/-.

Detailed explanations and calculations for the design of individual conveyors are given in this handbook. The first section of the book deals with the factors to be taken into account in the design of conveyors for specific purposes, and the following sections take up such essentials as idlers, drive equipment, trippers, brakes, and shaft design. Sample calculations for several types of conveyors are included, and tables of data are provided.

Introduction to solid state physics, 2nd ed.

Charles Kittel. New York, Wiley, 1956. 617p., illus., $12.00.

An introductory textbook in solid state physics, this book presupposes a general familiarity with modern atomic physics, while a knowledge of quantum mechanics is required for an understanding of the advanced topics developed in the appendices.

The emphasis in the book is on the areas of the subject which can be discussed in terms of simple, concrete, and well-developed models.

This second edition includes fuller explanations of the basic concepts of the subject, especially in the areas of crystal symmetry and energy band theory. New material is included on alloys, semi-conductors, photoconductivity, luminescence, and imperfections in solids.

• LIBRARY NOTES

Introduction to printed circuits.

R. L. Swigget. New York, Rider, 1956. 101p., illus., pa. $2.70 (U.S.)

Automation in the electronics manufacturing field has been made possible by the development of printed circuits, as they provide a system of making electrical interconnections without wires.

The various types of circuit found in electronic equipment are described, including ceramic based printed circuits, and etched and plated circuits, discussing the characteristics, functions and manufacture of each type, and their effect on servicing devices containing them. Other chapters cover components for printed circuits, assembly systems and the servicing of printed circuits.

Irrigation engineering, v. II.

I. E. Houk. New York, Wiley, 1956. 531p., illus., $14.00.

The first volume of this work discussed the agricultural and hydrological phases of irrigation. Based on information obtained from federal irrigation projects, the Bureau of Reclamation, published material, and the author's own experience, this volume considers irrigation projects, circuits and structure.

The first four chapters discuss irrigation projects, their feasibility and planning, and the study of project lands and water. The author considers the various methods of conveying irrigation water, and their different components: linings in canals and ditches, flumes, pipes, tunnels, diversion dams and intakes, storage dams, spillways, gates and valves, and fish protection.

This study gathers together information previously found only in periodical literature, and with the first volume provides very good coverage of the subject. Its value is increased by the bibliographies found at the end of each chapter.

Long-distance gas transport in the United States.

Paris, O.E.E.C., Toronto, Ryerson, 1956. 183p., illus., $1.50.

In the interests of promoting more efficient gas transport in Europe, this report was prepared by an O.E.E.C. technical assistance mission to the U.S.A. Some of the subjects covered include gas treatment before transport, transport networks, underground storage, treatment during transmission, pipe line operation and control, government inspection, sales and company organization. Considerable attention is given to materials specifications, and economic and political factors which affect this industry.

Management for tomorrow.

Society for the advancement of management. Philadelphia, Chilton, Montreal, Wallace, 1956. 179p., $6.75.

A report of the eighth annual conference held by the Philadelphia chapter of the Society for the advancement of management, the papers included consider such topics as the internal audit, opinion surveys, developing managers, control by incentives, integrated data processing, and the relations between management and labour.

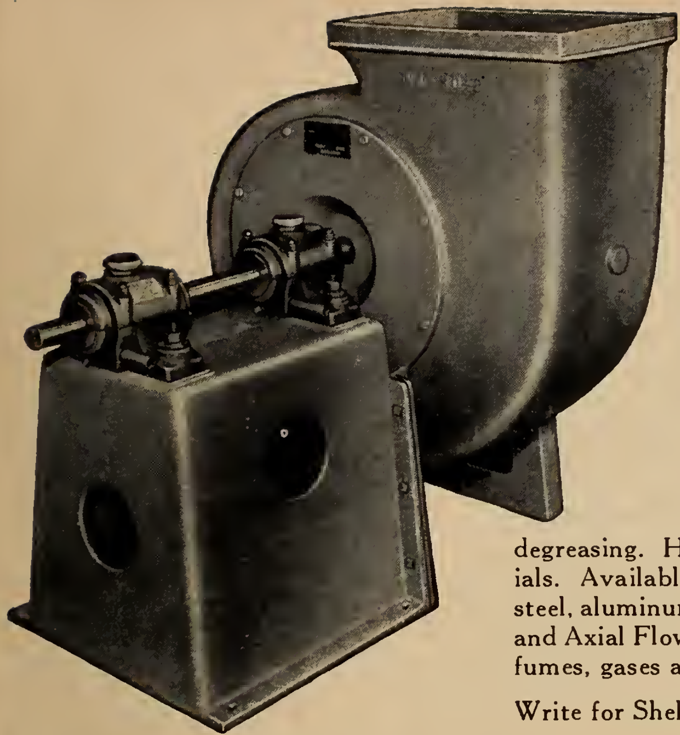
All the speakers were executives in various fields, and so able to illustrate their talks with examples drawn from their own experience.

Manual of departments and agencies of the Government of Canada.

R., J. H. and R. Quain. Toronto, Butterworth, 1956. 313p., $10.75.

A guide to the 20 departments, 40 boards and over 25 crown corporations comprising the Federal Government, this Manual is essential to anyone having any dealings with the government, and these days that includes just about everybody.

The various government agencies are considered under the headings of taxes and duties, government contracts, government services to business, transport



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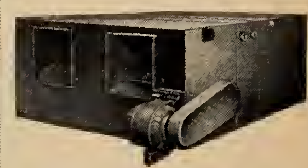

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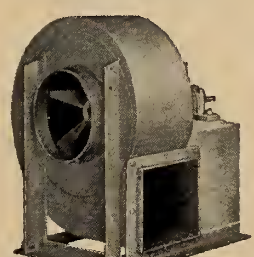

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and communications, and miscellaneous. This latter embraces such diverse agencies as the National film board, the St. Lawrence seaway authority and the Atomic energy control board.

Included in the appendices are charts showing the organization of various departments, a directory of sources of official information, the countries entitled to the most-favoured-nation tariff, etc.

The authors, a lawyer and two chartered accountants, give information on whom to approach in a government department, on appealing a ruling made by a government official, on the workings of the income tax department, and on many other topics of interest to businessmen, lawyers, accountants, executives, etc.

Supplied with each copy of the manual is a copy of the 1956 Government telephone directory giving the address of every department in Ottawa, and the telephone number of every official of any importance.

Modern welding.

H. G. Taylor. London, British welding research association, 1956. 64p., illus., 4/-.

The series of Cantor lectures delivered before the Royal society of arts in 1956 is reprinted in this publlication. Present day processes such as argon arc and resistance welding are described, as well as the tools and uses of welding. The need for further research in this subject is emphasized because of its very important part in modern industy and constuction.

Nachrichten aus dem Karten-und Vermessungswesen. Reihe 1, Deutsche Beiträge und Informationen.

Frankfurt, Institut fur Angewandte Geodâsie, 1956. 73p.

The first of a series on mapping and surveying, this volume deals with Germany.

The first section of the book deals with maps of Germany published under the auspices of ICAO, with a scale of 1:500,000 with aeronautical information superimposed on an ordinary topographical map. A map of the Frankfurt area is enclosed as an example.

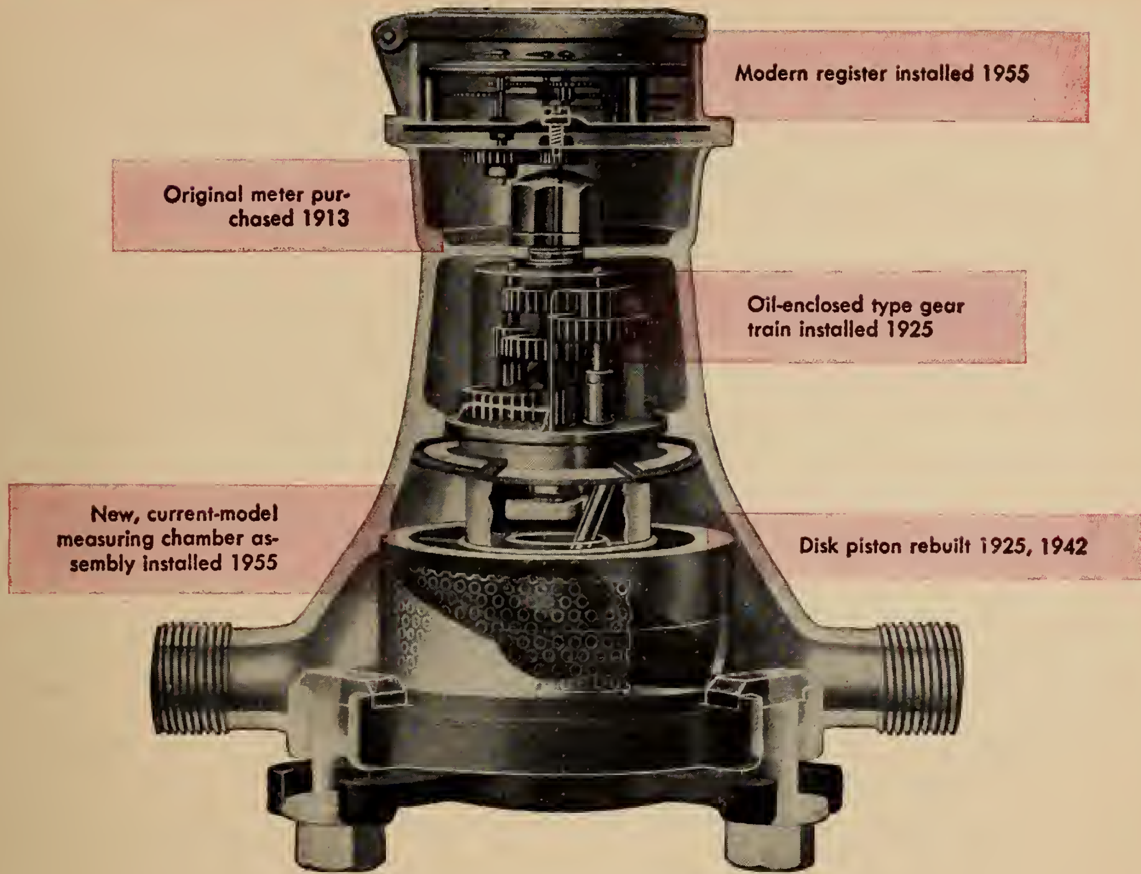
Other sections, by different authors, deal with aeronautical charts and flying safety, including tne work of ICAO and the ICAO aeronautical charts, and the map collection of the Institut für Angewandte Geodasie.

There is a bibliography listing several specifications for compiling maps, and aeronautical charts already published.

Nomographisches Rechnen.

Fritz Kieszler. Essen, Girardet, 1956. 190p., 9.80 DM.

This book on nomography is divided into two parts the first of which deals with the relation between two variable numbers, and the various systems of coordinates. The second part considers the relations between three variable numbers, networks etc. There is a brief bibli-



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ography of other books on nomograms. An earlier wok on the subject by the author, Angewandte Nomographie, appeared in 1952.

Oxidation resistant silicon aluminium steels.

E. A. Brandes. Stoke Poges, Buckinghamshire, Fulmer research institute, 1956. 40p., tables, 10/6.

This report presents the date on tests of steels containing up to 4% silicon and 3% aluminum. Those containing 2-3% silicon with 0.5-1% aluminum are comparable in resistance to oxidation with 18% chromium, 8% nickel austenitic steel. The results of mechanical tests are also given.

These steels are considered to be useful alternatives to the highly alloyed steels now used for heat exchangers and electric furnaces, etc.

Photoconductivity conference.

R. G. Breckenridge, ed. New York, Wiley, 1956. 653p., $13.50.

The 1954 Conference on Photoconductivity was sponsored by the University of Pennsylvania, the Radio Corporation of America and the Office of Naval Research. The purpose of the conference was to advance the science of photoconductivity through discussion. This volume presents the latest information available at the time of the conference and is arranged in five sections, the first of which deals with the phenomenological theory of photoconductivity. The second section discusses aspects of the problem of interaction of a photon with a crystal lattice. The six papers in the section on electron processes are concerned with the fate of charge carriers poduced by the incident photons. The two final sections deal with the properties of photoconducting materials and with various recent developments.

Many of the discussions which took place at the conference are included with the thirty papers. The volume serves as an introduction to the subject as well as a text for workers in the field, containing as it does review papers on major topics, detailed papers on specialized topics and brief reports on current research.

Power production; the practical application of world energy.

Hans Thirring. London, Harrap, Toronto, Clarke Irwin, 1956. 309p., $5.25.

The author believes that one of the greatest problems facing the world today is the provision of an adequate power supply. His aim in this book is to give a comprehensive survey of all possible means of present and future power production, the available sources of energy, and the merits and drawbacks of the different methods.

After a brief discussion of power, energy and heat, and a survey of the sources and uses of power, the author considers the different engines used in power production: steam and internal-combustion engines, gas turbines, heat pumps and electricity.

The second part of the book is devoted to a discussion of the sources of energy: coal, petroleum and natural gas, fuels from vegetation, wood, etc., water power, solar energy, and atomic energy, including chapters on nuclear reactors and thermo-nuclear reactions.

Pofessor Thirring points out that the world consumption of energy is increasing by more than two percent perannum, and that in a relatively short period there will be a shortage of fossil fuels. He believes that increasing use will be made of nuclear fuels, which will help conserve the supply of coal, oil etc.

There is a three page bibliography, increasing the value of this very interesting work.

Research is people.

New York, Industrial research institute, 1956. 69p., $4.00 U.S.

These papers, presented at the Institute's Symposium in 1956, cover the topics concerning good management prac-

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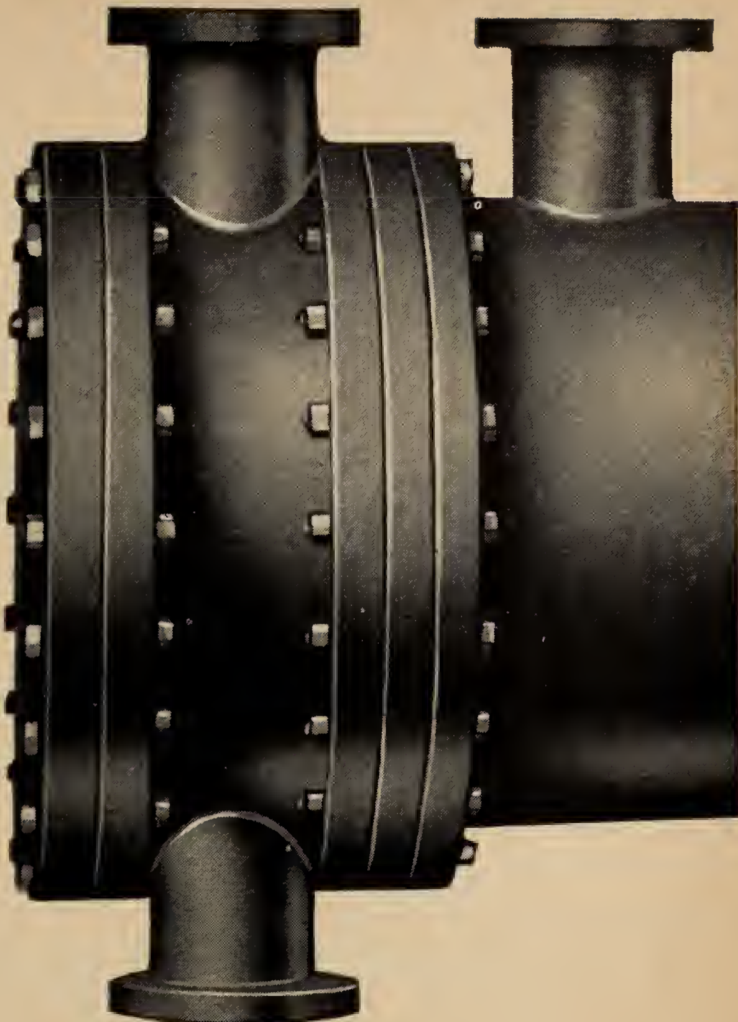

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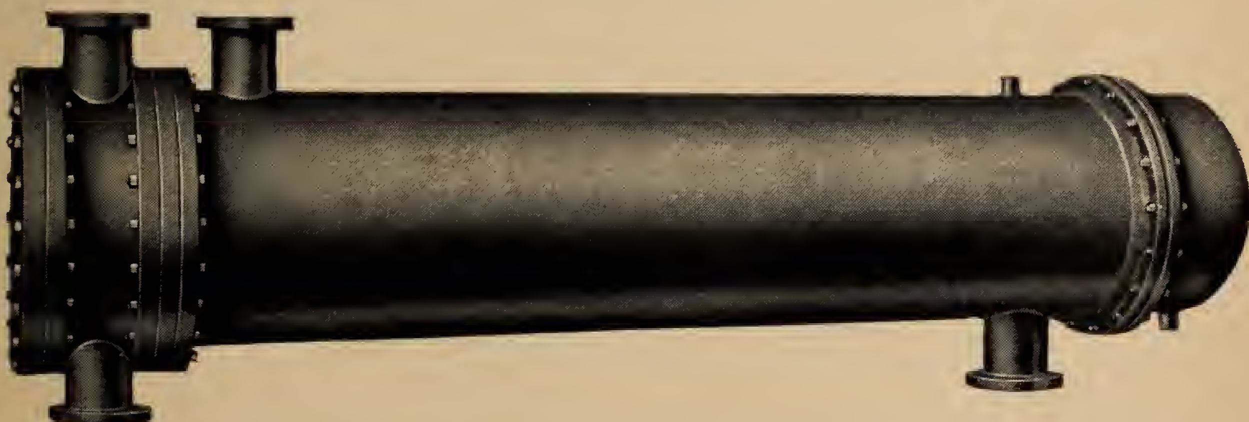

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tices in the field of industrial research. They deal especially with industry's policies regarding research personnel. The recruiting, motivation and evaluation of research scientists and engineers are discussed in an examination of the all-important human element which plays such a large part in a successful research program.

Smoley's four combined tables for engineers, architects and students.
C. K. Smoley. Chautauqua, Smoley, 1956. 4 v. in 1, $12.00 (U.S.)

The four sets of tables comprising this one volume may also be purchased separately.

The first volume, Parallel tables of logarithms and squares, contains in addition tables of angles and trigonometric functions for levels to 12" by 32nds", and multiplication tables for rivet spacing and spacing of lattice bars. Book two contains all the usual five figure logarithmic and trigonometric tables, including circumferences, lengths of arcs for radius 1, areas and circumferences for diameters in units and fractions, and constants, formulas and decimal equivalents.

The third volume contains tables of slopes and rises, and the last segmental functions.

All the tables are clearly printed and very legible; in the new tables spaces are used instead of vertical and horizontal lines. The book is thumb-indexed for easy reference, and will be a valuable addition to any engineer's reference shelf.

***Strength of materials, part II. Advanced theory and problems, 3rd ed.**

S. Timoshenko. Toronto, Van Nostrand, 1956. 572p., illus., $8.00.

The second volume of the revised edition of this standard work for graduate students, designers, and research engineer includes a considerable amount of new material. Major changes have been made in the chapters devoted to torsion, plastic deformation, and the mechanical properties of materials. In the latter chapter, information for the proper selection of working stresses has been presented in considerable detail. New references, figures, and problems have been inserted throughout the text.

Supervision of scientific and engineering personnel.

J. T. Lloyd and R. D. Gray, comps. Pasadena, California institute of technology, Industrial relations section, 1956. 82p., $8.75 (U.S.)

This publication is an outline in the form of lists, definitions and questions and answers on the many topics pertinent to an understanding of successful professional supervision. Eleven sections cover: characteristics and development of the professional employee, building and maintaining a good technical team, appraisal of performance, the supervisor's role in professional development, policies for salary administration, benefit plans, handling complaints and grievances, unionization of professional employees, communications, organization of a professional work group, and what professional workers expect of their supervisors.

An excellent manual for those interested in a comprehensive survey of the principles of professional supervision.

• LIBRARY NOTES

Traffic department organization.

J. H. Wallace. Philadelphia, Chilton, Montreal, Wallace, 1956. 142p., $6.75.

The traffic department is of great importance to industry today, as transportation may take as much as twenty-seven percent of a company's sales volume, and is the largest single item remaining in controllable costs.

In this book the author discusses the functions of the traffic department and its place in an organization. He considers such problems as central traffic control, individual plant responsibility, unification of scattered traffic activities when a firm operates in different parts of the country, transportation cost control, the assignment of responsibilities and the functional division of activities.

Dr. Frederick illustrates his book with examples drawn from the experiences of many companies which have solved traffic problems.

Water power resources in Yugoslavia, v. I.

Belgrade, Institute of hydraulic engineering, 1956. 456p., illus., maps.

The Yugoslav National Committee of the World Power Conference decided after the war that the information available on the power resources of their country was incomplete and, in many cases, unreliable. It was therefore decided that a complete survey should be made. The results of the survey, commenced in 1948 are to be published in three volumes, of which this is the first, and considers the available hydro resources. The other two volumes will give information on the possibilities of utilizing water power, and on the hydro power plants already in operation.

The first part of the volume, by Dr. V. M. Yevdjevic, is subtitled Investigation methods of water power resources, and considers various aspects of hydro-electric power including its potentials and the amount available for economic use. Other chapters cover the data needed for estimating hydro potentials; topographical and hydrological data, discharge curves, rainfall fluctuations etc.

The second part of the volume lists the actual water power resources of the country, the information given being divided into the different drainage areas. There are many charts and maps, and beautiful photographs of the Yugoslav countryside.

The text is in parallel columns of Serbo-Croat and English, and there are summaries in French, Russian, Spanish, German and Italian. This is a very interesting publication, and the Yugoslav National Committee is to be congratulated on its preparation.

STANDARDS REVIEWED

British Standards, British standards institution, 2 Park St., London W.1. Also available from the Canadian standards association.

B.S. 468:1956 Solid rolled steel railway wheels and disc wheel centres

Authorized by the Iron and Steel industry standards committee, B.S. 468 is part of a general revision of British standards for railway materials. Each specification includes requirements for the quality of the material and for marking and identification, tensile and falling weight tests, and test procedure in general. The specification for disc wheel centres permits the deflection test as an alternative to the falling weight test. The form of the tensile piece is given in an appendix. 3/-.

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

Automobiles

Facts and figures of the automobile industry (Canadian automobile chamber of commerce. 1956 ed).

Motor vehicle license fees. (Canadian automobile chamber of commerce. 1956)

Electrical engineering

Certificates of rating with special reference to supplementary proving tests of circuit-breakers. (Association of short-circuit testing authorities. Publication No. 18)

Ontario. Hydro-electric power commission. Annual report. 1955.

• LIBRARY NOTES

Engineering education

Federal support for science students in higher education. 1954. (U.S. National science foundation. NSF 56-18).

Explosives

The handling of explosives.

The storage of explosives. (Canada. Dept. of mines and technical surveys. Explosives division)

Materials testing

The behavior of under-reinforced concrete beams under long-term loads. H. A. Sawyer. (Connecticut. University. Engineering experiment station. Publication No. 12)

Column research council. Minutes of the annual meeting (1956); roster; proceedings of the fifth technical session. (1955)

Symposium on impact testing. A.S.T. M. s.t.p. no. 176)

Metallizing

Metallizing bibliography. (American welding society C2.5—1956)

Natural resources, Canada

Coal mines in Canada. (Canad. Dept. of mines and technical surveys. List 4-1)

New Brunswick's rising industrial potential. (Chemical institute of Canada)

Canada. Resources conference, 1954, Proceedings. (Canadian forestry assoc.)

Summary of legislation relating to soil and water conservation in Canada. (Agricultural institute of Canada. Conservation committee 1954-55)

Petroleum

Facts and figures about Canadian oil. (Imperial oil ltd.)

Propane fractionation of residual oils, E. E. Smith and C. Fleming.

Solvent extraction of lubrication oils. E. E. Smith and M. Grins. (Ohio. State university. Engineering experiment station bulletin no. 160)

Plywood

Guide for users of Douglas fir plywood. (Plywood manufacturers association of B.C.)

Waterways

Le Rhone. (Technica no. 191 Dec. 1955)

The Sault canal through 100 years. (Michigan. University)

Miscellaneous

Engineering societies directory 1956 (Engineers joint council) International finance corporation; policies and procedures.

Organization of the federal government for scientific activities. (U.S. National science foundation. NSF 56-17)

• BRANCH NEWS

(Continued from page 1758)

24 in the presentation of a paper entitled "Installation and Operating Experiences with the 2500 foot head Kemano Impulse Turbines".

This paper was prepared by J. T. Madill, M.E.I.C. manager of power operations, B.C. and F. P. Gordon, S.E.I.C. master mechanic of the Aluminum Company of Canada, at Kemano. Mr. Gordon presented the paper to the meeting, and exhibited a great many slides of the construction stages from the setting of the bottom plate to installation of the scroll cases. Since machines of three different manufacturers were involved, scroll case assembly details differed and the merits of each could be judged from a construction viewpoint.

The three runners were of considerable interest, one being integrally cast, another with bolted buckets and the third integrally welded.

Following installation all three turbines were tested for efficiency by the same method so that the relative results were highly accurate.

During the initial period of operation, cavitation was a serious problem but full co-operation with the manufacturer in changing material and bucket contours brought it well under control.

The meeting was well attended by seniors in the hydro-electric field who considered the paper a valuable contribution.

J. T. Madill, M.E.I.C.

Montreal

The Montreal Branch oyster party of November 9 was arranged by a joint committee of the senior and junior sections of the Branch. Top. The committee: left to right, Bernard Garceau, J. P. Cristel, and Leo Scharry. Bottom. G. N. Martin, publication committee chairman, at right, with Lucien L'Allier and P. E. Morrissette.

ENGINEERING CAREERS

Primary Metals and Metallurgical Industries

CANADA IS particularly fortunate in her great natural resources of power, forests, and mineral ores. Large industries have grown around these resources, all of them offering wide scope for engineers who play a large part in the development of the industries.

Possible careers for engineers in the power and forest products industries are outlined elsewhere in this series; this article will deal with the primary production of metals up to semi-finished products. The metal fabricating industries will be considered further in another article.

Non-Ferrous Metals

Among the principal producers of the world, Canada is second in output of aluminum metal, with some 19 per cent of the world total in 1955. Bauxite, the ore from which aluminum is extracted, is not one of Canada's major natural resources, but is imported; however, aluminum production requires abundant electric power, which is available in Canada at economic rates — in fact, the aluminum industry has itself developed several of the country's major hydroelectric power resources.

On a mine basis, Canada is the world's leading producer of nickel, with some 65 per cent of total production in 1955. Also on a mine basis, Canada is second in the world in production of zinc, fifth in copper, and fifth in production of lead. The greater part of all this production, including aluminum, is exported, and imports of these metals are virtually non-existent.

Other non-ferrous metals are also playing an increasing part in the Canadian economy. These include cobalt, magnesium, titanium, uranium, zirconium, and others, many of which may be used in the development of alloys for special applications.

Iron and Steel

One of the most impressive developments in the Canadian economy has been the enormous increase in output of iron ore in the last few years, largely as a result of opening up hitherto inaccessible deposits. The world's steel industries are continuously expanding, and there is an ever more urgent demand for high-grade iron ores. Canadian production rose from some 7.3 million tons in 1954 to 17.4 million tons in 1955, or from seventh to fifth largest producer in the field. Soon Canada will have moved up to third place as a producer of iron ore, behind the U.S.A. and USSR; already she is the largest exporter of this material in the world.

As a result of this great expansion, the Canadian iron and steel industry has received considerable encouragement to expand by making better use of existing capacity and introducing new techniques. At the end of 1955 steel furnace capacity was estimated at some 5.5 million tons, of which Ontario had over 70 per cent, Nova Scotia about 18 per cent, and Quebec nearly 7 per cent. Actual production of steel ingots was about 4.4 million tons; it is estimated that steel production will reach 11 million tons in the next twenty years.

Expansion

In both the non-ferrous metals and the iron and steel industries only major expansion can be foreseen in the next decade or so. Not only will this expansion be in the fields of primary production, but there is a greatly increased awareness of the need to develop a strong secondary industry to process the primary resources into finished products. At the same time the metals producers are expanding their facilities for making the semi-finished products, such as plate, sheet, strip, bar, wire, and other extruded and cast shapes, which are all an inherent part of major importance to the industries considered here.

All in all, therefore, the metals

A typical scene during smelting operations in one of Canada's more recently developed metallurgical industries. Among the mechanical equipment, two 60-ton cranes serve the furnaces. Plant must be designed for severe operating conditions.

industries in Canada face a period of major expansion in all fields; to accomplish this expansion they will need increasing manpower, particularly engineers and scientists.

Engineering Fields

In the metals industries there are several well-known very large organizations of international scope which operate in every field from mining to the manufacture of finished products; there are also many smaller firms that may specialize in a particular metallurgical field. Between them they offer opportunities to engineers in all branches of the profession in most parts of Canada and sometimes abroad.

Civil engineers are needed for construction, design and project engineering. Some of the projects in the industry are in remote areas in which whole new communities are established as the country's resources are developed. Engineers may have to design and build anything from a small plant extension to a whole new town.

Electrical engineering plays a large part in these as in other industries and, in addition, major electric power developments are directly associated with metals production, particularly in the aluminum industry. Here, the field ranges from the design of instrumentation for the control of metallurgical processes to 50,000-ampere switchgear, and transmission lines that cross mountain ranges.

Chemical processes are involved in much of the basic production of metals, and furthermore many chemical by-products arise from the industries. Consequently, there is a demand for chemical engineers in several fields.

In the primary industries, mechanical engineers are required to design, operate, and maintain machinery and equipment for ore, chemical, and metals processing, and for materials handling. In the field of semi-finished products a wide range of equipment is installed, for example, from steel rolling mills to fine wire-drawing machinery. Mechanical engineering staffs are engaged in many activities connected with the design, construction, and operation of this plant and equipment, including industrial engineering.

Other engineers find opportunities in metallurgical research and development, testing, quality control, alloy improvement, and so on. The industries frequently incorporate modern research laboratories in which processes, products, and fabricating methods are some of the fields fundamentally investigated.

As in other industries, various levels of production supervisors are in charge of different phases of the industry. Frequently these supervisory positions are held by engineers experienced in plant operation. There are thus opportunities for progress within purely engineering departments, or in production and other fields; in the industry generally there is no limit, up to the head of the organization, to the progress that can be made by a graduate engineer with the right qualifications. Indeed, many of the top positions in the metals industries are now filled by professional engineers.

It has been stated that the metals industries in Canada are expanding and that they are also major exporters of their products. The domestic and world markets are highly competitive, however; for example, plastics are competing seriously with metals in some structural fields, and aluminum conpetes with copper in electrical applications, while all the time the producers of other countries are striving to gain markets. Many engineers are needed to strengthen technical sales departments and to develop both new materials and new industrial applications for existing products.

An aerial view of the aluminum smelter at Kitimat, in northern British Columbia. Developments such as this call for engineers to contribute to the design, construction, and running of new towns, power projects, and industries in undeveloped areas.

Training

The industry generally follows the logical course of training the newly-graduated engineer by giving him experience of the operations through working in different plants and departments, and further specialized training to fit him for the field to which he is best suited.

In addition to many training programs, opportunities are frequently available to technical staffs to benefit from specific outside courses, some of which are sponsored by organizations in the metals industries.

Although not alone in such work, these industries make generous contributions to education in the form of grants to schools and universities, and scholarships to students.

Salaries and Benefits

Starting salaries are in line with those prevailing in other major Canadian industries. Prospects for advancement, as indicated in this article, are good.

Benefits to be generally expected include pension and health insurance schemes, and paid vacations. Bonus payments are made in some parts of the industries, and other advantages that may be offered are loans, grants towards further education, and facilities for obtaining company stock. One company has a well-known profit sharing scheme for its employees.

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Business and Industrial Briefs

A DIGEST OF INFORMATION RECEIVED BY THE EDITOR

Appointments and Transfers

Canadian Car & Foundry Company Limited. — The appointment of E. G. Burgess to the position of vice-president, planning and development, has been announced by Allan C. MacDonald, executive vice-president of the company.

Jaeger Machine Company of Canada Limited. — R. D. Macdonald, formerly general manager, has been appointed vice-president of the company.

Trans-Canada Pipe Lines Limited. — N. E. Tanner, president of the company, has announced the appointment of Robert C. Berry as treasurer; Mr. Berry will be located in the company's Toronto office.

Honeywell Controls Limited. — W. H. Evans, president of Honeywell Controls Limited, recently announced the following appointments: L. F. Wills, formerly works manager, will be vice-president in charge of administration and production; John H. Fox, M.E.I.C., becomes vice-president in charge of sales; Carl A. Anderson will be vice-president of the company's aeronautical division; C. J. Hooks, formerly comptroller of the company, has been named treasurer.

Canadian Marconi Company. — C. P. McNamara, manager, commercial products division, has announced the following changes: J. A. Hammond has been appointed general sales manager, commercial products division, and J. H. Martin has become sales manager of the standard lines department of the division

The International Nickel Company of Canada Limited.—Aubrey S. Tuttle, a member of the Canadian development and research division of the company for eleven years, has been transferred to Calgary to open a Western Canada technical field section.

Peacock Brothers Limited.—J. J. Hillen has been appointed general sales manager, and D. S. McCann assistant general sales manager.

Frank E. Miller

Bertram A. Wilson

J. Carl Wilson

J. A. Wilson Lighting & Display Limited. —J. A. Wilson, of J. A. Wilson Lighting & Display Limited, Toronto, and J. A. Wilson Lighting and Display Incorporated, Buffalo, N.Y., announces the following reorganization: J. Carl Wilson becomes president and general manager of the Canadian company; Bertram A. Wilson becomes president and general manager of the American company; Harry R. Yates has been elected a director and vice-president of the Canadian company.

Linde Air Products Company. — The appointment is announced of Robert G. Leckey as manager, advertising and sales promotion, of the company (Division of Union Carbide Canada Limited).

Monsanto Canada Limited.—It has been announced that R. M. Beaugrand has been promoted to the position of operating superintendent - plastics, and T. P. Foley to the newly-created position of traffic superintendent.

The Pressure Pipe Company of Canada Limited.—The company has announced the appointment of Frank E. Miller as Ontario manager in charge of their new

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a revolutionary new molded case breaker that provides short circuit protection to 100,000 rms AMPS

The new CORDON circuit breaker solves a serious problem for designers and users of low voltage electrical distribution systems (up to 600 volts A-C) who are faced with ever increasing short circuit loads due to high concentrations of power.

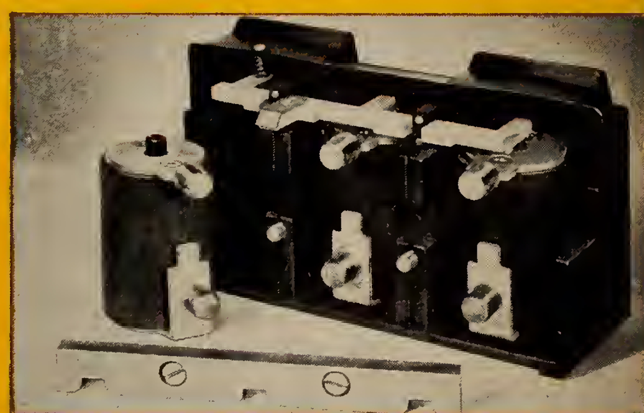
The CORDON breaker combines a standard moulded-case circuit breaker with a specially designed current-limiting device called Amp-Trap. This entirely new approach extends short circuit protection from 25,000 to 100,000 rms. amperes—while retaining all circuit breaker automatic operational advantages!

The standard section of the CORDON circuit breaker contains a conventional thermal trip for minor overloads and instantaneous magnetic trip for all faults below extreme short circuit currents.

The new Amp-Trap current limiting device takes over the interrupting duty at a value below the maximum interrupting rating of the breaker and is designed to minimize arcing even under unusually high short circuit currents. It will positively interrupt short circuit currents in a quarter of a cycle. Thus, all magnetic stresses and heat produced by the short circuit are kept well within the capacity of the breaker.

The CORDON circuit breaker is available in four frame sizes with continuous current ratings of 100, 225, 400 and 600 amperes. Its standard features include interchangeable thermal magnetic trip units, choice of rear-connected studs, plug-in mounting or front-connected terminals for switchboard mounting, special features are also available.

For full information on this entirely new CORDON circuit breaker, write or call EPD.



The Amp-Trap (*which extends short circuit protection up to 100,000 rms. amperes*) *remains extremely cool under rated load current and does not affect conventional thermal trip operation for minor overloads. The spring-loaded plunger in the centre of each fuse is released when subjected to high fault currents thus providing a visual indication of the phase that shorted. In addition the projected plunger actuates a common tripper bar, opening all three phases of the circuit breaker.*

5513-R

**Cordon* (*Definition Webster's*) (*Military*) *A chain of forts—A line of sentinels protecting an area, or a body of men.*

New Cordon Circuit Breakers are the sentinels that protect your electrical equipment!

EPD

EASTERN POWER DEVICES LIMITED / SPECIALISTS SWITCHGEAR

TORONTO • HEAD OFFICE 29 WABASH AVENUE — MONTREAL • 620 CATHCART ST. ROOM 1021
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plant in Toronto; until the end of this year Mr. Miller will be located at the company's head office in Montreal.

A. D. Margison and Associates Ltd. — Harold B. Johnson is a newcomer to the company from the consulting engineering firm of Merz and McLellan in Great Britain. The latter firm is now allied with A. D. Margison and Associates Ltd. Toronto.

Canadian Resins and Chemicals Limited. —The company has announced the following appointments Arthur G. Pinard as sales supervisor, resin and chemical products; Edward A. Clout as sales supervisor, granular products; Maurice F. Malone as sales development supervisor, industrial products division. James C. Bacon has been appointed a technical representative, industrial products division, Toronto office.

The British Thomson-Houston Co. (Canada) Ltd.—H. G. McHaffie, general manager, announces the following appointments: B. N. Callaghan, manager, apparatus department, and J. Grant, manager, industrial products department, both with headquarters in Toronto; J. R. Platts, sales manager, Quebec and Maritime Provinces, with headquarters in Montreal.

Sun Oil Company Ltd. — A. G. Galoska has been appointed sales representative for the industrial products department of the company in the Montreal area.

Alcan Chief Engineer. — Franklin T. Matthias has been appointed chief engineer of the Aluminum Company of Canada Limited. He succeeds W. L. Pugh, M.E.I.C., who is retiring after many years of service, but who will continue to act as consultant to the company.

Air Reduction Canada Limited.—Allan F. Smardon and Ernest Ehrhardt have been appointed technical sales representatives for the company.

Department of Public Works, Canada.— The following senior staff changes at headquarters, Department of Public Works, have been announced in Ottawa by Major-General H. A. Young, Deputy Minister: Robbins L. Elliott, formerly assistant director, property and building management branch, becomes the new chief of the personnel division; H. G. Hunt, former chief of the personnel division, is the new chief of the purchasing and stores branch; R. G. McFarlane, who was chief of the purchasing and stores branch, takes over as assistant director, property and building management branch.

News of Business and Industry

Federated Consultants Limited.—Twelve consulting engineering firms and individual consultants, combined to form an organization, Federated Consultants Limited, will be able to provide services in nearly every major engineering field. Since its formation the organization has been engaged in major operations in Canada and internationally.

The member firms are: Hunting Technical & Exploration Services Ltd.; T. O. Lazarides, Lount & Partners; Karel Rybka & Associates; and Milner Naismith. The associated consultants are: Gordon S. Adamson, consulting architect; Stanley R. Frost, M.E.I.C., consultant on heavy industrial engineering; R. A. Hanright & Co., consultants on thermal power engineering and various aspects of heavy industry; Jens C. Holm, consultant on cement production and cement plant engineering; G. Ross Lord, M.E.I.C., consultant on projects involving hydraulics and fluid mechanics engineering; Norman D. Wilson, M.E.I.C., consultant on public transit and traffic studies; and Clyde Wynant and Associates, consultants on pipeline engineering practice. Federated Consultants was established as a private company incorporated under Dominion charter in November, 1955. All members retain their individuality and private practices.

Dugald Cameron Associates. — It is announced that Dugald Cameron, M.E.I.C., has as of October 30, 1956, resigned from his position, as vice-president and managing director of Dexion (Canada) Ltd., in order to devote his full attention to the expanding business of Dugald Cameron Associates Ltd., Malton, Ont. The latter firm has, since 1946, manufactured office and factory partitions and engaged in general steel fabrication, including welding, marketing under the trade name of Fur-Nail Steel Products.

Hydro Project in Pakistan. — An order for the supply of two 9,000 h.p. Kaplan turbines for the Shadiwal canal hydro-electric development in Pakistan has been awarded to Dominion Engineering Company, Limited. These turbines were ordered on behalf of the Colombo Plan Administration of the Government of Canada. Dominion Engineering is also manufacturing four 55,000 h.p. Francis type hydraulic turbines and other equipment for the Warsak development in Pakistan, also to be supplied under the Colombo Plan. H. G. Acres and Company Limited of Niagara Falls, Ontario are acting as consulting engineers for the two projects.

Canadian Representation. — Pacific Division, Bendix Aviation Corporation, of California, announce complete sales, engineering, and service for Bendix-Pacific Electro-Span digital remote control and telemetering equipment in Canada, through recent association with Computing Devices of Canada Limited, in Ottawa.

Change of Address. — R. M. Way & Company Limited, consulting engineers, have moved (from 696 Yonge Street) to 321 Bloor Street East, Toronto.

Early Aerial Surveys. — Records of the earliest aerial surveys in Canada were exhibited at the recent opening of new quarters for Photographic Surveys (Quebec) Limited, at 8375 Bougainville Street, Montreal. The company's predecessor, Interprovincial Airways, was formed in 1923 as Canada's first commercial air survey organization. Photographic files have been maintained since 1923.

Fifty-year Celebration. — A. R. Williams Machinery Western Limited, recently celebrated 50 years' operations in western Canada with a machinery show in the company's head office in Vancouver.

Canadian Carborundum Expansion. — The silicon carbide plant of Canadian Carborundum Co. Ltd., at Shawinigan Falls, Que., is to be enlarged and modernized. Some 20,000 sq. ft. of additional floor space will accommodate new furnace units and will be equipped with the latest materials handling equipment. It is planned to have the new plant in operation in September, 1957.

New Montreal Plant. — Federated Metals Canada Limited has opened a new plant for non-ferrous metal fabrication and processing. The 40,000 sq. ft. plant is in Lachine, near Montreal. Another plant was recently opened in Scarborough, near Toronto.

Wire and Cable Developments. — Western Canada's first telephone cable plant and a wire and cable factory were recently opened at Fort Garry, Manitoba. Both plants are operated by Canada Wire and Cable Co. Ltd. but the telephone cable is produced by Telecables and Wires Ltd., a new company in which Canada Wire has the majority share interest; minority holdings are owned by the General Cable Corporation, of the United States, and the Telegaph Construction and Maintenance Co. Ltd., of London, England. Among other products the Canada Wire plant will supply soft copper wires to Telecables.

Federal Public Works Contracts. — Public Works Minister Robert Winters has announced that contracts involving expenditures totalling $4,873,006.66 were awarded by the Federal Department of Public Works during October, 1956. The amount for new works is $3,531,964.25; for the repair and maintenance of existing structures, $1,000,785.41; and for dredging $340,257.00.

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